

THE ROLE OF GEOMATICS ENGINEER IN SMART CITIES: A VIEW WITHIN THE FRAMEWORK OF TURKISH 2020-2023 NATIONAL SMART CITIES STRATEGY AND ACTION PLAN

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KEY WORDS: Smart City, Digital City, Geomatics Engineering, Geospatial Data, Positioning, GIS.

ABSTRACT:

The development of technology resulted major revolutions in the cities. With the integration of technological developments into cities, the concept of smart cities began to emerge. Today, applications are made on smart cities in many countries. It is not possible to build a smart city without geographic data. It is one of the main duties of Geomatics Engineers to produce, use, process and finalize the geographic data and present it to the user. In this study, referring to the role of Geomatics Engineer in smart cities across Turkey 2020-2023 National Smart Cities Strategy and Action Plan framework is made in the investigations. When this plan is examined, it is seen that the importance of geographical/geo-spatial data and geo-information technologies for the realization of smart cities is an undeniable fact. In the 2020-2023 National Smart Cities Strategy and Action Plan, it has been clearly demonstrated that Geographic Information Systems and Geographic Information Technologies have a great role in creating smart cities.

1. INTRODUCTION

It is a known fact that many positive reasons such as soil insufficiency in rural areas, population growth, lack of infrastructure in rural areas, technological developments in agriculture, as well as employment opportunities in cities, social life opportunities have encouraged people to migrate from rural areas to the city. However, as a result of this uncontrolled migration movement, distorted urbanization and slums have been observed due to the disproportionate growth of the urban population. This negatively affected the people living in the cities and the living standards in the cities decreased. In order to minimize the negative effects of the uncontrolled increase in the population of the cities after the migration, the states started to develop city planning strategies. It is aimed to minimize problems in cities and maximize human welfare and happiness. In recent years, with the increase in technological developments, it is getting easier to solve the problems in the cities, while trying to minimize the damage to nature while using the facilities at our maximum. In this context, a city management model and strategies called 'Smart Cities' are being developed worldwide. Although the smart city cannot be precisely defined, it has been expressed in many different ways in the national and international arena. For instance, it was defined as: *"It is a new concept and a new model in which new generation information communication technologies such as the internet of things, cloud computing, big data and integrated geographical information systems are implemented, which will facilitate the planning, management, construction, and smart services of the city"* (URL 1). Another definition was made as: *"Smart and sustainable city, while considering the economic, social, environmental and cultural needs of current and future generations; It is an innovative city that uses information and communication technologies and other tools to increase the quality of life, the efficiency and competitiveness of urban service delivery"* (URL 1). As can be understood from the definitions, the main purpose of smart cities is to increase the efficiency and quality of life in cities with smart technology. When we think of the word, 'city', a spatial space comes alive directly in our minds. The smart city is to create a functional,

nature and human friendly city by increasing the interaction of the data in this space. Geomatics Engineers play a crucial role in this spatial data management and indirectly in the smart city because many components in the smart city requires spatial data. The smart city has a very wide coverage. It has been mainly including Smart Environment, Smart Security, Smart Human, Smart Structures, Smart Economy, Smart Space Management, Smart Health, Smart Governance, Information Technologies, Smart Transportation, Smart Energy, Communication Technologies, Information Security, Smart Infrastructure, Disaster and Emergency Management and Geographic Information Systems (GIS). The main purpose of all is to save energy, protect nature and facilitate human life by using the available resources in the most efficient way. However, they all have many different functions in their field. In general, minimizing the above-mentioned problems in cities and maximizing human welfare and happiness with a sustainable environmental understanding are among the main goals of the Smart City concept.

In this study, after giving basic information about the smart city and its main components, the subject of what Geomatics Engineers can do within the smart city components is discussed within the framework of the "Turkish 2020-2023 National Smart Cities Strategy and Action Plan".

2. THE ROLE OF GEOMATICS ENGINEERS IN A SMART CITIES

Cities are the largest settlements and they are spatially meaningful. Almost all of the applications and projects in the cities are location-based. Roads, buildings, malls, parks, bumps, Electronic Monitoring System (EMS), traffic mobile applications and so on. Along with the developing technology, the geomatics applications in the cities are sized up. With technological activities such as GNSS, remote sensing data, photogrammetric measurements, drones, position data is obtained easier, faster and more accurate. With technology, we receive more location data, and it is Geomatics Engineers who

analyze and process this data, turn it into a product and deliver it to the end user. With smart cities, the concept of location data has gained more importance. Because, with the Internet of Things, there is continuous data flow from thousands of sensors, and with the spread of fifth generation (5G) technology in the future, this flow will be much faster and much more. Geographic Information Systems infrastructure is used to organize, analyze, visualize and present them. For example, we have many location data such as the data to calculate in how many minutes a bus will arrive at a particular stop, which route it will use. The traffic data on the road is received by the GNSS signal data on the phones of the people at the stops and the location data of the bus. However, we need to relate them to each other and obtain a meaningful end product. Thus, the bus driver and the passengers waiting at the station can see in real time with the infrastructure created by Geomatics Engineers, how many minutes later that bus will be at the station. This example is a typical and basic smart city application. It is the duty of a widespread but will be used with the development of smart cities and technology, to move smoothly in traffic, to perceive and react to the surrounding mobility. Because driverless vehicles cannot use map applications that people always use. Maps with much more precise location data should be created for them. Sensor sensitivities should also be very high. Thus, possible accidents and dangers can be prevented. In addition, it is another task of Geomatics Engineers to determine the location of the buildings, to create their models while making urban transformations while building cities. By creating 3D city models, new plans can be made before the structures to be built, effective management of cities can be made, different data can be added on them and they can be used for other purposes, thematic queries and analyzes can be made. While creating 3D models, aerial photographs or laser scanning equipment are generally used. In order to obtain a three-dimensional model, firstly the Digital Elevation Model (DEM) is obtained and then 3D building models are obtained. In order to increase the reality, three-dimensional virtual reality can be obtained by dressing the photographs taken from the ground by using terrestrial photogrammetry on the building facades.

Sensors, which are the main tool in the creation of smart cities, are critical as mentioned above. The accuracy, resolution, repeatability (sensitivity) and linearity of the position sensors are of great importance during data collection, analysis and processing. Many different purposes can be achieved with the location data received with different accuracy and precision. For example, sensors placed in cars need to be highly accurate and precise in position data, while individual navigation applications do not need. In particular, the navigation systems and sensors of autonomous cars must be of very high accuracy. Because the environmental sensitivity of autonomous cars must be very high and must interact with other vehicles. Improvements are made in many areas such as obstacle detection, mapping, route planning, navigation. By using a 2D laser scanner instead of high-cost 3D LIDARs, the development of a low-cost and 360-degree field of vision has become transformable into distance cloud data. Thus, an economical and effective solution has been found (Kağızman and Altuğ, 2019).

Along with sensors, photogrammetric techniques, remote sensing, geographic information systems technologies, laser scanning and terrestrial measurement techniques are still used today to create smart cities. Geomatics applications differ depending on the desired accuracy level and time constraints.

Today, indoor navigation applications have also gained speed in order to develop smart cities even more. Thus, people can be easily directed to the places they want to reach in airports, shopping malls and hospitals. Mushtaq et al., (2018) shown that indoor navigation systems have different properties and they have many advantages and disadvantages. 6 different indoor navigation systems are compared: Cricket, Active Bat, Active Badge, Dolphin, Ubisense, FIND. Their accuracy values differ from each other. The system with the most accuracy is Dolphin with 2 cm accuracy. Necessary indoor system can be selected according to usage areas and locations (Mushtaq et al., 2018).

As shown in Figure 1, the attainable accuracy level of the geomatics applications applied in smart cities are shown according to the area they are used in.

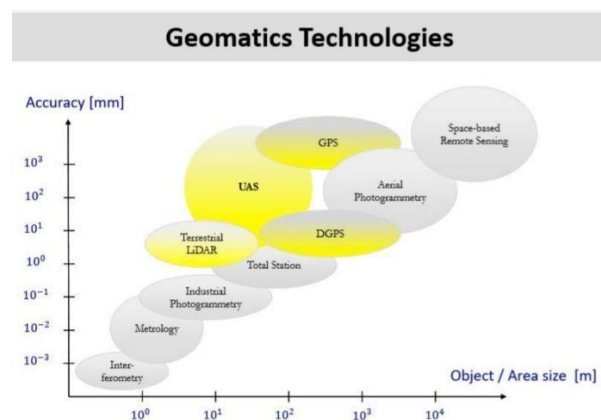


Figure 1. Accuracy of Most Common Surveying Techniques (Toth, 2018)

As briefly explained above, high accuracy positional data are needed when building smart cities and Geomatics Engineers are main responsible for producing, collecting, processing, analyzing, visualizing and presenting the geo-spatial data. Geomatics Engineers play a crucial role in many areas, from modeling cities in smart cities to mobile applications that will facilitate the lives of citizens. Although the place and importance of Geomatics Engineers are still not at the forefront of today, they are on the background and basis of the works, because in today's world, most things include location data. With the development and spread of smart cities, the need for them also increases.

3. 2020-2023 NATIONAL SMART CITIES STRATEGY AND ACTION PLAN

In 2019, the 2020-2023 National Smart Cities Strategy and Action Plan was published by the Ministry of Environment and Urbanization. In this document, smart cities are defined as *"More livable, sustainable cities, implemented with cooperation between stakeholders, using new technologies and innovative approaches, justified based on data and expertise, and creating solutions that add value to life by anticipating future problems and needs"* (URL 2). Smart Cities are divided into 16 main components in this strategy and action plan as follow (Figure 2):

1. Smart Environment
2. Smart Security
3. Smart People
4. Smart Buildings
5. Smart Economy

6. Smart Place Management
7. Smart Health
8. Smart Governance
9. Information Technologies
10. Smart Transportation
11. Smart Energy
12. Communication Technologies
13. Security of Information
14. Smart Infrastructure
15. Disaster and Emergency Management
16. Geographic Information System (GIS)



Figure 2. Smart Cities Components

Within the scope of this strategy plan, 4 main strategic goals are planned primarily. These are creating a smart city ecosystem and consequently creating financial management and governance mechanism, increasing the speed of conversion to smart cities, preparing a suitable environment for this transformation, taking smart steps in city services. A step-by-step road map has been created to achieve these 4 main strategic goals. There are 40 actions (26+14) within the scope of the mentioned strategy and action plan (URL 2). In the following part of the study, each action, main responsible institution/organization for this action, and what a geomatics engineer can do in this process are briefly explained.

4. DUTIES OF GEOMATICS ENGINEERS WITHIN THE FRAMEWORK OF "TURKISH 2020-2023 NATIONAL SMART CITIES STRATEGY AND ACTION PLAN"

Within the scope of the above-mentioned strategic plan, studies will be carried out to shape the future of the cities in our country in a way that is human-oriented, respectful to natural life and historical heritage, using technology to the maximum extent. Within this frame what the geomatics engineering discipline can carry out within the scope of the 26 main and 14 sub-group actions are explained below.

ACTION 1: A City-Specific Local Smart City Strategy and Road Map will be Prepared

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems, Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Establishing a geographic data infrastructure in the local layer,
- Ensuring compliance with the Geographic Information Strategy, Action Plan objectives and TNGIS of strategies.

ACTION 2: Smart City Maturity Development Programs and Guidance Mechanism will be Prepared and Implemented

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General, Directorate of Geographic Information Systems, Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- The use of Geographic Information System of institutions will be expanded and their capacities will be increased,
- Increasing capacity in local governments in order to encourage the widespread and efficient use of Geographic Information technologies.

ACTION 3: Smart City Index Will Be Created Using the Smart City Maturity Assessment Model and Its Sustainability will Be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- GIS analysis for Smart City Applications with all ecosystem assets of cities such as people, technology, facilities, institutions.

ACTION 4: 2020-2023 National Smart Cities Strategy and Action Plan will be Implemented, Monitored and Evaluated

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems-TurkStatistics.

WHAT DOES A GEOMATICS ENGINEER DO?

- Creating the necessary information sharing environment among all stakeholders using the Monitoring and Evaluation System.

ACTION 5: Smart City Projects with High Public Value will be Developed, Effectively Planned, Implemented and Expanded

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Removing the main obstacles (lack of standards, open data and protocols) in adapting Smart City Projects to other cities,
- Creating the National Smart City Project Inventory and Local Smart City Project Inventory and ensuring that the information in the inventories is compatible with the Smart City Project Preparation Standard.

ACTION 6: A Holistic and Planned Investment Environment will be Provided for the Efficient and Efficient Use of Resources in Smart City Investments.

RESPONSIBLE INSTITUTION/ORGANIZATION:
Presidency-Strategy and Budget Directorate Ministry of Treasury and Finance Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Completion of existing projects in the field of Geographic Information Systems,
- Making new projects considering the priorities to be put forward in the Geographic Information Strategy and Action Plan and Smart Cities Strategy.

ACTION 7: A Financially Encouraging and Facilitating Environment will be Created in Smart City Transformation

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Conducting feasibility studies on urban planning, Geographic Information Systems, urban information systems and urban transformation Preparing of urban transformation strategies.

ACTION 8: Smart City Technology Radar will be Created

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Increasing our satellite communication capacity with new satellites, accelerating domestic technology development efforts in this field,
- Spatial precision in the field of cartography, strengthening digitalization.

ACTION 9: Smart City Market will be Established

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Industry and Technology, Ministry of Trade, General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Developing smart city and smart transportation systems to reduce foreign dependency.

ACTION 10: A National Smart City Governance Mechanism and Organization will be Established, Its Operability and Sustainability will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Defining the roles and governance structure of central and local government institutions and organizations that will

operate in the field of smart cities within the scope of Smart City Architecture.

ACTION 11: A Local Smart City Governance Mechanism and Organization will be Established, Its Operability and Sustainability will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Ministry of Environment and Urbanization-General Directorate of Local Administrations Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Strengthening the institutional, technical and legal infrastructure for the creation and sharing of urban data infrastructure at provincial, district and neighborhood scale,
- Developing a method to ensure the standardization of local administration services and the control of compliance with these standards.

ACTION 12: Using Smart City Solutions, Urban Planning Services will be Provided with Service Integrity

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems, Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Performing the title deed transactions electronically,
- Increasing the urban space and service quality with the effective management of real estate value increases,
- Providing the expansion of urban services.

ACTION 13: Qualified Human Resources Capacity Involved in the Development and Presentation of Urbanization Services will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of National Education Ministry of Family, Labor and Social Services, Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Establishing mechanisms (such as in-service trainings, certificate programs) that will enable employees in the areas of expertise related to Smart Cities to improve their qualifications after graduating from school or entering business life,
- To ensure the development of human resources working in this field and therefore the areas where they are employed.

ACTION 14: Cooperation and Coordination between Smart City Stakeholders will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:
Presidency Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems, Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- With ECHS (Electronic Communication Infrastructure Information System), collecting electronic communication

infrastructure information belonging to operators in a single center, displaying this information on a Geographic Information System (GIS),

- Base map, data updating, effective and rapid execution of processes related to right of way and facility sharing, management and implementation,
- Establishing urban information systems.

ACTION 15: Maturity of Smart City Components will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Determining in which regions Smart City solutions will be applied,
- Choosing the location of renewable energy sources
- Determining the suitable investment area for the city and making the impact analysis of the project,
- Determining the maturity levels of Smart City Components by evaluating the Local Smart City Solution Inventory using the Smart City Maturity Assessment Model.

ACTION 15.1: Maturity of Smart Governance Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Presenting and managing GIS supported spatial data such as Urban Information System,
- Supporting corporate applications with Geographic Information System (GIS),
- Ensuring that GIS and Urban Information System solutions become widespread in local governments,
- Creating a harmonious and effective information system between institutions / organizations that produce and use spatial data.

ACTION 15.2: The Maturity of the Smart Environment Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION :
Ministry of Environment and Urbanization-General Directorate of Environmental Management Ministry of Environment and Urbanization-General Directorate of Conservation of Natural Assets Ministry of Environment and Urbanization-General Directorate of Environmental Impact Assessment Permit and Inspection Ministry of Environment and Urbanization-General Directorate of Spatial Planning Ministry of Environment and Urbanization-General Directorate of Local Governments Ministry of Agriculture and Forestry-General Directorate of Water Management Ministry of Agriculture and Forestry-General Directorate of Nature Conservation and National Parks.

WHAT DOES A GEOMATICS ENGINEER DO?

- Making the Smart Route application widespread,
- Observing the incoming damage using GIS analysis and taking relevant measures,
- Conducting analyses for air quality and pollution using GIS analysis and taking relevant measures when necessary

- Creation of Geographic Information System-based National Drought Database,
- Establishing an integrated information management system in order to increase information sharing,
- Preparation of noise maps and determination of exposure to environmental noise,
- Creating a National Soil Database and land use planning by using remote sensing and geographic information systems.

ACTION 15.3: The Maturity of the Smart Economy Component Will Be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Industry and Technology Ministry of Treasury and Finance Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Estimating which field of activity should be focused on, where the population is concentrated, the need for business areas, social areas, social assistance needs by evaluating the data in the Smart City area with GIS analyses,
- Making GIS data available to decision-making mechanisms at an analytical level,
- Since companies need analysis about where to invest providing solutions with location information.

ACTION 15.4: Maturity of the Smart Energy Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Energy and Natural Resources Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Designing the city's energy distribution systems with production integrations in mind,
- Positioning alternative energy production facilities such as geothermal, biogas, solar and wind energy,
- Extending remote surveillance and management in energy resources.

ACTION 15.5: The Maturity of the Smart Human Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of National Education Ministry of Culture and Tourism Ministry of Youth and Sports Ministry of Family, Labor and Social Services Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Creating awareness of Smart City among city residents, ensuring readiness for the use of urban services using Smart City solutions,
- Disseminating location-based smart city mobile applications among citizens,
- Making population analysis with the help of GIS,
- Developing a digital divide map and index that will enable the development of policies focused on different segments of the society.

ACTION 15.6: Maturity of Smart Transportation Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Transport and Infrastructure, General Directorate of Communication Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Developing smart transportation technologies such as Density Sensing Sensors, Smart Intersection Solution Center, Real Time and Dynamic Intersection Management Systems, Traffic Measurement System, Smart Stop, Smart Vehicle Highway Systems, Lane Warning System, Lane Control System, Electronic Control System, Public Transport GPS Systems, Smart Guidance System, Smart Parking Management and Payment Solutions, Online Parking Reservation System, Parking Management and Guidance System, Determination of Vehicle Routes with the Help of GPRS Data, Indoor Mapping in Transportation, Smart Transportation Cloud Systems, Railway Infrastructure, High Speed Transport, Train Control System, Railway Safety Monitoring Systems, Tunnel Management System, Planned Road Maintenance, Urban Vehicle Registration System.

ACTION 15.7: Maturity of Smart Structures Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Environment and Urbanization-General Directorate of Construction Affairs Ministry of Environment and Urbanization-General Directorate of Local Administrations Ministry of Environment and Urbanization-General Directorate of Professional Services.

WHAT DOES A GEOMATICS ENGINEER DO?

- Evaluation of Integrated Building Security Systems, Remote Security Control Systems, Instant Transmission to the Emergency Warning Service, User Information Systems for Taking Security Measures, Early Warning Systems, Emergency Infrastructure, Disaster Living Rooms and Shelters, Integrated Emergency Systems, Use of Mobile Sensors in the Moment of Disaster.

ACTION 15.8: Maturity of Smart Health Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Health, Ministry of Agriculture and Forestry, Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- "Tracking the Geographical Distribution of Epidemic Diseases" practices for monitoring the distribution of epidemic diseases by analyzing them according to geographical regions, and carrying out activities to prevent chronic diseases and non-communicable diseases and to increase awareness on this,
- Integration of many health data such as chronic diseases and communicable diseases into the system, which is developed by the Ministry of Health and has a geographic information systems infrastructure,
- Developing of remote control and tracking system.

ACTION 15.9: Maturity of Disaster and Emergency Management Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Disaster and Emergency Management Presidency (AFAD) Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Developing of Advanced Flood Warning, Flood Risk Map, Disaster Sensitivity Maps and Simulations, Landslide Sensitivity Map, Smart Warning Systems, Earthquake Early Warning Systems, Fire Detection and Warning Systems, National Blood Supply, Flood Protection / Coastal Protection Strategies, Earthquake Hazard Map, Disaster Hazard Maps, CBRN Detection Sensor Systems, Technological Disasters Notification System and Network Monitoring Station, some provincial Disaster Risk Reduction Plan, Plan for Disaster Risk Reduction and Disaster Risk Reduction System,
- Creating durability maps for durable construction as well as existing maps,
- Developing systems where data can be monitored and evaluated in integration with GIS with various bases, flood notification is transferred to the GIS system by both citizens and employees of the institution with location information, photographs and additional notes directly to the GIS system.

ACTION 15.10: Maturity of Smart Security Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Interior-Department of Internal Security Strategies Ministry of Environment and Urbanization-General Directorate of Local Administrations Presidency-Local Government Policies Board Presidency-Security and Foreign Policy Council Presidency-Legal Policies Board.

WHAT DOES A GEOMATICS ENGINEER DO?

- Developing Identity and Access Control, GIS Mapping Systems, Lighting Control Systems, Detection of Environmental Violations, Intrusion Prevention Systems, Security Sensor Networks and First Responder,
- Establishing Safe Cities by evaluating the use of Security Consultancy applications and ensuring physical security governance.

ACTION 15.11: Maturity of Information and Communication Technologies Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:
Ministry of Transport and Infrastructure Information Technologies and Communication Authority.

WHAT DOES A GEOMATICS ENGINEER DO?

- Collecting country's electronic communication infrastructure information in a single center, displaying this information on a Geographic Information System (GIS) based map, effective and rapid implementation of the processes regarding the right of way and facility sharing, the spread of broadband access and fiber infrastructure.

ACTION 15.12: The Maturity of the Smart Space Management Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Local Authorities Ministry of Environment and Urbanization-General Directorate of Infrastructure and Urban Transformation Services Ministry of Environment and Urbanization-General Directorate of Conservation of Natural Assets Ministry of Environment and Urbanization-General Directorate of National Real Estate Ministry of Environment and Urbanization-General Directorate of Spatial Planning Environment and Ministry of Urbanization-General Directorate of Construction Affairs Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Spatial planning, mapping, survey, land and land arrangement, urban development and design studies for human-oriented and environmentally friendly cities,
- Prioritizing urban transformation applications with GIS analysis, making applications within the scope of "Research and Development Project of 3D Topography and City Data Model" initiated by the Ministry of Environment and Urbanization.

ACTION 15.13: Maturity of Geographic Information Systems Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

In order to increase the maturity of the Geographic Information System (GIS);

- Geospatial data will be shared in accordance with TNGIS standards by the institutions producing geographical data,
- Compliance with the geographical data quality components will be observed during the geographical data production,
- The use of GIS will be expanded and integrated and activities will be carried out accordingly.

ACTION 15.14: The Maturity of the Smart Infrastructure Component will be Increased

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Infrastructure and Urban Transformation Services Ministry of Transport and Infrastructure Ministry of Agriculture and Forestry.

WHAT DOES A GEOMATICS ENGINEER DO?

- In line with the strengthening of physical infrastructure in cities, danger maps created for disaster and emergency management can be integrated with smart systems and the infrastructure (such as energy, building) maps in cities can be modernized,
- Environmental precautions, existing infrastructure facilities, availability of appropriate evacuation points, parcel and building layout, purpose of the use of buildings, planning and coordination of infrastructure services, adverse conditions during construction, construction methods and related risks, existing connections, gradual construction plans if necessary considering the slopes and excavation depths in the construction area, real-time control capability, controlling water levels in the receiving water environments, groundwater levels, accessibility

conditions for inspection and maintenance, obstacles arising from other infrastructure facilities, ownership of the land and the current vegetation cover.

ACTION 16: Smart City Terminology, Smart City Data Dictionary, Smart City Interoperability Model and Reference Architecture Model will be Created

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- To create many interoperability frameworks within the scope of Spatial Interoperability for data other than geographical data,
- Creating a structure that complies with the geographic data infrastructure TNGIS interoperability rules.

ACTION 17: National Smart City Architecture and National Smart City Data Sharing Governance Platform will be Developed, Operability and Sustainability will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Geographical data standardization studies carried out by the General Directorate of Geographic Information Systems within the TNGIS infrastructure and compliance and standard development studies with GeoPortal, the geographical data sharing infrastructure arrangement application at the national layer.

ACTION 18: Local Smart City Architecture and Data Sharing Platforms will be Established, and Operability and Sustainability will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Local Authorities.

WHAT DOES A GEOMATICS ENGINEER DO?

- Sharing data to improve coordination and cooperation between institutions in the field of cartography,
- Associating the Information Management System (relational) database used in Smart City Applications with the GIS database.

ACTION 19: National and Local Smart City Open Data Platforms will be Established, Operability and Sustainability will be Ensured

RESPONSIBLE INSTITUTION/ORGANIZATION:

Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Local Authorities.

WHAT DOES A GEOMATICS ENGINEER DO?

- Big data and data analysis studies on national and local Smart City Open Data Platforms.

ACTION 20: Service Delivery Channels will be Improved and Diversity will be Increased in order to Extend the Use of Urban Planning Services Using Smart City Solution

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Ministry of Environment and Urbanization-General Directorate of Local Administrations Ministry of Family, Labor and Social Services.

WHAT DOES A GEOMATICS ENGINEER DO?

- Developing services using Smart City Solution by performing GIS analysis for different user profiles,
- Conducting needs analysis studies.

ACTION 21: Promotion Channels for Urbanism Services Using Smart City Solution will be Diversified

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Preparing a Smart City Solutions Information Platform to promote and inform the services in which Smart City Solutions are used in cities.

ACTION 22: Environments that Allow City Residents to Transform into Smart City Solution Providers will be Created

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Industry and Technology Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems.

WHAT DOES A GEOMATICS ENGINEER DO?

- Determination of areas where different application centers such as incubation centers and living laboratories will be established in order to create an enabling environment in the Smart City transformation,
- The exchange of ideas to increase the awareness, knowledge and experience of city residents, Smart City service users and employees involved in the delivery of urban services and to create innovation in the field of Smart Cities creating environment.

ACTION 23: Smart City Information Security Governance Mechanism and Organization will be Established

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Transport and Infrastructure Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Local Authorities.

WHAT DOES A GEOMATICS ENGINEER DO?

- Obtaining information about where possible threats are made,
- Establishing Smart City Information Security Governance Mechanisms and Organizations to ensure data security.

ACTION 24: Protection of Personal Data Created and Used within the Scope of Smart City will be Ensured

RESPONSIBLE **INSTITUTION/ORGANIZATION :**
Ministry of Environment and Urbanization-General Directorate

of Geographic Information Systems Ministry of Environment and Urbanization-General Directorate of Local Administrations Personal Data Protection Authority.

WHAT DOES A GEOMATICS ENGINEER DO?

- GIS infrastructure development project with cloud technology,
- Working towards the protection of the personal data of citizens trying to adapt and integrate with the Smart City.

ACTION 25: User Participation in the Use of Smart City Solutions in the Development and Improvement of Urbanization Services will be Increased

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Environment and Urbanization-General Directorate of Geographic Information Systems Ministry of Environment and Urbanization-General Directorate of Local Administrations.

WHAT DOES A GEOMATICS ENGINEER DO?

- Ensuring the participation of citizens in every stage of the spatial planning process,
- Ensuring open governance that includes a stakeholder perspective in the development and improvement of services using Smart City Solutions.

ACTION 26: Urban Transformation and Urban Development Areas will be Evaluated As Smart Zones

RESPONSIBLE **INSTITUTION/ORGANIZATION:**
Ministry of Environment and Urbanization-General Directorate of Infrastructure and Urban Transformation Services Ministry of Environment and Urbanization-General Directorate of Spatial Planning.

WHAT DOES A GEOMATICS ENGINEER DO?

- Creating Smart Zones by evaluating urban transformation and urban development areas.

Looking at the actions in the strategic plan discussed above, it is seen that Geomatics Engineers will take part in most of the studies to be carried out, as explained above. When Smart Cities are examined, the importance of position information is clearly seen. For the design, modelling and planning of smart cities, accurate and reliable geospatial data is highly crucial and this data can be obtained by using Geomatics Engineers which has always played a significant role in real-time data acquisition and processing. As the main producer for spatially enabled data which is crucial for smart cities, geomatics discipline has an important role for this concept since the smart geo-spatial data is generated from the work of geodesists (Alkan, 2019).

5. CONCLUSIONS

In this study, the role of Geomatics Engineer in smart cities is investigated within the framework of Turkish 2020-2023 National Smart Cities Strategy and Action Plan. When the actions in this strategic plan are examined, it is seen that the production and management of geo-spatial data for smart cities is of great importance. In this sense, Geomatics Engineers, who are primarily responsible for spatial data production/collection, has an important role for this concept since the smart geo-spatial data is generated from the work of geodesists. The reliable and accurate geo-spatial data is a key for smart city and

thus geodesists are playing very important role in the development of the smart cities.

The study shows that the Smart City concept has emerged a new working area for the discipline of Geomatics Engineering. For this reason, it is recommended that geodesists should include this subject in their field of study and lead the studies to be done in this field. On the other hand, considering the necessity of educating professionals who have a high level of knowledge on the subject, it is recommended to raise awareness about the concept of Smart City in undergraduate education and to encourage graduate studies.

ACKNOWLEDGEMENTS

This study was prepared on the basis of the studies carried out within the scope of Graduation Project prepared by the authors.

REFERENCES

Alkan, R.M. 2019. The Importance of Geospatial Data in the Smart City. *Book of Abstract Proceedings of 2nd International Conference on Advanced Technologies, Computer Engineering and Science (ICATCES 2019)*, p.21, Antalya, Turkey, 26-28 April.

Kağızman, A., Altuğ, E., 2019. Development of A Low-Cost, Portable and 360° Field of View New 3D LIDAR System for The Navigation of Autonomous Vehicles. *Süleyman Demirel University Journal of Natural and Applied Sciences*, 23(3), 759-769. DOI: 10.19113/sdufenbed.527888 (in Turkish).

Mushtaq, S., Akram, A., Farooq, S. 2018. Suitability of Indoor Positioning System for Smart City IoT Applications. *International Journal of Computer Applications*, 182(17), 40-44. DOI:10.5120/ijca2018917881

Toth, C. 2018. Smart Cities: The Mobility Component. *XXVI FIG Congress 2018*, Istanbul, Turkey.

URL 1. 2019. Akıllı Şehir Nedir?, <https://www.akillisehirler.gov.tr/akilli-sehir-nedir/> (Accessed on: August 10, 2021).

URL 2. 2019. TC Çevre ve Şehircilik Bakanlığı, 2020-2023 Ulusal Akıllı Şehirler Stratejisi ve Eylem Planı. <https://www.akillisehirler.gov.tr/wp-content/uploads/EylemPlani.pdf> (Accessed on: August 10, 2021).