IMPLICATIONS OF SMART CITY SOLUTIONS IN ISTANBUL

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IMPLICATIONS OF SMART CITY SOLUTIONS IN ISTANBUL

DISSERTATION SUBMITTED TO THE DEPARTMENT OF MANAGEMENT INFORMATION SYSTEM (E-COMMERCE AND TECHNOLOGY MANAGEMENT) FOR THE MASTER’S DEGREE AT YEDITEPE UNIVERSITY

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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

The rapid increasing of urbanization brings not only significant opportunities but also challenges to society, governments, and local administrations across the world. Environmental pollution, security, mobility, and health related issues are some of the global problems we are facing day by day.

Due to the facts that urbanization, industrialization, and digitalization are creating new and previously unknown challenges and consequences in contemporary society, the development of smart technologies is becoming critical from many different aspects, including ecological issues, energy, healthcare, mobility among many others. Thus, the contribution of this study is to provide an academic input to the stakeholders mentioned below, for their strategic planning and model development studies:

- Policymakers: Related departments of Government and Municipality, to develop their smart city related policies and strategies
- Companies: Who need to develop their own distribution and transportation model
- Other Stakeholders: "Stakeholders" group will be defined and extended within this study and the implications and results will be provided to them accordingly.

The purpose of this study is to provide an overall framework of smart city components by focusing on smart mobility, which plays a key role in smart city concept due to the impact on other components of smart cities.

Key Words: Smart City, Smart Mobility, Urbanization, Smart Technology, Istanbul

ÖZET

Kentleşmenin hızla artması, dünya çapında topluma, hükümetlere ve yerel yönetimlere sadece önemli fırsatlar değil aynı zamanda zorluklar da getiriyor. Çevre kirliliği, güvenlik, hareketlilik ve sağlıkla ilgili konular, her gün karşılaştığımız küresel sorunlardan sadece bazıları.

Kentleşme, sanayileşme ve dijitalleşmenin çağdaş toplumda yeni ve önceden bilinmeyen zorluklar ve sonuçlar yaratması nedeniyle, akıllı teknolojilerin gelişimi, ekolojik sorunlar, enerji, sağlık, mobilite ve diğerleri dahil olmak üzere birçok farklı açıdan kritik hale geliyor. Bu nedenle, bu çalışmanın katkısı, aşağıda belirtilen paydaşlara stratejik planlama ve model geliştirme çalışmaları için akademik bir girdi sağlamaktır:

- Politika yapıcılar: Akıllı şehirle ilgili politika ve stratejilerini geliştirmek için Hükümet ve Belediyelerin ilgili departmanları
- Şirketler: Kendi dağıtım ve taşıma modellerini geliştirmesi gerekenler
- Diğer Paydaşlar: Bu çalışma kapsamında "Paydaşlar" grubu tanımlanacak, genişletilecek ve bunlara göre çıkarımlar ve sonuçlar bildirilecektir.

Bu çalışmanın amacı, akıllı şehirlerin diğer bileşenleri üzerindeki etkisi nedeniyle akıllı şehir kavramında kilit rol oynayan akıllı mobiliteye odaklanarak akıllı şehir bileşenlerinin genel bir çerçevesini sunmaktır.

Anahtar Kelimeler: Akıllı Şehir, Akıllı Hareketlilik, Kentleşme, Akıllı Teknoloji, İstanbul

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During this study, I had opportunity to meet so many great professionals from different sectors.

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1.1 Background of the Study

Urbanization has been increasing rapidly across the world due to natural increase, migration and reclassification of rural areas. Population is shifting from rural areas to urban areas (towns and cities) due to some main motivations and benefits such as better working-, education-, health- and social opportunities and conditions.

According to *the "World Urbanization Prospects Report_2018" of United Nations, Department of Economic and Social Affairs*, due to the rapidly increasing of urban population, in 2007 population in urban areas (cities and towns) became more than the rural and countryside for the first time. **55%** of the world's population is living in Urban areas in 2018. Share of urban population was **30%** in **1950s** and by **2050**, in accordance with the estimates and projections, **68%** of the world population will be living in urban areas.

Figure 1 is showing the comparison and the projection of the urban population by years and development level of the regions.

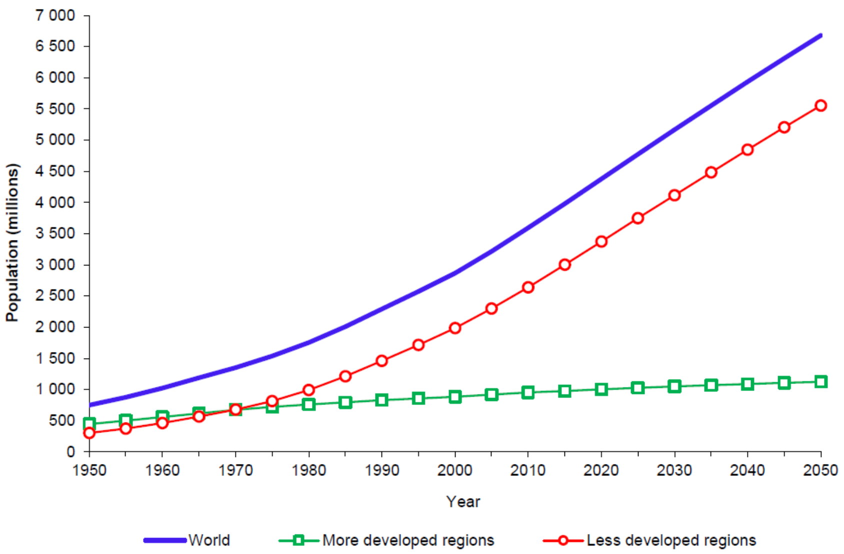

Figure 1: Estimated and Projected Urban Population of the World, the more developed regions and the less developed regions, 1950-2050 (**Source:** World Urbanization

Prospects Report_2018" of United Nations, Department of Economic and Social Affairs)

Figure1 is the visualization of the urban population distribution by region and years. As is seen, according to the estimation and projection for 2050, share of the urban population will become more than **60%** across the world.

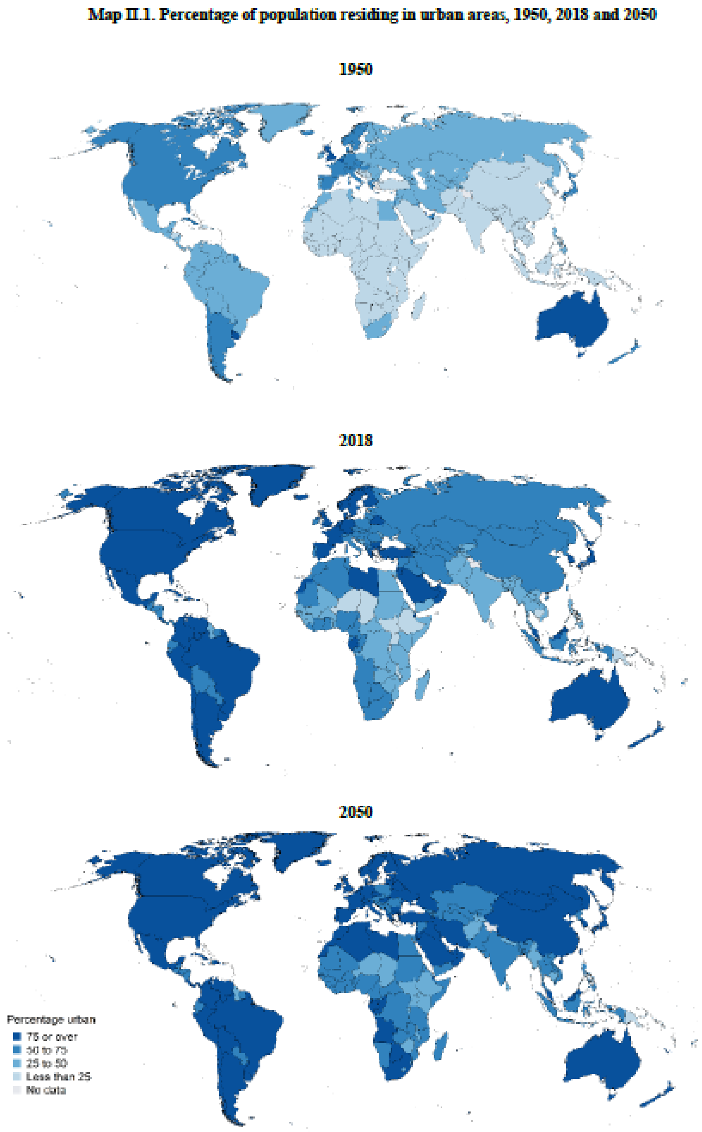

Figure 2: Percentage of Population residing in Urban Areas, 1950, 2018 and 2050

Main reason of living in urban rather than rural areas to have better living conditions and benefits. Movement of people from countryside or rural areas to developed urban areas provide not only benefits cause but also significant problems, which are related to environment, health, safety, living conditions. To overcome these difficulties for the mentioned problems above, governments and local administrations should design “cities” in accordance with the needs and expectations of the urban stakeholders, in parallel they should provide permanent and sustainable solutions.

1.2 Problem Definition

Urbanization brings not only opportunities but also challenges to the civilians, companies and decision makers. *“Creating and sustain a better life” is not optional but mandatory for authorities.* Day-by-day increasing challenges and consequences of urbanization have impact on quality of live and environment.

Rapid Population Growth: In addition to natural increase, population has been increasing rapidly in Urban areas by migration due to the motivation and benefits of having better life.

Industrialization: Industrialization is considered both consequence and reason of urbanization. *Industrialization* has been evolved because of urbanization to meet the need and consumption of population, on the other hand industrialization has brought job opportunities as a reason to migrate from rural areas to urban cities.

Climate and Environment: Significant changes on housing, services, consumption, and mobility because of the increasing population in urban areas, environment and climate have been impacted negatively. Depletion of natural resources and increasing environmental pollution has contributed global attention across the world.

Social Impact: One of the important reasons to move from rural areas to urban cities is having better social and life conditions. Education, health and other social opportunities bring advantages but on the other hand reaching and gaining these opportunities create also challenges.

To manage these challenges and balance quality of life and conditions urban areas on the other hand need, pain points and expectations of all stakeholders should be identified and understood clearly. To ensure a sustainable life quality, a seamless and integrated governance model needed for urbans.

1.3 Scope, Purpose and Contribution of the Study

The purpose of this study is to provide components of “smart city” with an overall perspective and focusing on “Smart Mobility” concept and to provide implications and solutions to the respective stakeholders. To achieve this, “smart mobility” concept will be analyzed thoroughly and comprehensively with the impacts of the other components of smart city topic. To provide a harmonized structure of academic knowledge and real-life examples and applications, “Smart Mobility” will be analyzed in Istanbul, where is one of the world's leading metropolises. Research and analysis will refer to the importance of relation between e-commerce and mobility, since e-commerce is one of the developing areas which has a highly impact on mobility.

Other components of the research will involve key concepts including ICT, big data, IoT, machine learning and implications of smart city technologies and e-commerce.

Scope is including smart city main components and dimensions and the applicable solutions and implications of smart mobility for a city.

The contribution of this study is to provide an academic input to the stakeholders mentioned below for their strategic planning and model development studies and analyses the possibilities to apply the Smart Mobility concept in İstanbul

- Policymakers: Related departments of Government and Municipality, to develop their smart city related policies and strategies
- Companies: to develop their own distribution and transportation model
- Other Stakeholders: "Stakeholders" group will be defined and extended within this study and the implications and results will be provided to them accordingly.

1.4 Hypothesis and Research Questions

To perform this study, required hypothesis and research questions are given below;

- What are the main requirements to transform a conventional city to smart city?
- What are the dimensions of Smart Mobility?
- Why is Smart Mobility critical in Smart City concept?
- What are the interrelations between B2B and B2C Transportation and Smart Mobility?
- What are the critical factors and key roles on building a sustainable Smart City model?

2. LITERATURE REVIEW

2.1 Smart City and Components

History of "Smart City" terminology date back to 1970s, first urban big data project: "A Cluster Analysis of Los Angeles" report in Los Angeles. This continued with the Amsterdam, to promote internet usage by creating a virtual digital city "De Digital Stad (DDS)". In 2000's, this new trend was supported by IBM and Cisco, who played an important role for this initiative as technology partners.

Creating a Smart City is a transformation and required a long and planned journey, where all stakeholders from policy makers to inhabitants contribute to each step of it.

Main trigger of this transformation is the rapidly increasing urbanization due to more job opportunities, education needs, better knowledge about health and all connectivity related topics such as reaching and obtaining social activities on time with desired expectations. Rapidly increasing urbanization is bringing not only economic and industrial change but also concern and risks, which are explaining the main reason **"Why"** we need to transform "conventional cities" to "smart cities". Current operations, services, infrastructure and people (citizens and inhabitants) are the areas **"What"** we need to change. And the last but not the least **"How"** we are transforming cities to "smart" is technology. Following figure is showing the details of **"Why-What-How"** to transform in being a Smart City journey.

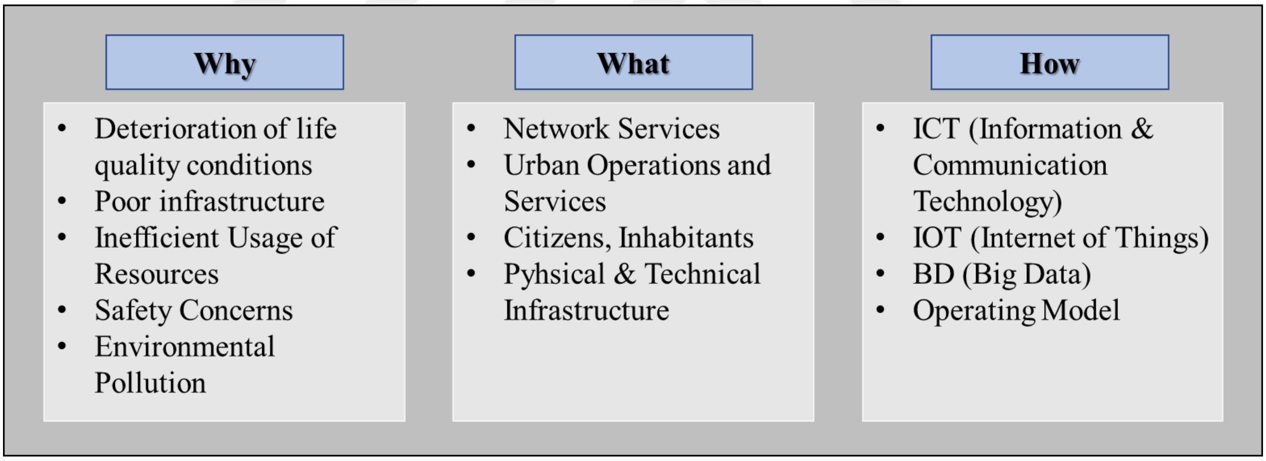

Figure 3: Smart City Transformation (Why / What / How to Transform)

Within the scope of this facts, there are a lot of definition of "smart city" extending year by year aligned with the improvements and key points of the terminology.

According to the global definition of <u>*European Commission*</u> "A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also means a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population.”

According to Lazaroiu and Roscia (2012), Smart Cities are “a community of average technology size, interconnected and sustainable, comfortable, attractive and secure.

Marsal-Llacuna et al. (2014) defines Smart Cities, as initiatives try to improve urban performance by using data, information, and information technologies (IT) to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors.

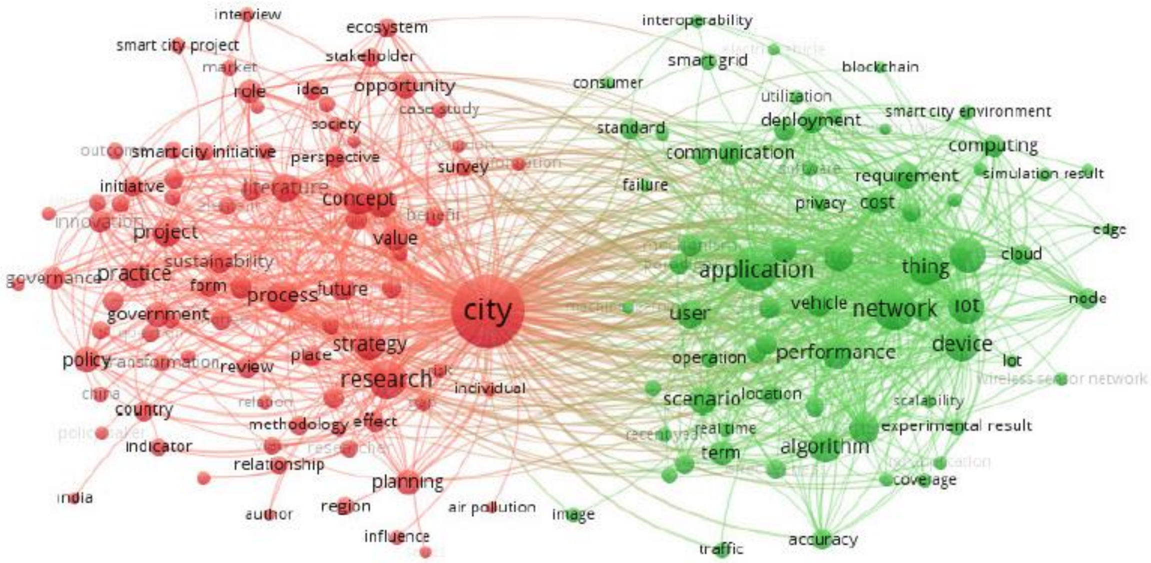

Figure 4: Comprehensive Scope of a Smart City Concept

“Smart City” is consisting of the following components.

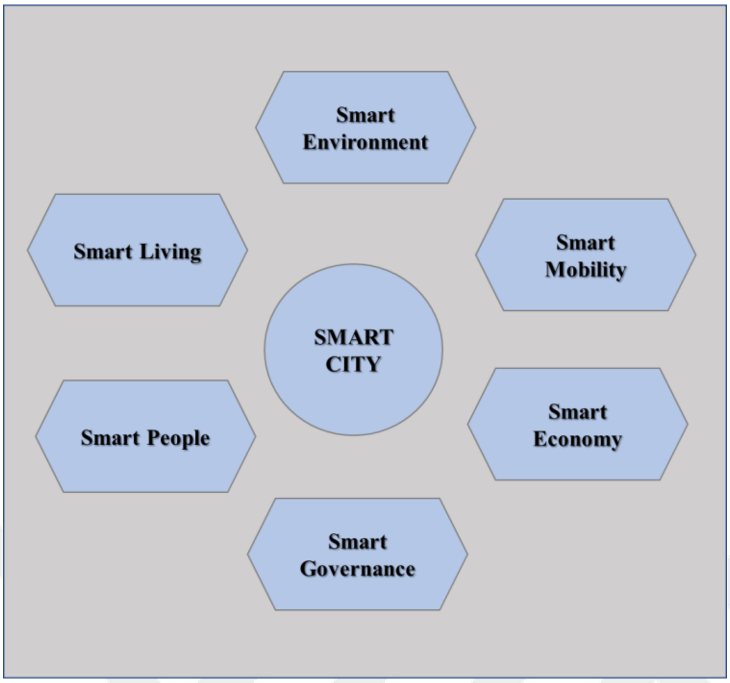

Figure 5: Components of Smart City

Smart Environment is consisting of smart systems and technologies which enable to manage environmental and energy related topics such as waste, water usage, air pollution. Main approach of creating smart environment is to increase environmental quality and efficient resource usage. Design of a “Smart Environment” based on systems and policies to use resources efficiently with an appropriate and consistent governance model within a smart city concept.

Smart Mobility *is crossed* point of technology and transportation and a one of the most difficult topics in urban areas. Smart Mobility has direct impact on the other components of smart city concept, therefore developing any solution in smart mobility creates value for a city and its stakeholders.

This component integrates modes of transportation via technology and enable to manage urban mobility via monitoring and notification systems. Objective of this component is to create sustainable, safe and efficient product and services for transportation by improving conventional network and systems via IOT, ICT and data analytics and machine learning.

Smart Economy: Due to the disruptive changes in technology, requires new jobs in most of the areas. Smart Economy is a new concept of economic growth, which is growing in parallel with the transformation of smart city. In some cases Smart Economy is called as innovative, green, digital, knowledge, learning, competitive or network economy, since this concept is built based on technology, provide competitive profit and productivity, connecting different networks such as government, universities and other institutes.

This economy focuses on innovation, technology, and data. On the other hand, it is targeting to generate more product and services, by using efficient resource and taking sustainability into consideration. Smart economy based on sustainable developments via technological innovations on the other hand brings new entrepreneurial initiatives, competitiveness to increase overall quality of life.

Smart Governance enable to gain strength connection between inhabitants and authorities (government, municipalities). Smart Governance is one of the critical parts of smart city "Operating Model", which is consisting of also decision making, roles and responsibilities, processes and policies to sustain a system or business model in any organization. Smart Governance is extended concept of conventional governance by utilizing technology and ICT to create a transparent and collaborative environment for inhabitants and authorities.

Smart People aims to increase efficient interaction between government and citizens. This component consisting of using technology, information systems and data by inhabitants to increase quality of their life. This component is focusing on transforming citizens/inhabitants into smart people, education and lifelong learning of smart people, and creation a strength connection between citizens, systems and infrastructure of smart cities.

Smart people component is structured around increasing social, economic, and environmental motivations of citizens.

Smart Living is the component which is highly impacted from the outputs of other smart city components, since it is covering highly critical elements which enable to improve the quality-of-life citizens. This dimension is the total crossed point and fundamental objective of smart city initiatives.

2.2 Stakeholders of Smart City

Smart city stakeholders are main success factors of transformation, who are contributing to each step of the transition, on the other hand who are highly impacted due to the changes.

Stakeholders of a smart city are citizens, industry, academia and research institutions, government (departments), local authorities (municipalities) and non-profit organizations.

Citizens, who are living in cities and impacted from the challenges and developments directly on the other hand involving with their inputs and feedback to improve smart city solutions.

Industry, who provide product and service to stakeholders in a city. They are impacted from the solutions as the citizens.

Academia and Research Institutions, who contribute to develop solutions with research, academic background, and knowledge.

Government, local authorities, and non-profit organizations are key stakeholders of smart cities, who are the owners of smart city developments on the other hands enablers to make sure smart city governance.

This grouping is good enough to set roles and responsibilities but not sufficient to provide desired product and services. To understand need and expectations of stakeholders correctly, in addition to stakeholders' classifications, definition of "personas" per stakeholder group is highly important.

2.3 Role of Smart Mobility in Smart City Concept

Mobility is gaining importance in Smart City concept recently due to the rapidly increasing of urban population. Every day, to reach out to work and school, most of the urban citizens are facing a lot of different challenges. Industry and private companies are generating mobility by distributing their products and providing their services to meet the expectation of their customers. Negative and direct consequences of the mobility such as traffic congestion, environmental pollution, accidents, lack of sufficient walkability areas effect the life of urban citizen. In addition to this cost of non-productive mobility creates another challenge for private companies. Economic, environmental and time related cost and consequences compel the departments of government and local authorities to develop sustainable and appropriate solutions by focusing on digital solutions and technologies as given in below framework.

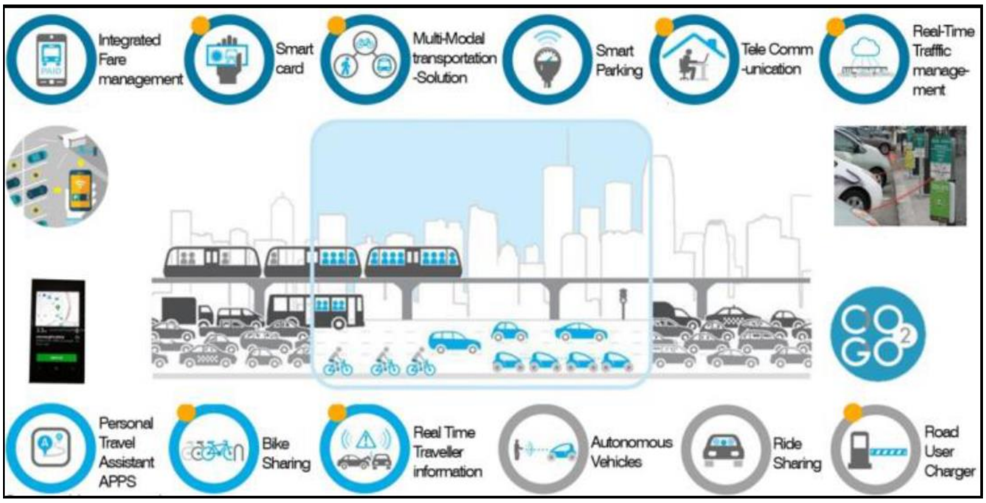

Figure 6: Smart Mobility Concept (source: The Role of Smart mobility in Smart Cities Davor Brčić, Marko Slavulj, Dino Šojat and Julijan Jurak; University of Zagreb Faculty of Transport and Traffic Sciences, Croatia)

This Framework is including all applicable solutions for a smart city. To build and implement the adequate smart mobility technologies to the cities, need, expectations and capabilities of stakeholders should be identified primarily. On the other hand, also *visible* and *invisible* factors on mobility such as seasonal, unforeseeable changes like natural disasters, pandemic, have been taken into consideration. For instance, due to pandemic (covid 19), e-commerce operations have been expanded unexpectedly.

According to the Mckinsey report "The Future of Work After Covid 19" (February 18, 2021), e commerce has grown two to five times faster than before pandemic.

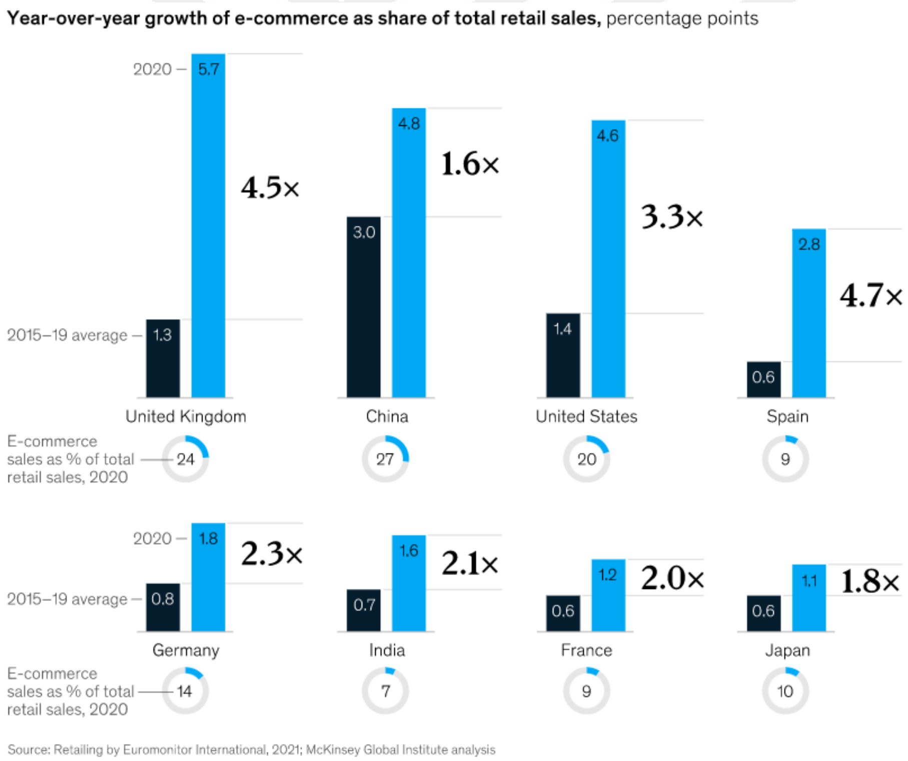

Figure 7: E-Commerce Share of Total Retails (Mckinsey Global Institute Analysis:2021)

Global significant growth of e-commerce has the similar impact on commerce in Turkey. According to the statistical data shared by https://www.eticaret.gov.tr , e-commerce volume has increased **66%** in **2020** vs **2019**, from **136** Billion TL to **226.2** Billion TL. Number of e commerce order (in piece) has increased **68%** in **2020** vs **2019,** from **1.36** Billion pieces to **2.29** Billion pieces.

Figure 8: E-Commerce Volume and Number of Order (2020 vs 2019) (source: https://www.eticaret.gov.tr)

According to the statistics shared by https://www.eticaret.gov.tr, the biggest share of e-commerce shopping is from Istanbul with the **35 %** percentage.

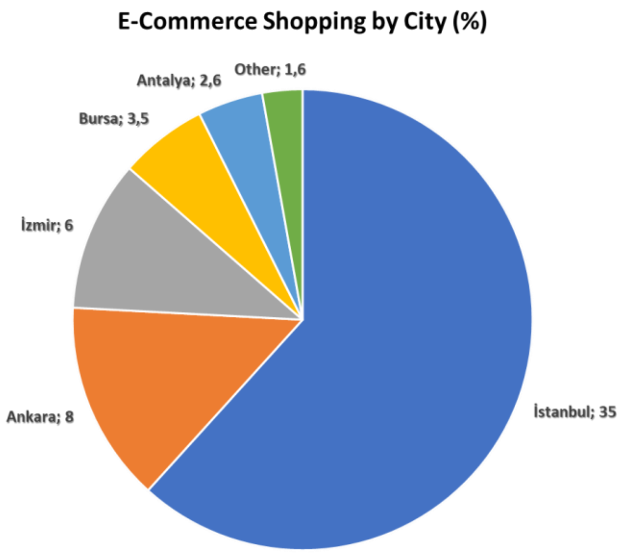

Figure 9: E-Commerce Shopping Share by City (Turkey)

According to the report “The Outstanding Success of E-Commerce, Changes in Consumer Behavior, and Digitalization” published by TUSIAD in 2022, e commerce volume in Turkey has reached **161** Billion TL in the first half of 2021.

With this unprecedented growth on e-commerce, B2B and B2C transportation have been impacted directly from this change.

Pandemic accelerated not only the growth of e-commerce but also the transformation of working and education models. Remote working and education due to Covid 19 lockdown, decreased the mobility of citizens on the other hand created an unforeseen mobility increase through the changes of shopper behaviors. Because of the behavioral changes of customers and consumers, retailers and suppliers from private sectors have reshaped their business models for order and distribution processes to meet the demand. New business models enable a sustainable order and distribution operations gained popularity across the world and create opportunity to re-build B2B and B2C transportation in urban mobility.

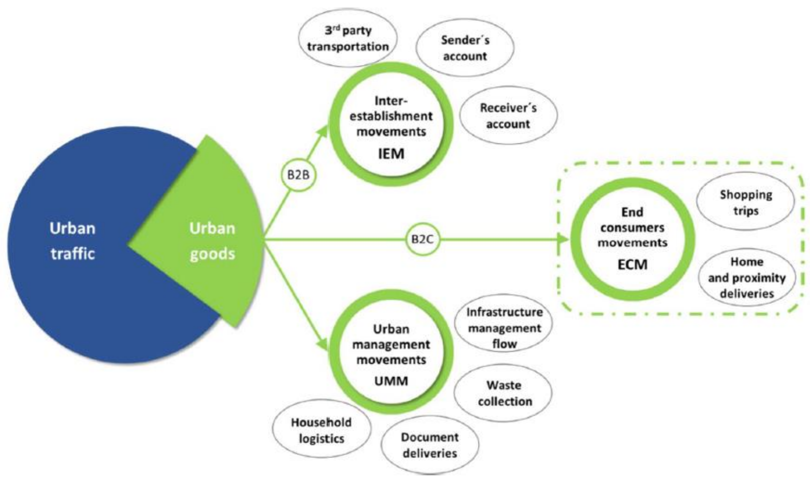

Figure 10: Classification of Urban Goods Movement. (Source: Mobility Restrictions and E-Commerce: Holistic Balance in Madrid Centre during COVID-19 Lockdown adapted from Cattaruzza et al. 2017)

According to the framework established by Delivery Hero *(Delivery Hero: Quick Commerce: Pioneering the Next Generation of Delivery (2020));* quick commerce has grouped under 3 evolution phases:

Process	**1st Generation**	**2nd Generation**	**3rd Generation**
Order	Brick	Click	Click
Delivery	Self Service	Delivery 2-3 Days	Small Selection Available
Delivery Vehicles	***Privately Owned Car***	***Delivery Truck***	***Two Wheeled Vehicle***
Distribution	***Dedicated***	***Combined***	***Dedicated***
Warehouse	***Super Stores***	***Mega Warehouses***	***Local Store or Warehouses***
Logistics Modeling	***3PL***	***Courier Network***	***Last Mile-Specialist***
Lifestyle	Three to Four People Households	Three to Four People Households	Often Single Person Households
Matters / Priorities	Discount Matters	Discount Matters	Speed Matters

Table 1: Evolution of Quick Commerce; source: *(Delivery Hero: Quick Commerce: Pioneering the Next Generation of Delivery (2020)*

As seen in the above figure, priorities and expectations have impact on the evolution of e-commerce dynamics by changing the vehicles, delivery types, warehousing models, and logistics modeling.

In Turkey, Growth of e commerce volume and order rate has direct impact on a lot of sectors. Logistics and Transportation is one of the sectors, which has impacted from this growth on the other hand has an impact on quality of e-commerce operations and services.

According to the *"Progress of E-Commerce, Crossing Borders, and New Norms"* Report (2019) published by TUSIAD, changes on *payment services, logistics services and regulations* are highlighted as important topics in e-commerce ecosystem.

As mentioned in this report "Logistic Infrastructure is the one of the important factors effecting the progress of e-commerce." With the rapidly increasing e-commerce volume around world, delivery of products "on time-with expected quality" is one of the standard expectations of customers. Companies have been developing new and permanent solution to meet customer expectations, but however keeping and sustaining this performance between excepted performance levels, bring companies additional cost and operational issues.

Due to changing urban logistics in cities, both logistics, e-commerce and platform companies have been developing new distributions models to overcome operational and financial difficulties. Different delivery solutions such as smart locker, pick up drop off has been developed as alternative delivery methods by companies. Most of the companies have been looking for different solutions to extend distribution networks via different channels.

Below, you may find the main implications of this reports.

- Increasing the awareness of logistics companies that, customer experience is an important factor in e-commerce and collaboration between e-commerce and logistics companies should be increased.
- High inert capacity and old fleet problems are important development areas for businesses.
- Companies should focus on training and certification of their employees, continue to invest on research and technology. Logistics education and profession standards should be developed, should focus on customer satisfaction and service quality.

– Logistics centers and freight villages should be established aligned with world-wide accepted standards.

These implications have impact on mobility and transportation directly.

2.4 "Istanbul" one of the "Smart City" Candidate in Turkey

Istanbul is Turkey's largest metropolis with a population of over 15 million, larger than 38 countries in Europe and the most receiving immigration city in Turkey due to working, education and health opportunities.

Istanbul is considered as a "cosmopolite" city because of the diversity of population. Below figure shows an overview to the diversity in Istanbul population.

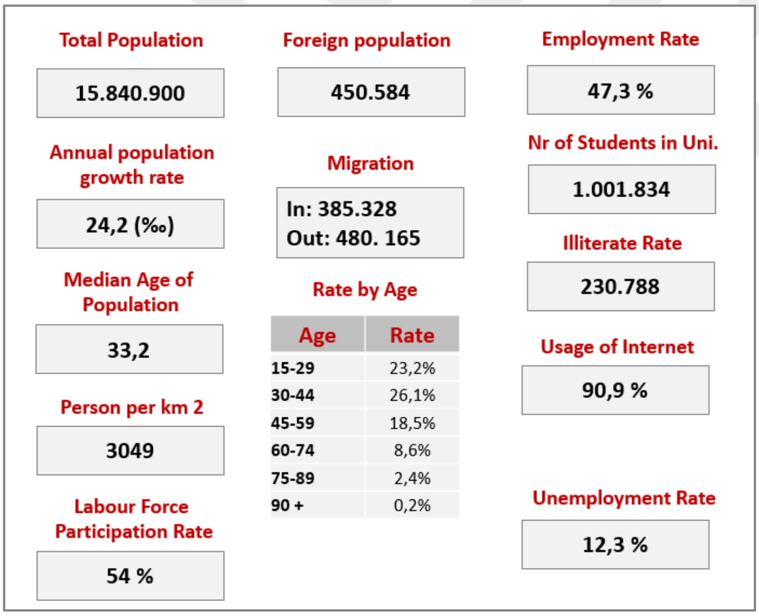

Figure 11: Population Details in Istanbul

Although this diversity enables to meet different culture together, on the other hand brings along a lot of problems and chaos to solve to meet changing need and expectations of citizens.

"Mobility" is one of the importance challenges in Istanbul due to its consequences such as traffic congestion, environmental pollution, loss of time, which has a crucial impact on quality of life.

According to the shared data in "*Istanbul Data Driven Hackathon"* 31,7M daily trips, 4M registered vehicles and average 300 vehicles are involved in current traffic every day. Istanbul is the 5th place in traffic congestion globally in 2020 and 6th place before 2020, 27 min is added for every 30-minute trips during rush hours.

Mobility Challenges shared in "*Data Driven Mobility in Istanbul "Hackathon,* given below.

- Lack of compact cities and mobility together
- Focus on moving people, not vehicles
- Efficient use of space and assets
- Engage stakeholders in decision-making
- Design for equitable Access
- Transition towards zero emissions
- Seek fair user fees
- Deliver public benefits via open data
- Promote integration and seamless connectivity
- Automated vehicles must be shared

Below figure shows some of the mobility related data provided by TUIK and Istanbul Metropolitan Municipality.

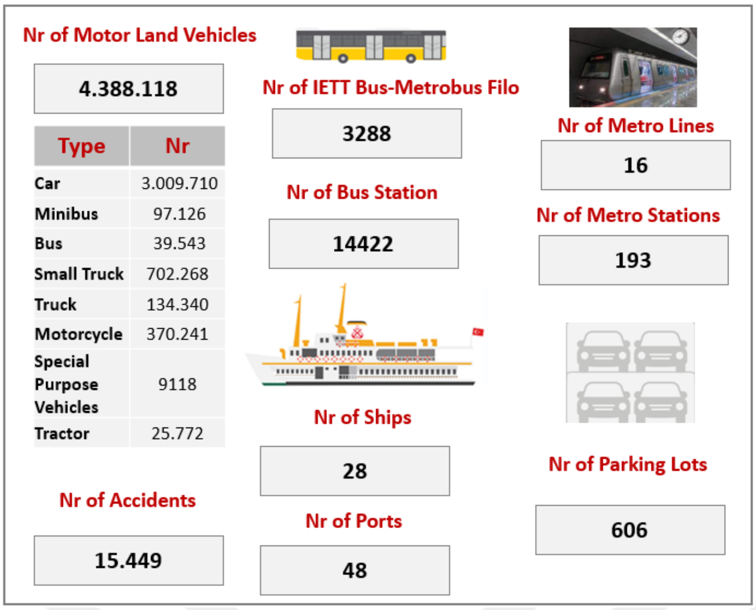

Figure 12: Number of Mobility in Istanbul

Government and local authorities have been working to manage and ensure a sustainable in Istanbul. One of the important local authorities in Istanbul is Istanbul Metropolitan Municipality, which has 30 municipal enterprises, 2 subsidiary public utility corporations, 86,701 personnel and its service area 5.461 km2.

Metropolitan Municipality is responsible for environmental services, social services, sport and entertainment services, reconstruction and city planning and mobility of Istanbul. In recent years, the importance of mobility has been increasing in Istanbul as the other cities in the world. Not only government and local authorities but also academic institutions have been working on the studies to optimize mobility. According to the “Urban Mobility Ranking” of Arthur D. Little Consultant Company, Istanbul is in average index with **64 %** performance.

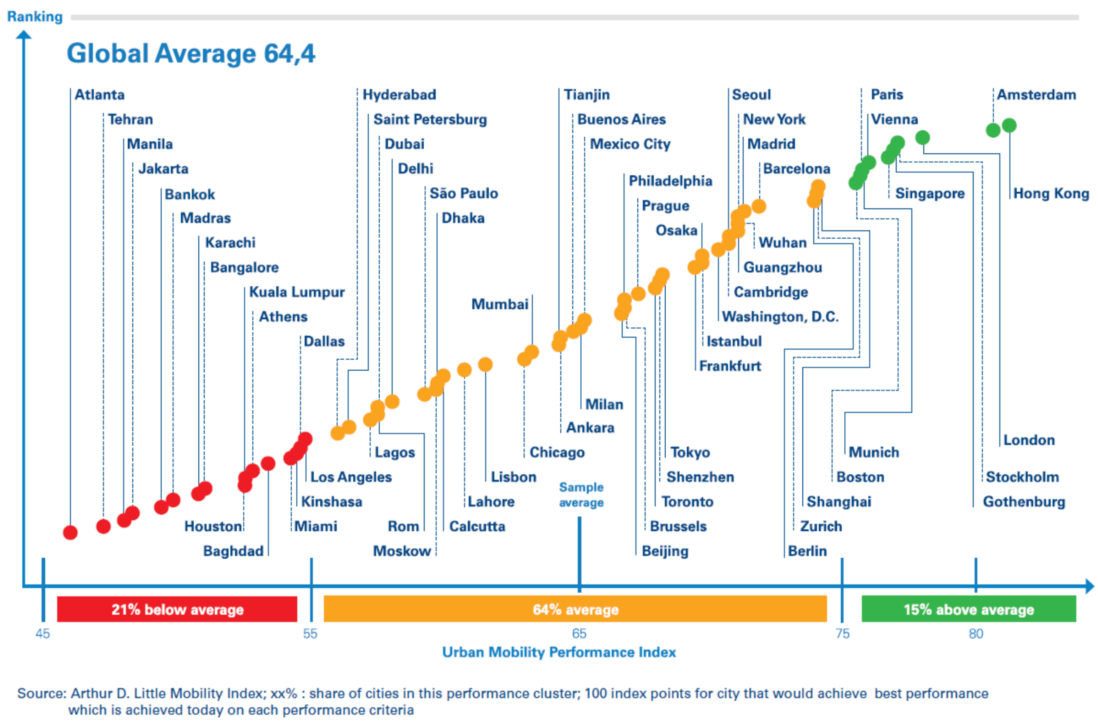

Figure 13: Global Mobility Index (source: Arthur D. Little Mobility Index Report)

This performance given above is a significant result of the achievements up until today, but there are still pending challenges and issues to be solved. To be on the "above average" performance as *Amsterdam, Hong Kong, London, Stockholm and Gothenburg*, Istanbul should be transformed from a *"conventional"* city to a *"smart"* city immediately.

With the awareness and purpose of this transformation, in 2016 "Smart City Department" has been established in Istanbul Metropolitan Municipality based on a comprehensive academic literature review and global best practices and all initiatives are managed by this department in line with National Smart Cities Strategies and Action Plan.

Organization and the mission of this department has been set accordingly. In 2017, in order to determine as-is situation and identify need and expectations, GAP analysis has been conducted. Smart city vision, strategy and roadmap have been developed in 2018 with the research of global best practices and best smart cities. In 2019 smart city index study has been performed to identify the ranking of Istanbul and smart city dictionary has been developed in line with world-wide accepted definitions and standards. In addition to this, maturity assessment has been conducted to determine maturity level of Smart City Department’s capabilities. In 2020 Smart City strategy, vision and mission have been reviewed and current roadmap has been revisited.

Main responsibilities of this department to coordinate Smart City related initiatives, coordinate projects and ensure the quality of project outputs and alignment between domains, building and maintenance of Smart City governance model.

According to the information shared on Istanbul Metropolitan Municipality website, comprehensive and detailed responsibilities of this department are;

- Researching Smart City Strategies, Practices, Architecture, Legislation, National Development Strategy, policies, and academic publications in the world,
- Within the scope of the functional areas and enablers that make up the Smart City task area in the national and international arena; to perform index scanning, to determine indicators, to monitor the determined indicators and to ensure coordination,
- Carrying out national or international promotional activities and organizing events within the scope of the functional areas and influencers that make up the Smart City task area,
- To follow the legislative preparations, current studies and changes related to the functional areas and activators that fall within the scope of Smart City in the Presidency and Ministries at the national level, to ensure that these are implemented in the works of the directorate, to offer proposals and suggestions suitable for the needs,

- Within the framework of the Strategic Plan of the Istanbul Metropolitan Municipality, within the scope of the functional areas and activators that constitute the Smart City task area, to determine the strategies and policies, to establish the goals and objectives, to carry out the necessary studies and to ensure coordination,
- To research national or international projects within the scope of the functional areas and enablers that make up the Smart City task area, to develop projects by ensuring coordination and cooperation with the relevant units in IMM,
- To determine the Smart City architectural standards of Istanbul Metropolitan Municipality units and affiliates, to control their compliance with the standards within the scope of cooperation and coordination,
- Developing and monitoring performance indicators within the scope of the functional areas and enablers that constitute the Smart City task area of Istanbul Metropolitan Municipality units and affiliates, and to cooperate in this context, to make suggestions and to ensure coordination,
- To follow, evaluate and report the activities carried out on behalf of Smart City in Istanbul,
- To cooperate in the design, development and management of projects developed within the scope of Smart Urbanism in Istanbul Metropolitan Municipality units, to make suggestions, to coordinate and to monitor their development,
- On behalf of Istanbul Metropolitan Municipality, to cooperate with District Municipalities, Unions of Municipalities and Local Administrations, Other Public Institutions, Universities, Non-Governmental Organizations, Private Sector and International Organizations on Smart City applications, develop joint projects and ensure coordination,

- To carry out the coordination and secretariat activities of the Smart City Advisory and Executive Board established within the Istanbul Metropolitan Municipality,
- To establish, manage and operate the "Smart City Platform", which collects, monitors and analyzes the data collected from the operational systems of the Istanbul Metropolitan Municipality's directorates, subordinates and affiliates, and enables the city ecosystem to work in an integrated and coordinated manner,
- Collecting and analyzing the data of Istanbul Metropolitan Municipality units, affiliates and other external stakeholders, if any, collected on the Smart City Platform in a big data environment, supporting decision makers with these analyzes, artificial intelligence, deep learning to create learning systems using technologies,
- To determine open data standards in accordance with relevant laws and regulations,
- To manage, develop and maintain the Big Data Platform and Open Data Platform of the Istanbul Metropolitan Municipality, which includes the units and affiliates of the Istanbul Metropolitan Municipality,
- Zemin Istanbul, which serves to develop innovative services and products that will meet the needs of smart urban planning, to bring successful entrepreneurs together with İBB and its affiliate companies, to bring technology manufacturers, users and investors together, to prepare children for the future with technology and to carry out innovation activities. operating technology and innovation centers,
- In order to enable entrepreneurs, academics, researchers, students to develop value-added products using IMM open data and to support innovation activities. operating technology and innovation centers,
- Researching new technologies within the scope of Smart Urbanism, conducting in-house awareness studies,
- Preparing, following and executing the tenders of the Smart City Directorate,

- To ensure the maintenance, repair and preservation of vehicles, equipment, materials and systems belonging to the directorate,
- Contributing to the Metropolitan Municipality Analytical Budget studies and preparing the unit budget proposal,
- To fulfill the duties to be given by the Metropolitan Municipality within the framework of the relevant law and regulation,
- To prepare the investment program of the directorate for each calendar year and submit it to the relevant authorities for the purpose of decision,
- To prepare the files of the works to be tendered within the scope of the investment program,
- To follow and control the construction of the works for which the tender has been carried out, in accordance with the specifications,
- To carry out the necessary observation, control, research and development studies in order to ensure quality and efficiency in the services it is responsible for.

As per the shared information from Metropolitan Municipality, their new roadmap is including 174 smart city projects. In addition to this they have been working on to strengthen their organization structure by integrating technology capabilities such as big data and data modeling, machine learning and artificial intelligence.

As shared in the annual activity reports (between 2011-2021) of Istanbul Metropolitan Municipality, Smart City related projects and activities have been compiled as given below.

Projects / Activities, which have been assigned to more years such as 2011-2012 , are on going projects or activities.

Year (s)	Projects / Activities
2011	CONDUITS - Smart Urban For Transportation Systems By Creating Networks Providing Coordination Project
2011-2012-2013	CitySDK Project – Smart City Service Development Kit and Application Pilots Project
2011-2012-2013-2018	Recyclable Solid Waste Collection Vending Machine Development (Smart Container) Project
2011-2012-2013	Smart Card Passenger Information (Ak-Yol-Bil) Project
2011-2012-2013-2014-2015-2016	Smart Taxi Stations and Smart Taxi Management Project
2011-2012-2013-2014-2015-2017	Smart Transportation and Signaling System Studies
2012-2013-2014-2015-2016-2017	Smart Bike (ISBIKE)
2012-2016	Smart Ticket for Minibuses
2013	Geographic Information System
2014-2015	COMOSEF-The Future Collaborative for Smart Traffic Systems and Mobile Services Project
2014-2015	Increasing Service Quality in Public Transportation by Smart Public Transportation Systems

2015	VITAL – In Smart Cities Internet Based Smart, Secure, Virtual, Convenient Costly Programmable Creating Interface
2017	Istanbul Smart City Project Master Plan, Literature Review and Roadmap
2016-2017	Smart Parking Systems
2017	World Cities Expo Istanbul (Smart City Transformation, Smart City Strategies, Smart Vehicles)
2017-2018-2020	iTaksi
2018	World Cities Expo Istanbul
2018-2020	Establishing and Improving “Zemin Istanbul” for developing models to contribute Smart City Journey of Istanbul
2020	Smart City and Information Technologies Committee
2020	Related with Smart City Strategies, specific objective has been set as “Developing Urban Transport in the Scope of Sustainable Mobility”
2020	In the category of Smart City Applications / Big Data Management Building Infrastructure and 360 Degree Citizens View Project

2020	Smart Cities Idea for Municipalities Contest: "Traffic Lights Using Navigation Data" Optimization"
2020	Istanbul Smart City Roadmap (Master Plan) Revision In 2018, “Smart City Vision, Strategy and Roadmap Vision, values and manifesto created, citizen, legal entity and social media needs analysis was made and as a result, 24 strategic objectives, 33 strategic goals, 50 initiatives, 101 projects roadmap was created.
2020	Completion of www.akillisehir.istanbul web portal
2020	Completion of www.smartcityindex.ibb.istanbul portal
2020	Completion of “İstanbul Senin” application
2020	Free Internet for Citizens: IBB-Wi-fi Project
2020	“Data Istanbul” Platform for Big Data to identify opportunities for improvement areas
2020	Smart Transportation Passenger System (ATAYOL)
2020	Smart Mobile Transfer Stations for Waste
2020	Establishing Tech Istanbul Platform
2020	200 activities have been organized to contribute Smart City Projects

2021	Open Data Portal
2021	Digital GAP Mapping
2021	34 Minutes Istanbul
2021	Rapid 3B Project (Mobility Laboratory)
2021	Revision of Istanbul Smart City Roadmap
2021	Vision-Mission Definition Workshop
2021	Smart City Projects Idea Collection Workshop and Surveys
2021	Developing of Smart City Governance Model

Table 2: Smart City Projects / Activities in Istanbul by years

In addition to activities given above, in 2021, November, *"Data Driven Mobility in Istanbul"* Hackathon has been conducted, since mobility is highly important for Istanbul due to, day by day increasing traffic congestion, which is mostly highlighted in critical challenges list of Istanbul.

All initiatives have been defined aligned with the Smart City Action Plan of 2020-2023 National Smart Cities Strategies. In Turkey, Smart City related strategies and initiatives are managed by "Environment, Urbanization and Climate Change Department. 2020-2023 National Smart Cities Strategies and Action Plan has been developed and published in 2019, July via the website https://akillisehirler.gov.tr .

In 2020-2023 National Smart Cities Strategies and Action Plan report, details of 2020-2023 plans are explained as given below.

"*2020-2023 National Smart Cities Strategy and Action Plan has been drawn up with the aim to gain the ability of interoperability by means of bringing an integrated perspective in Smart City policy on a national level, and to ensure that the investments are utilized in the correct projects and activities by the component and producing Smart City Ecosystem by means of prioritizing the investments that meet the requirements of the designated policies. With an integrated strategy address the needs of the stakeholders, paying regard to the current state by attaching importance to the experiences gained, and evaluating the international applications, it is aimed*

- *to set a mutual vision and a roadmap,*
- *to monitor and evaluate with a systematic and open governance process,*
- *to accommodate new conditions,*
- *to develop Smart City maturity with a common perspective in the cities*"

Figure 14 is showing the main steps of smart city transformation roadmap.

Figure 14: 2020-2023 National Smart Cities Strategy and Action Plan

In addition to the strategic and action plan, some smart city best practices from Istanbul, Kocaeli, Aydın and Konya, shared by Environment, Urbanization and Climate Change Department.

3. RESEARCH METHOD

3.1 Research Methodology

In the context of this research, following methodologies have been conducted.

- ***Surveys:*** To understand main pain points and get solution proposals and feedback from citizens, who live in Istanbul.
- ***Interviews:*** To understand main pain points and get solution proposals and feedback from Privat Companies in Istanbul. To understand the current studies, organization and roadmap of local authorities.
- ***Workshop:*** To hear the challenges from 1st parties, to identify root causes with a different perspective and see the proper solutions and proposals. (*Attended to Data Driven Mobility Hackathon organized by Istanbul Metropolitan Municipality-(2021, November 7th-8th*))

In addition to mentioned research methods given above, best practices from other countries, report from consulting companies and non-profit organizations and publicly available data have been also used for analysis and proposed solutions.

3.2 Participants

3.2.1 Participants for Survey

3.2.1.1 Background and Selection of the Participants

Target Group has been determined as the Citizens who are 18 years old and above and live in Istanbul permanently. Foreigners are out of scope of this research.

With the purpose of reaching out the comprehensive and consistent results, diversity of the sample universe has ensured by sharing questionary set with different participants via different channels.

You may see the demographic information of participants in following graphs and figures.

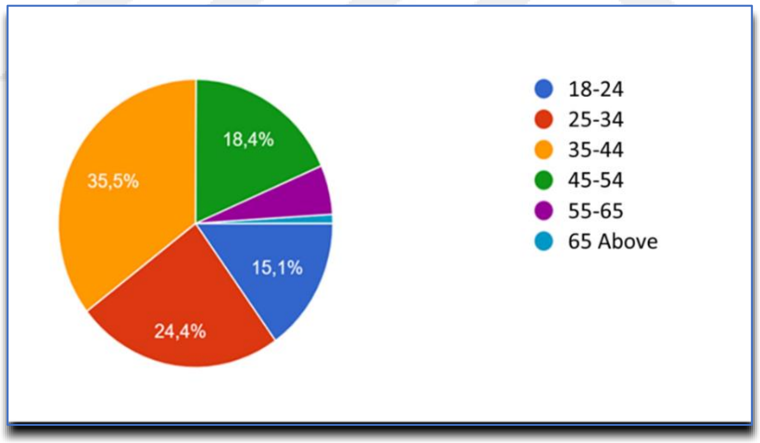

Figure 15: Distribution of Participants by Age

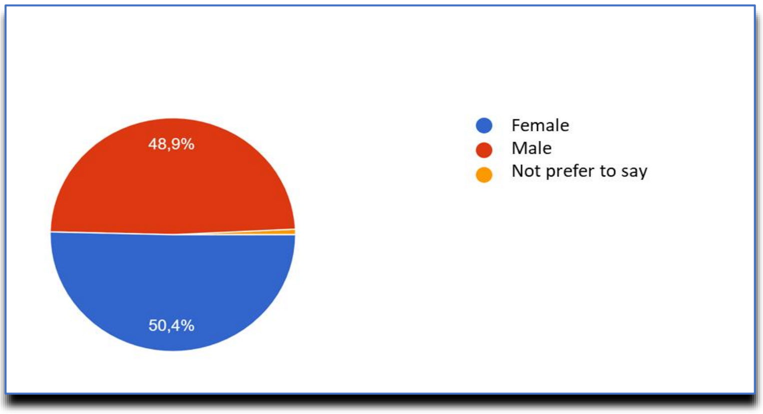

Figure 16: Distribution of Participants by Gender

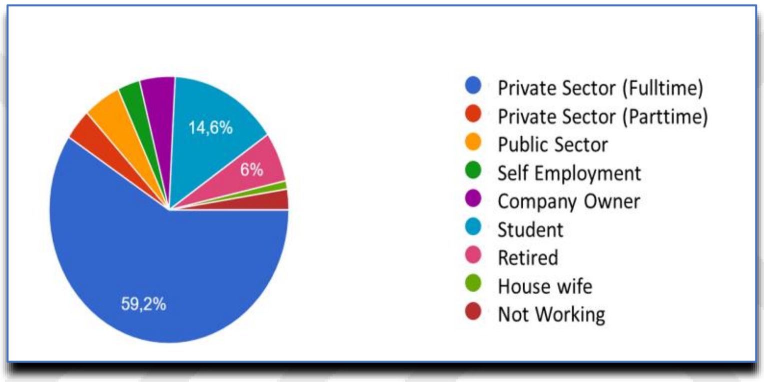

Figure 17: Distribution of Participants by Employment Status

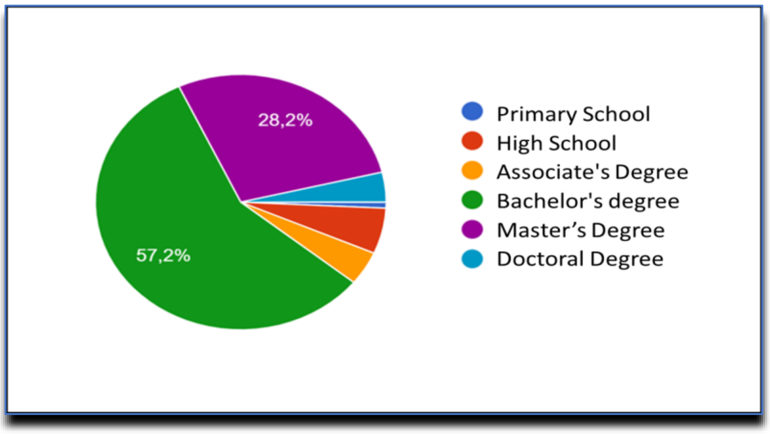

Figure 18: Distribution of Participants by Education Level

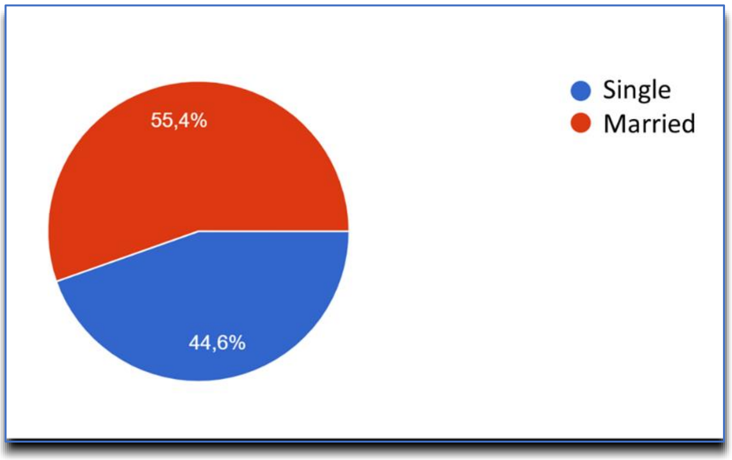

Figure 19: Distribution of Participants by Marital Status

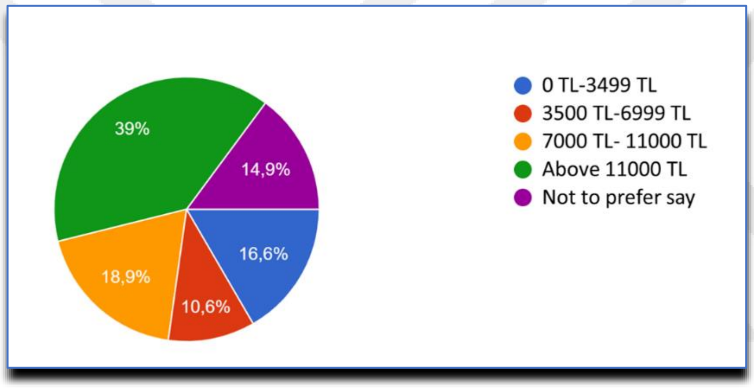

Figure 20: Distribution of Participants by Income

Figure 21: Distribution of Participants by Living District

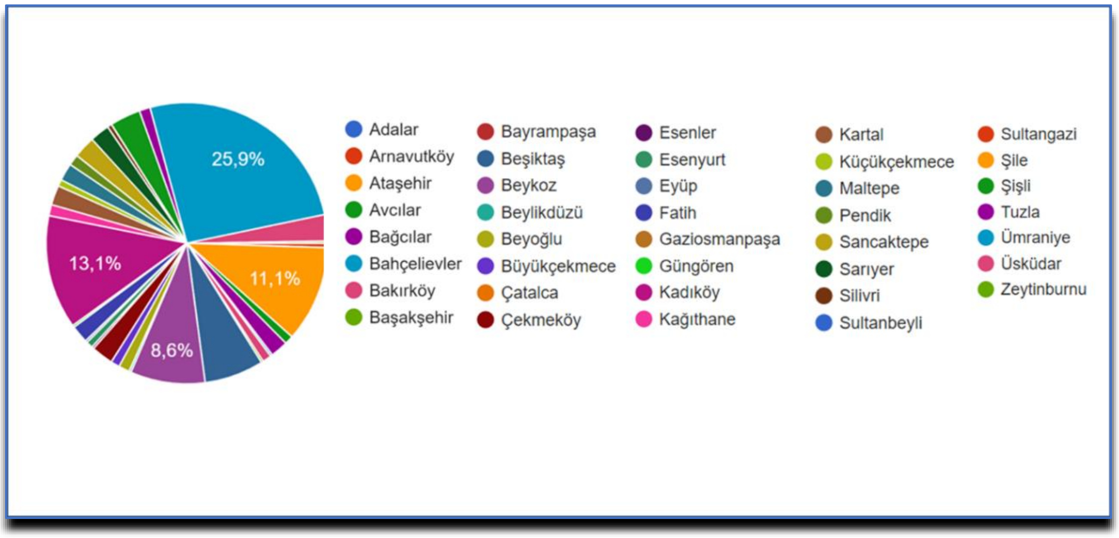

Figure 22: Distribution of Participants by Frequently Visited District

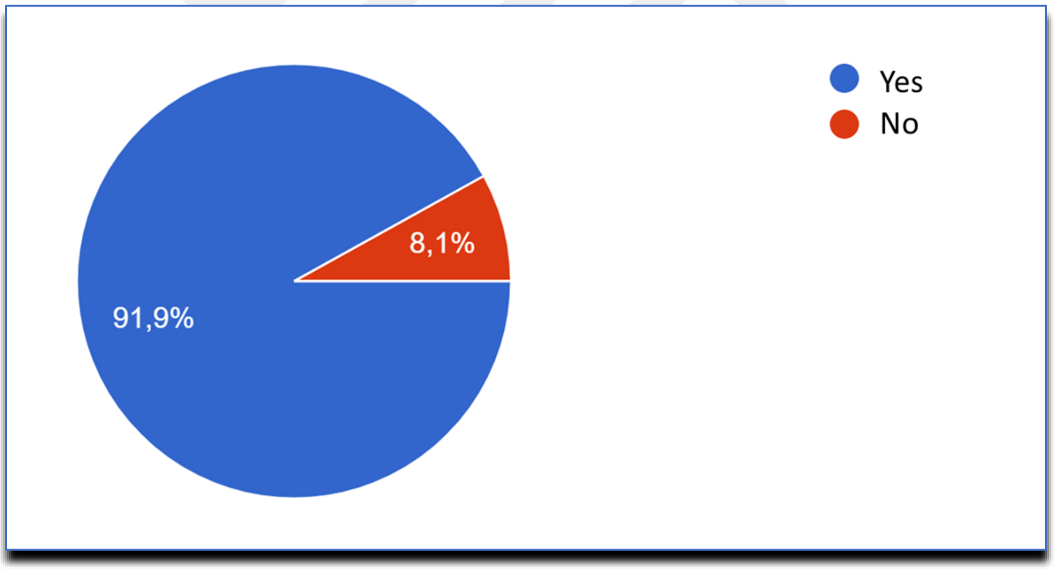

Figure 23: Distribution of Participants by Having “Istanbul Card”

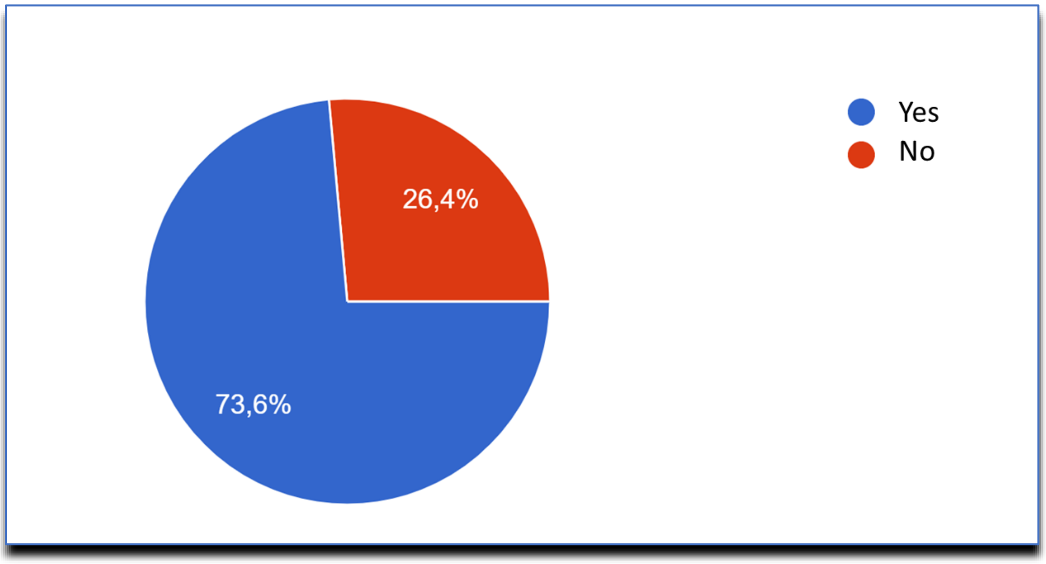

Figure 24: Distribution of Participants by Having "Private/Company Car"

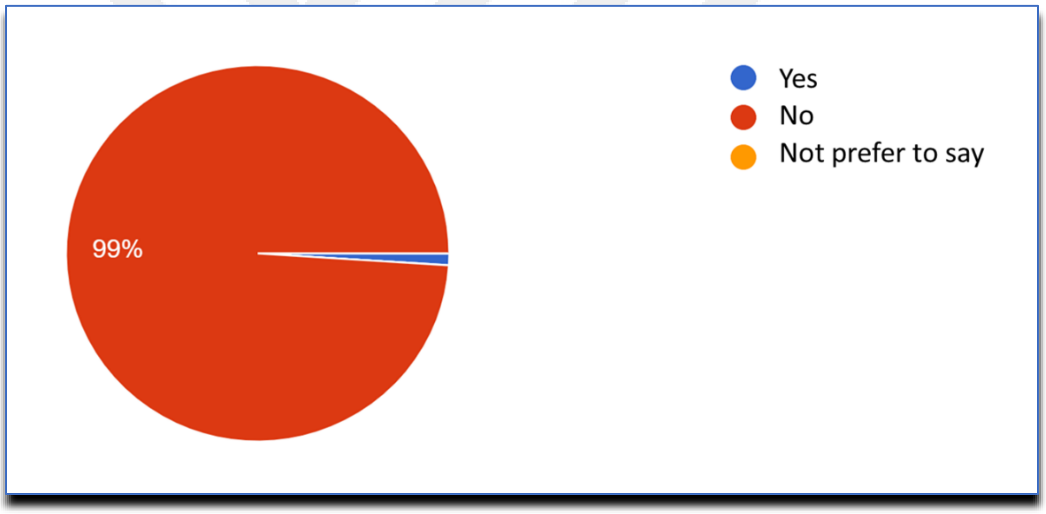

Figure 25: Distribution of Participants by Having any "Disability"

397 citizens from different groups have got back to the survey questions. To ensure the data accuracy, missing/inconsistent data have been excluded from data set and results of **385** citizens have been included to the analysis.

In addition to questionary set, **127** participants shared their detailed solution proposals, which are categorized and integrated to the implications.

3.2.2 Participants for Interview

3.2.2.1 Background and Selection of the Participants

Private Companies mobility is highly critical as the mobility created by citizens. To develop comprehensive and sustainable mobility solutions for a city, implications should cover not only citizens but also private companies and local authorities.

Within the scope of this step, 2 interviews have been conducted with private companies in logistics and FMCG sectors. Not only Lead of related departments but also the respective team members, who are operating the processes, have been attended to the interviews. By this way, feedback and solutions have been received from 1st parties directly.

3.2.3 Participants for "Data Driven Mobility" Hackathon

3.2.3.1 Background and Selection of the Participants

Participants of Hackathon have been selected by *Istanbul Metropolitan Municipality, the Consulate General of the Kingdom of the Netherlands in Istanbul, and World Resources Institute.*

Aligned with the purpose and content of this thesis, we have created a study group, including Academics with background for smart technologies, corporate governance, MSc degree on work zone traffic management of Istanbul; Professionals with e-commerce, technology, data, sustainability, project management and innovation experiences.

3.3 Research Design

3.3.1 Survey Design

To identify the pain points and to understand general habits and behavior of citizens, “Istanbul Mobility” Survey has been conducted within the scope of this thesis.

Main purpose of this Survey is to;

- identify frequency of main activities caused mobility
- identify transportation methods/vehicles per activity
- demonstrate average daily loss of time in traffic
- measure how much they are satisfied with Public Transportation
- find out the readiness of private/company car owner to use Public Transportation

Questionary Set has been developed with the purpose of finding out the frequency and preferred transportation method/methods of routines and activities, which are mostly causing mobility in our daily life. Via Survey questionary, collection of mostly qualitative data is targeted.

All required analysis is conducted within the framework of these activities given below.

- Go to Work and Back from Work
- Go to School and Back from School
- Visit Family-Meet Friends
- Shopping
- Go to Hospital / Dr. Appointment
- Go to Bank/Government Agency
- Go to Airport / Bus Terminal (to go out of the city)

- Attend to other activities (Sport, Course, Seminar)

Before sharing the survey, questionary set has been reviewed by thesis supervisor and an Academician from Turk-Alman University, who has a master's degree on work zone traffic management of Istanbul and PhD on ride-sharing matching algorithms. Questionary set has been revisited accordingly.

In addition to this review, a pilot run has been performed for 20 test users by face-to face meeting to receive feedback/comment, to measure required time for completion of survey and see whether they face with any technical difficulties and obstacles.

Once required revision and improvements completed, surveys have been shared via a common online platform. To reach out more participants social media platforms, platforms of universities, non-governmental organizations and some of the blue-collar employers' companies have been used as survey sharing channels.

Questionary set has been distributed per participant and purpose of this study has been communicated clearly.

To eliminate the pandemic effect on daily life, traffic, usual behavior and habits, this survey has been conducted in the first week of December and the proposed solutions have been reviewed and re-interpreted accordingly.

Questionary responses have been collected with anonymous approach in 2 weeks.

You may find the details of questionary in **3.4.1 Survey Results** section, before the related result.

3.3.2 Interviews Design

With the purpose of involving the private companies to the solutions, interviews have been conducted with respective team members of Istanbul Metropolitan Municipality

Smart City Department and respective team members who are working in logistics, distribution, planning, and e-commerce departments from companies.

Interviews have been performed via both face-to-face and online meetings.

To understand pain point, receive suggestions, interviews have been performed with the scope of following questionary set;

- Main processes and activities of related department
- Objectives and Key Performance Indicators
- Key Points for logistics and distribution related activities
- Main pain points and difficulties for mobility and traffic in Istanbul
- Solutions developed and currently applied in companies
- Currently used software or planning tools
- Planned / On-going Projects to solve traffic / mobility related issues
- Suggestions and proposals for solutions

3.3.3 Data Driven Mobility Hackathon Design

"Data Driven Mobility Hackathon" has been designed by *Istanbul Metropolitan Municipality, the Consulate General of the Kingdom of the Netherlands in Istanbul, and World Resources Institute.*

Scope is not covering all district of Istanbul, only **Kadıköy** has been selected as a pilot area. Purpose is to develop solutions for a region thereafter extend and adapt the proper ones to all areas.

Agenda was “Sharing the main Mobility Challenges of Istanbul”, “Sharing the main Mobility Challenges of Kadıköy”, “Developing Solutions aligned with Data Driven Mobility”.

3.4 Results

3.4.1 Survey Results

To define a starting point and to form a basis for solution development, demonstration of the prior issues and subject is highly crucial for analysis. Segregation of “most important” topics from the “less important” ones is the first step to find out the opportunities for improvements areas. Focusing on the most significant topics, issues, or areas, looking at their specific components and broad relations bring a comprehensive approach to data analysis.

With the purpose of providing consistent input for solution development, *Pareto Analysis* has been conducted per activity.

Pareto Analysis is used as a basic method for determination of priorities via classification and separation method. This technique enables to show a situation with the help of graphics and to focus on the most important cause or frequency of the problem or issue. And it can be used in almost any field to set priorities.

Identifying the causes of the problem, especially in quality control and quality improvement programs by this technique, which errors or focus area have a greater percentage can be easily detected *(Ishikawa, 1982).*

Via this analysis method, solutions are suggested, can be ranked according to their importance and as a result solution roadmap can be developed accordingly.

As the result of Pareto Analysis, major percentages have been highlighted by daily routines and activities to focus on relevant improvement areas.

Survey Question-1: Considering the last month, how often did you do the following activities on average?

Activities: Go to Work and Back from Work, Go to School and Back from School, Visit Family-Meet Friends, Shopping, Go to Hospital / Dr. Appointment, Go to Bank/Government Agency, Go to Airport / Bus Terminal (to go out of the city), Attend to other activities (Sport, Course, Seminar)

Frequency: 5 Times a week and more, 3-4 Times a week, 1-2 Times a week, 1-2 Times a month, never, other.

Go to Work and Back from Work: **48,3 %** of participants go to work 5 Times a week and more, **14,5 %** of them go to work 3-4 Times a week. (Please note that number of the working participants is 293.)

- **Go to School and Back from School:** **14,3 %** of participants go to school 1-2 Times a week, **10,1 %** of them go to school 3-4 Times a week. (Please note that number of the student participants is 55.)
- **Visit Family-Meet Friends:** **46,5 %** of participants visit their family and friends 1-2 Times a week, **29,9 %** of them visit 1-2 Times a month, **14,3 %** of them visit 3-4 Times a week

– **Shopping:** **46 %** of participants go shopping 1-2 Times a week, **34%** of them go shopping 1-2 Times a month, **12,7 %** of them go shopping 3-4 Times a week

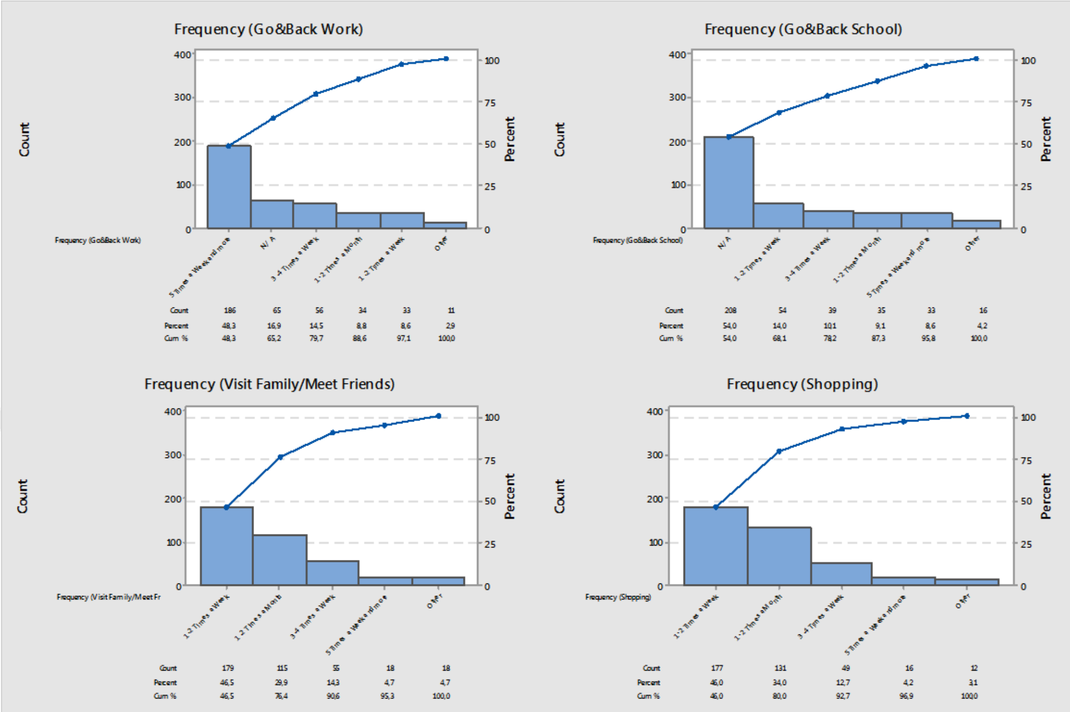

Figure 26: Distribution of Frequency by Activity-1

– **Go to Hospital / Dr. Appointment:** **54, %** of participants go to Hospital/Dr Appointment 1-2 Times a month,

– **Go to Bank/Government Agency:** **39,2 %** of participants go to Bank/Government Agency 1-2 Times a month,

– **Go to Airport / Bus Terminal (to go out of the city):** **39,2 %** of participants go to Airport and Bus Terminal 1-2 Times a month to go out from city.

– **Attend to other activities (Sport, Course, Seminar):** **31,9 %** of participants attend to other activities 1-2 Times a month, **18,7 %** of them attend to other activities 1-2 Times a week.

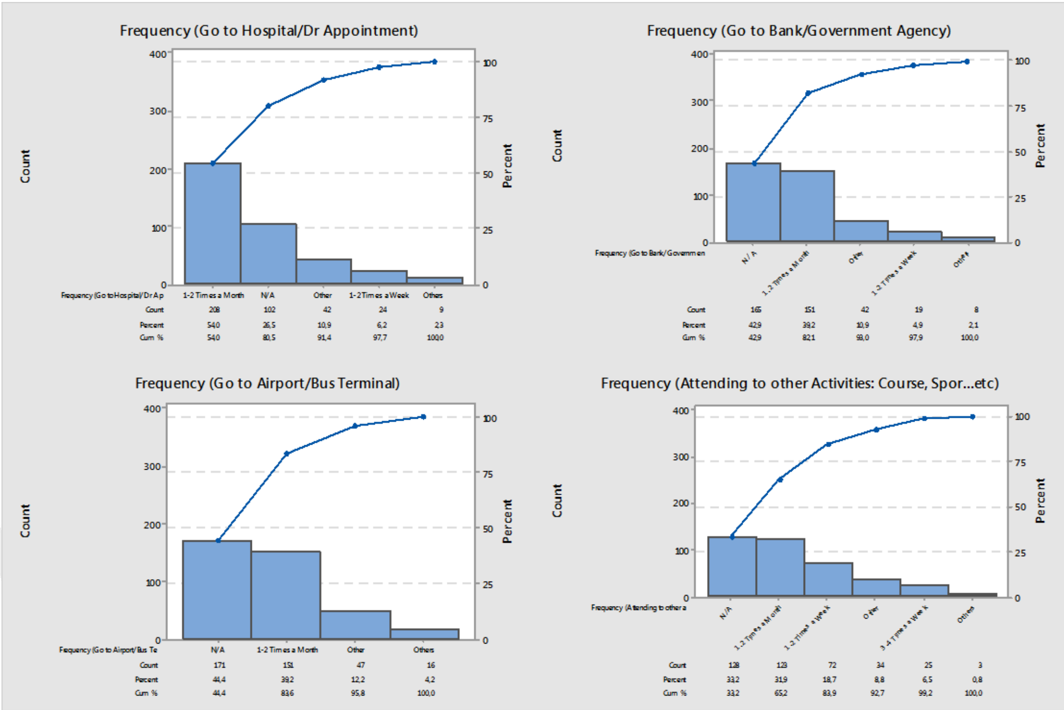

Figure 27: Distribution of Frequency by Activity-2

<u>Focus Areas for Improvements</u>

In order to provide the appropriate and sustainable solutions, focus areas have been defined by taking the frequency and the ratio majority of per activity.

Below you may see the prioritization matrix for each activity.

Activities	<u>Frequency of Activities</u>				
	5 Times a Week and more	**3-4 Times a Week**	**1-2 Times a Week**	**1-2 Times a Month**	**Other**
Go to Work and Back from Work	48,3 %	14,5 %	8,6 %	8,8 %	19,8 %
Go to School and Back from School	8,6 %	10,1 %	14 %	9,1 %	58,2 %
Visit Family-Meet Friends	4,7 %	14,3 %	46,5 %	29,9 %	4,7 %
Shopping	4,2 %	12,7 %	46 %	34 %	3,1 %

Go to Hospital / Dr. Appointment	-	-	6,2 %	54 %	39,7 %
Go to Bank/Government Agency	-	-	4,9 %	39,2 %	55,9 %
Go to Airport / Bus Terminal (to go out of the city)	-	-	-	39,2 %	60,8 %
Attend to other activities (Sport, Course, Seminar)	-	6,5 %	18,7 %	31,9 %	42,8

Table 3: Prioritization Matrix to identify Focus Areas

As shown in above matrix, the most frequently with a major ratio conducted activities are;

- Go to Work and Back from Work
- Go to School and Back from School
- Visit Family-Meet Friends
- Shopping

Therefore, in the context of this thesis, it is targeted to develop solutions by focusing on these activities primarily. To develop applicable implications, detailed analysis has been conducted with different perspectives for these activities.

Survey Question-2: Considering the last 1 month, which transportation/method did you use for the following activities? (You can tick more than one option.)

Activities: Go to Work and Back from Work, Go to School and Back from School, Visit Family-Meet Friends, Shopping, Go to Hospital / Dr. Appointment, Go to

Bank/Government Agency, Go to Airport / Bus Terminal (to go out of the city), Attend to other activities (Sport, Course, Seminar)

<u>*Transportation / Method:*</u> Private / Company Car, Taxi, Shuttle, Public Transportation, Motorbike-Bike-Scooter, By Walk, I don't do this activity

<u>Go to and Back from Work</u>

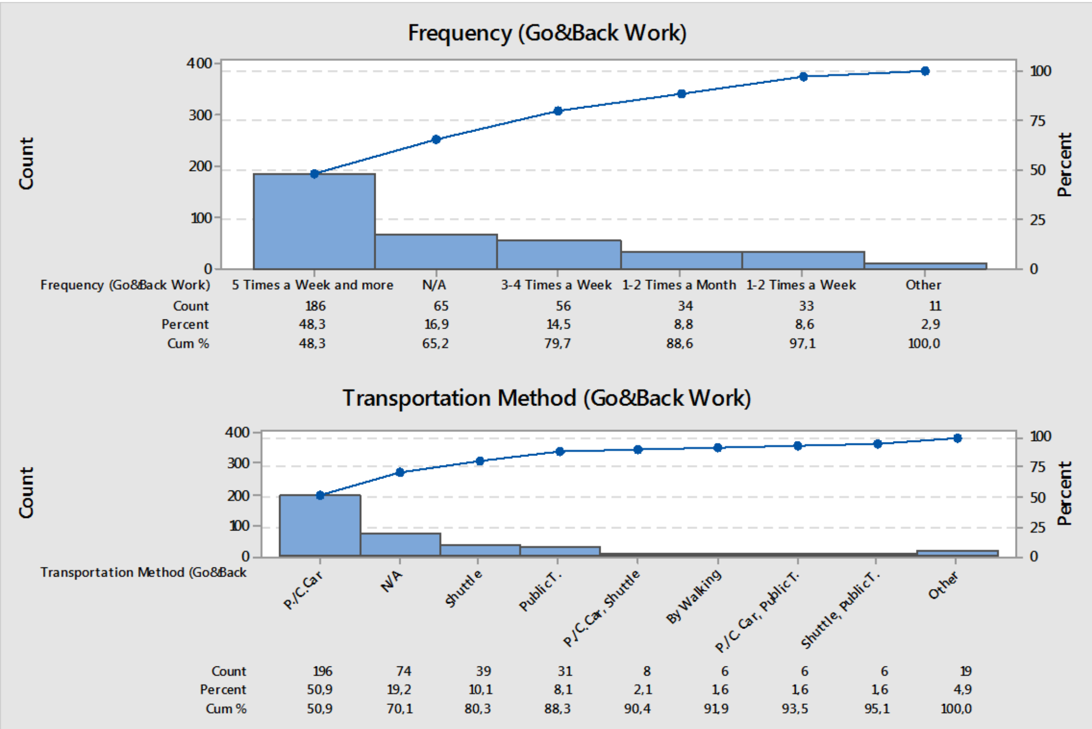

Figure 28: Frequency and Transportation Method for Go to and Back from Work "

As per the result of survey **83,1** % percentage of the participants are doing <u>"Go to and Back from Work"</u> activity with the following frequency.

- **48,3 %** of participants go to work **5 Times a Week and more**
- **14,5 %** of participants go to work **3-4 Times a Week**
- **8,6 %** of participants go to work **1-2 Times a Week**
- **8,8 %** of participants go to work **1-2 Times a Month**

And participants who does this activity, prefer to use following transportation method(s).

- **50,9 %** of participants go to work **by Privat/Company Car**
- **10,1 %** of participants go to work **by Shuttle**
- **8,1 %** of participants go to work **by Public Transportation**
- **2,1 %** of participants go to work **Privat/Company Car or by Shuttle**
- **1,6 %** of participants go to work **by Privat/Company Car or by Public Transportation**

As shown in the below figure, there is significant difference for private/company car using participants, who are going to work frequently, e.g: 5 Times a Week and more.

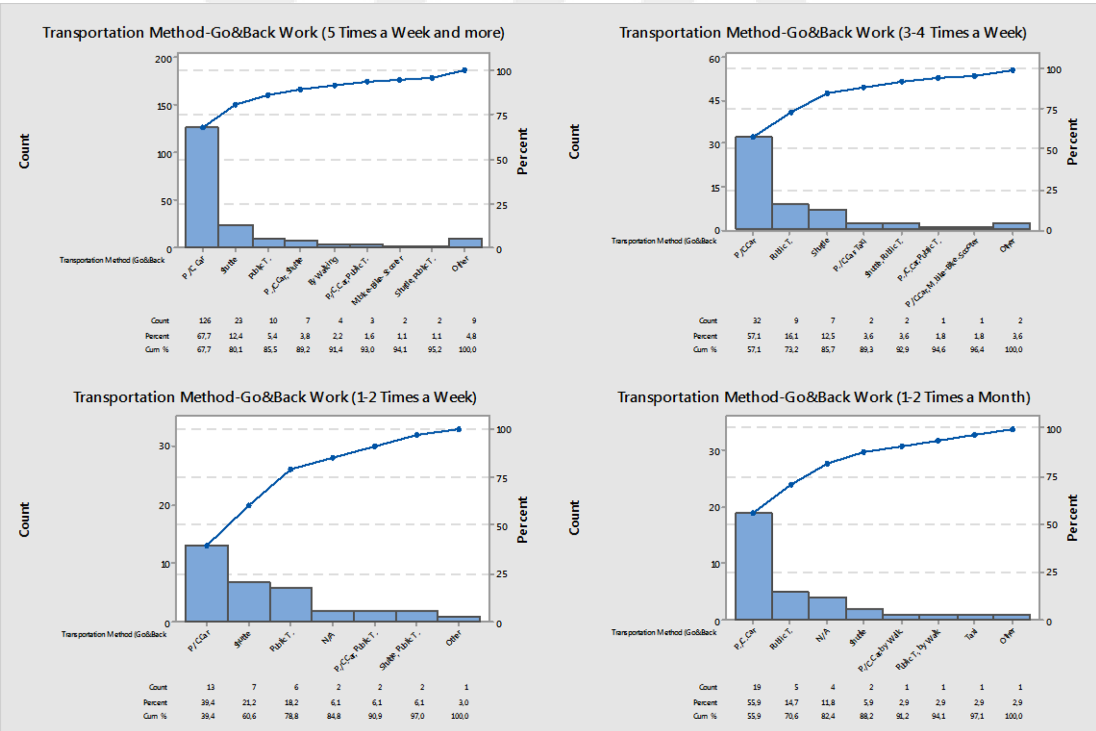

Figure 29: Go to and Back from Work “ by Frequency and Transportation Method

Majority of the participants who go to work frequently in a week by their private / company car is higher than the other groups.

- **67,7 %** of participants, who go to work 5 Times a Week and more,
- **57,1 %** of participants go to work 3-4 Times a Week
- **39,4 %** of participants go to work 1-2 Times a Week

Go to and Back from School

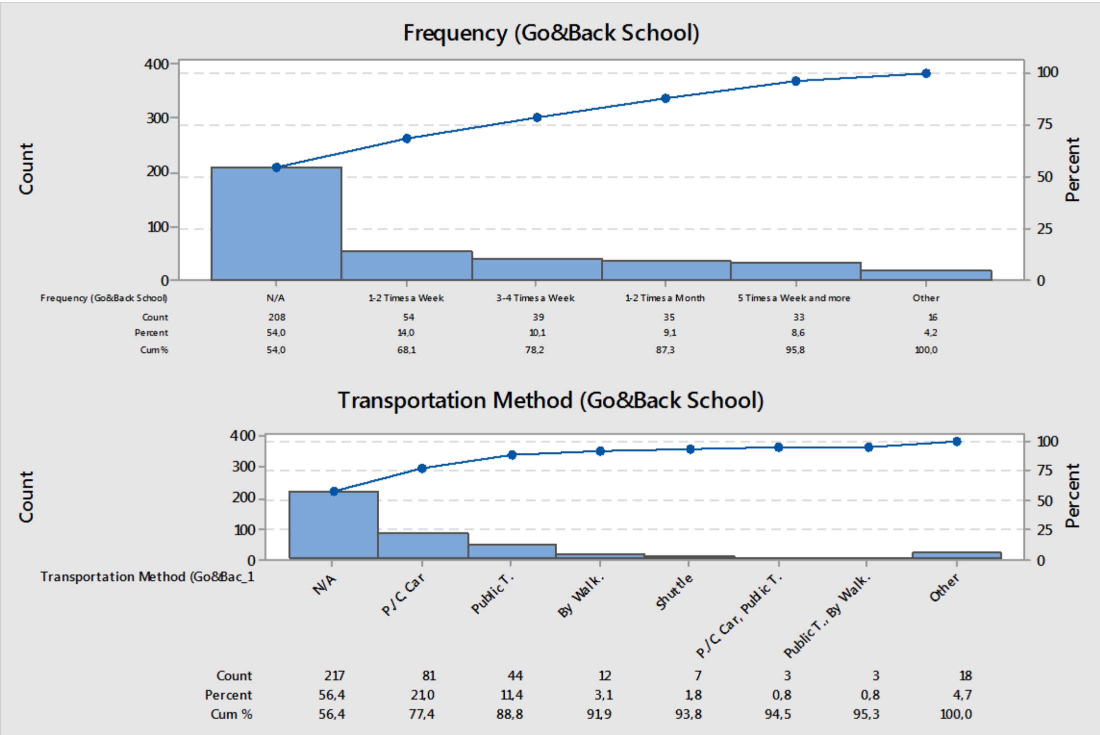

Figure 30: Frequency and Transportation Method for Go to and Back from School "

As per the result of survey **46** % percentage of the participants are doing <u>"Go to and Back from School"</u> activity with the following frequency.

- **8,6 %** of participants go to school **5 Times a Week and more**
- **10,1 %** of participants go to school **3-4 Times a Week**
- **14 %** of participants go to school **1-2 Times a Week**
- **9,1 %** of participants go to school **1-2 Times a Month**

And participants who does this activity, prefer to use following transportation method(s).

- **21 %** of participants go to school **by Privat/Company Car**
- **11,4 %** of participants go to school **by Public Transportation**
- **1,8 %** of participants go to school **by Shuttle**
- **3,1 %** of participants go to school **by Walking**

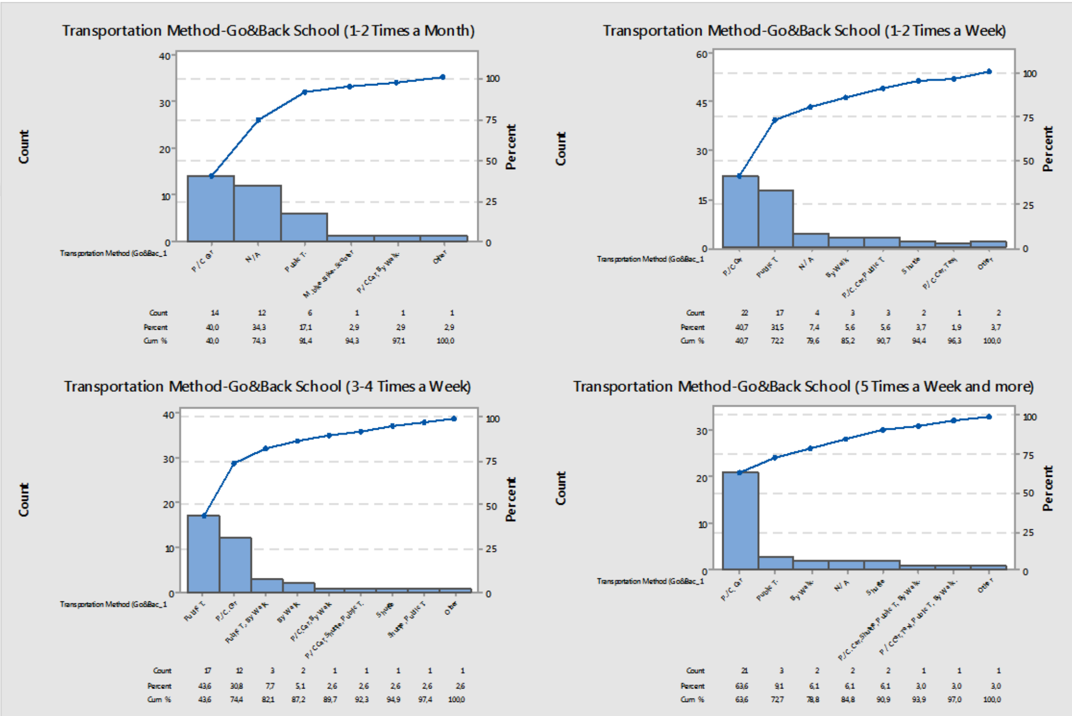

Figure 31: Go to and Back from School " by Frequency and Transportation Method

Majority of participants prefer to use their own cars to go to and back from school.

You may see the percentage of the participants who prefer to use Private/Company Car to go to school.

- **40 %** of participants (1-2 Times a month)
- **40,7 %** of participants (1-2 Times a Week)
- **63,6 %** of participants (5 Times a Week and more)

Only the participants who go to school <u>3-4 Times a Week</u> prefer to use Public Transportation with a **43,6 %** rate, however 31 % of participants are using their own or company car for this frequency level.

<u>Visit Family and Meet Friends</u>

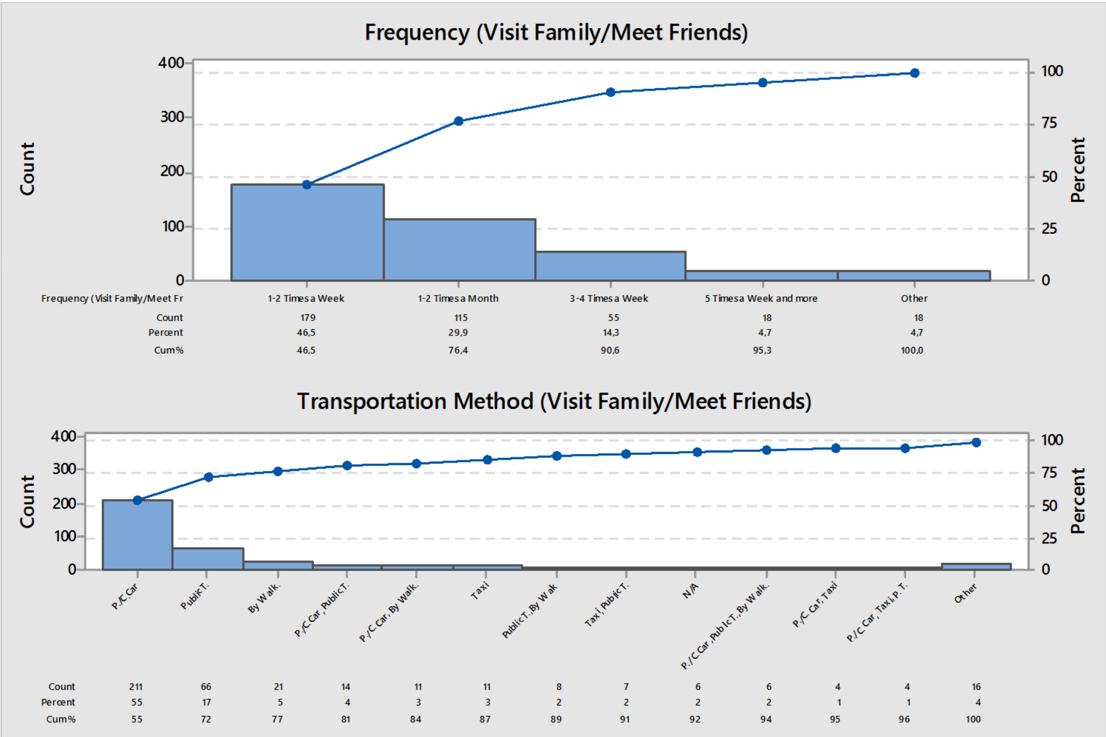

Figure 32: Frequency and Transportation Method for Visit Family and Meet Friends "

As per the result of survey **96** % percentage of the participants are doing <u>"Visit Family and Meet Friends"</u> activity with the following frequency.

- **46,5 %** of participants visit family and meet friends **1-2 Times a Week**
- **29,9 %** of participants visit family and meet friends **1-2 Times a Month**
- **14,3 %** of participants visit family and meet friends **3-4 Times a Week**
- **4,7 %** of participants visit family and meet friends **5 Times a Week and more**

And participants who does this activity, prefer to use following transportation method(s).

- **55 %** of participants visit family and meet friends **by Privat/Company Car**
- **17 %** of participants visit family and meet friends **by Public Transportation**
- **5 %** of participants visit family and meet friends **by Walking**

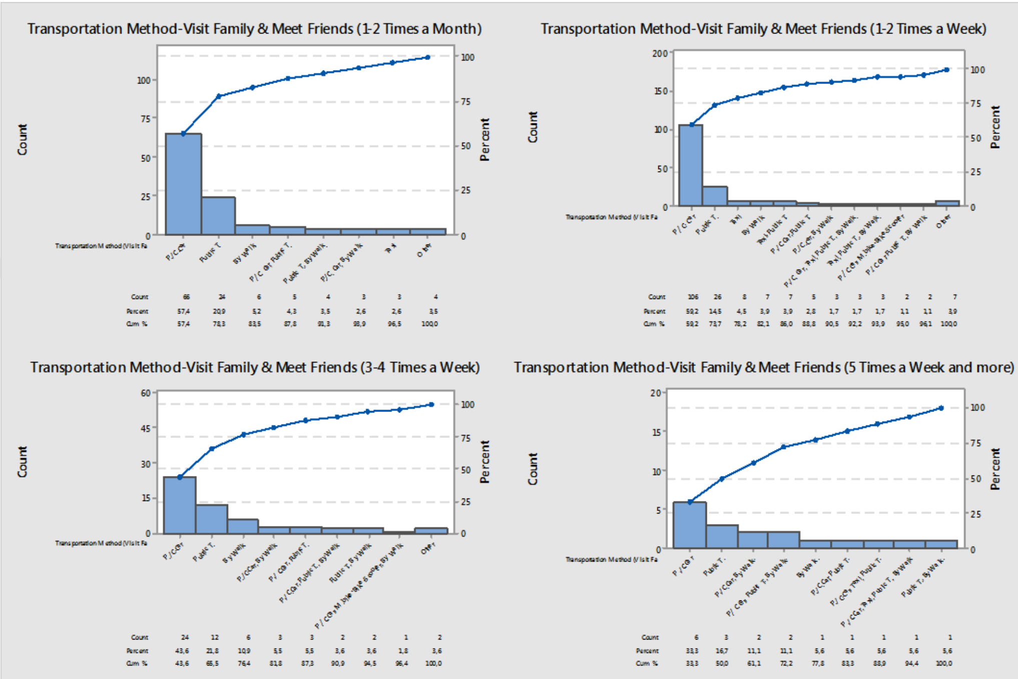

Figure 33: Visit Family and Meet Friends " by Frequency and Transportation Method

Majority of participants prefer to use their own or company car to visit their families and meet their friends

You may see the percentage of the participants who prefer to use <u>Private/Company Car</u> to go to school.

- **57,4 %** of participants (1-2 Times a month)
- **59,2 %** of participants (1-2 Times a Week)
- **44 %** of participants (3-4 Times a Week)
- **33,3 %** of participants (5 Times a Week and more)

On the other hand, almost 20 % of the participants prefer to use Public Transportation, which place on the 2nd level as rate.

<u>Shopping</u>

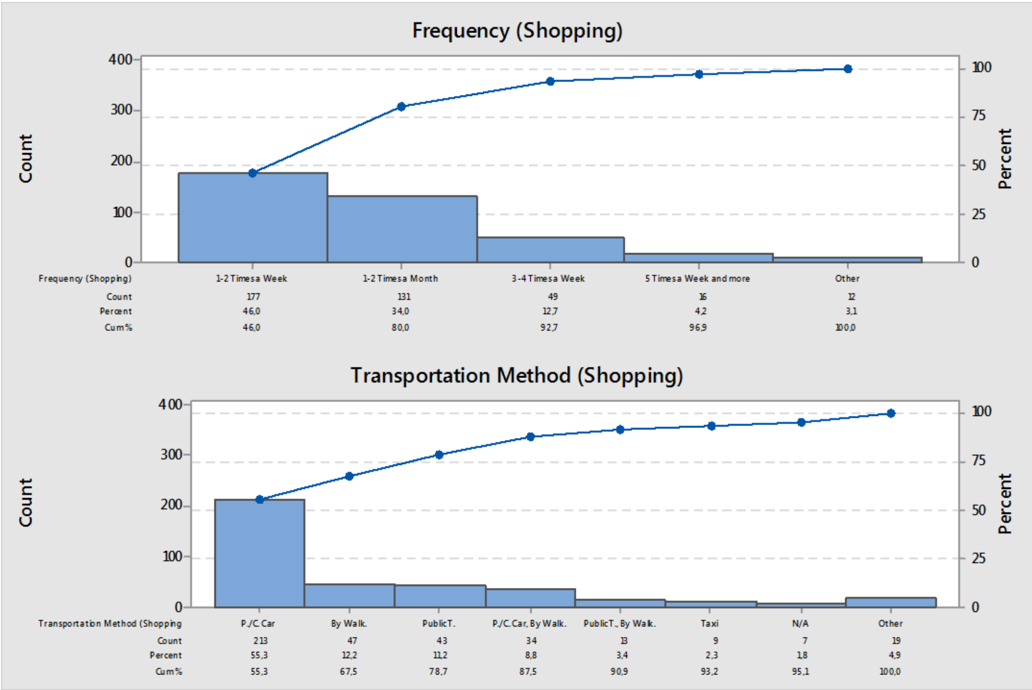

Figure 34: Frequency and Transportation Method for Shopping

As per the result of survey **97** % percentage of the participants are doing <u>“Shopping”</u> activity with the following frequency.

- **46 %** of participants go shopping **1-2 Times a Week**
- **34 %** of participants go shopping **1-2 Times a Month**
- **13 %** of participants go shopping **3-4 Times a Week**
- **4,2 %** of participants go shopping **5 Times a Week and more**

And participants who does this activity, prefer to use following transportation method(s).

- **55, 3%** of participants go shopping **by Privat/Company Car**

– **12,2 %** of participants go shopping **by Walking**

– **11,2 %** of participants go shopping **by Public Transportation**

– **8,8 %** of participants go shopping **by Privat/Company Car / by Walking**

<u>Survey Question-3:</u> Considering the last 1 month, how often did you use the following transportation vehicle /method on average?

<u>Transportation Vehicle /Method:</u> Private / Company Car, Taxi, Shuttle, Bus / Minibus, Motorbike-Bike-Scooter, Railway, Seaway.

<u>Frequency:</u> 5 Times a week and more, 3-4 Times a week, 1-2 Times a week, 1-2 Times a month, never, other.

In this survey, frequency of usage of public transportation has been asked to the participants. As per the results,

– **48,1 %** of participants using their private/company car 5 Times a Week and more

– **9,9 %** of participants using shuttle 5 Times a Week and more

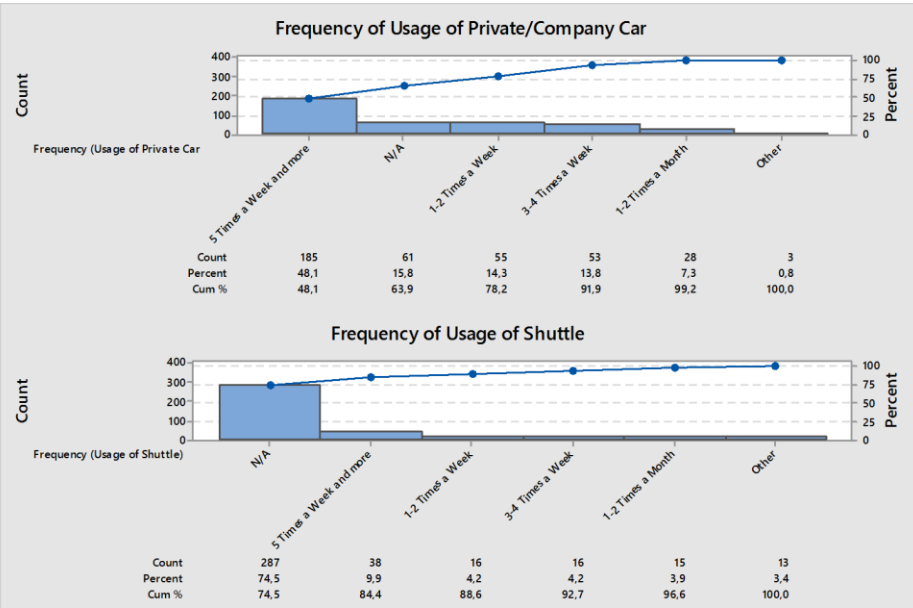

Figure 35: Frequency of Usage of Transportation Vehicles (Private/Company Car and Shuttle)

- **17,4 %** of participants using Bus/Minibus 1-2 Times a Month
- **27,3 %** of participants using Rail systems 1-2 Times a Month

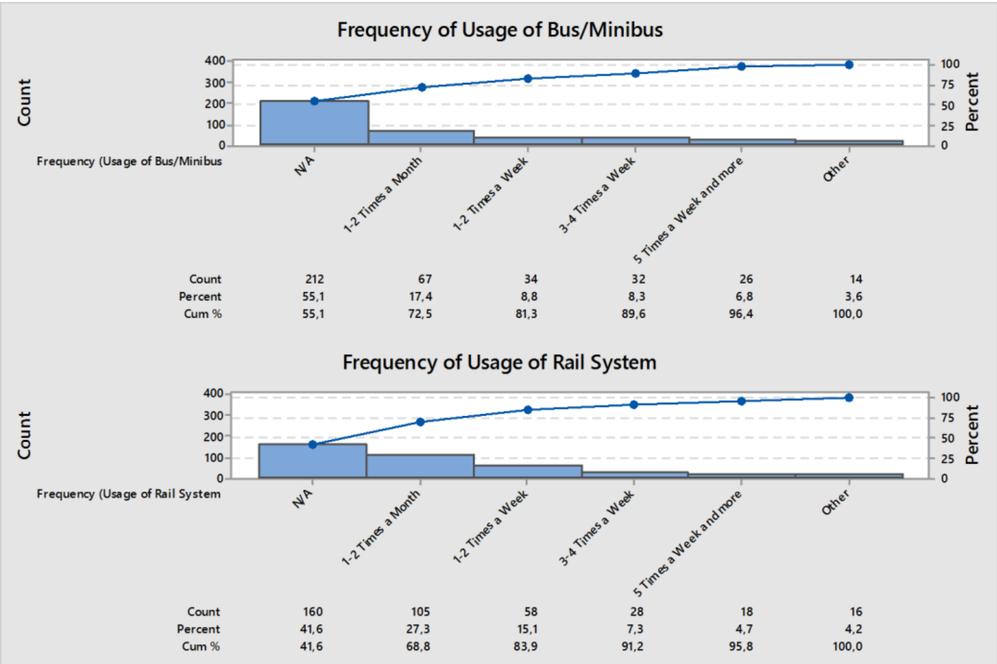

Figure 36: Frequency of Usage of Transportation Vehicles (Bus/Minibus/Railsystems)

- **25,2 %** of participants using Seaway 1-2 Times a Month
- **5,5 %** of participants using Motorbike/Bike/Scooter 1-2 Times a Month

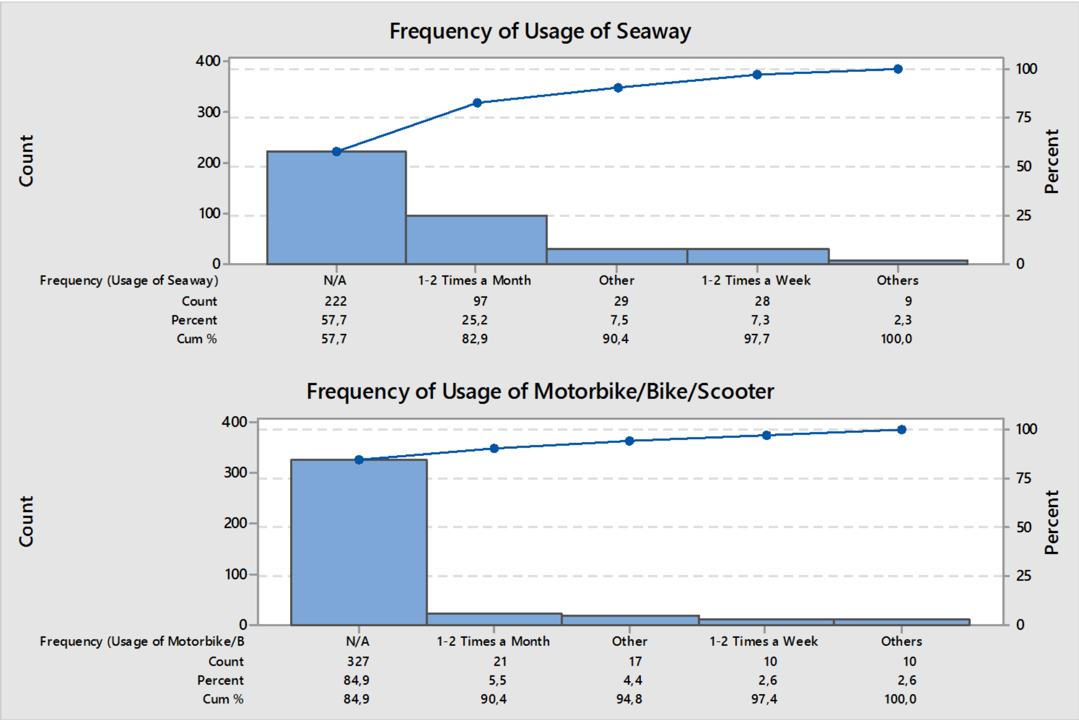

Figure 37: Frequency of Usage of Transportation Vehicle (Seaway and Motorbike/Bike/Scooter)

Survey Question-4: Can you evaluate "Public Transport" in Istanbul according to the following criteria? (You may find the criteria in following figures by subjects.)

To understand the perception and problems of participants about Public Transportation, 10 dimensions of public transportation have been asked to the participants.

– **63 %** of participants agree /slightly agree that stations are enough and reachable.

– **57 %** of participants agree /slightly agree that public transportation is safe, **30,1 %** of participants disagree.

– **40, 4 %** of participants agree /slightly agree that public transportation is hygienic, **43 %** of participants disagree.

– **70 %** of participants are disagree that public transportation has enough vehicle capacity for passengers.

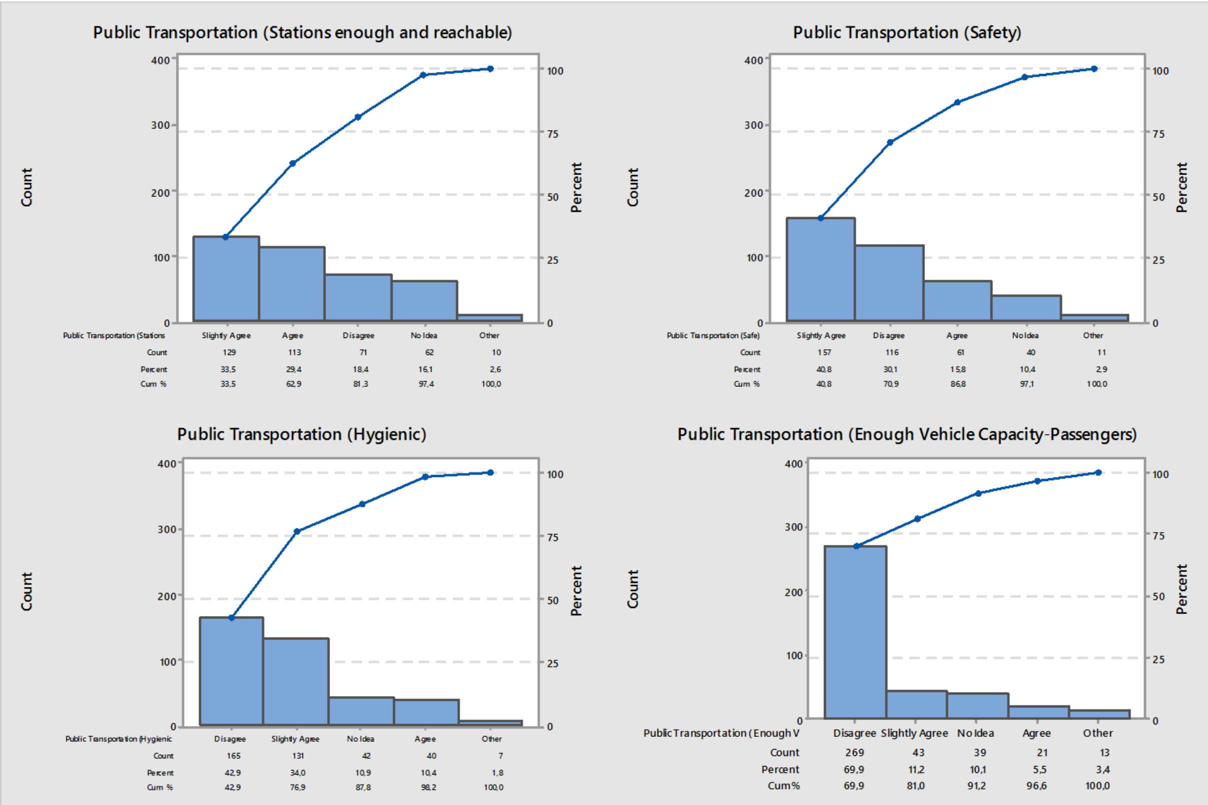

Figure 38: Perception of Public Transportation-1

- **47 %** of participants disagree that public transportation is disabled friendly.
- **49 %** of participants agree /slightly agree that public transportation has enough route.
- **49 %** of participants agree /slightly agree that public transportation has enough and appropriate lines.
- **50 %** of participants agree /slightly agree that public transportation complying with departure time.

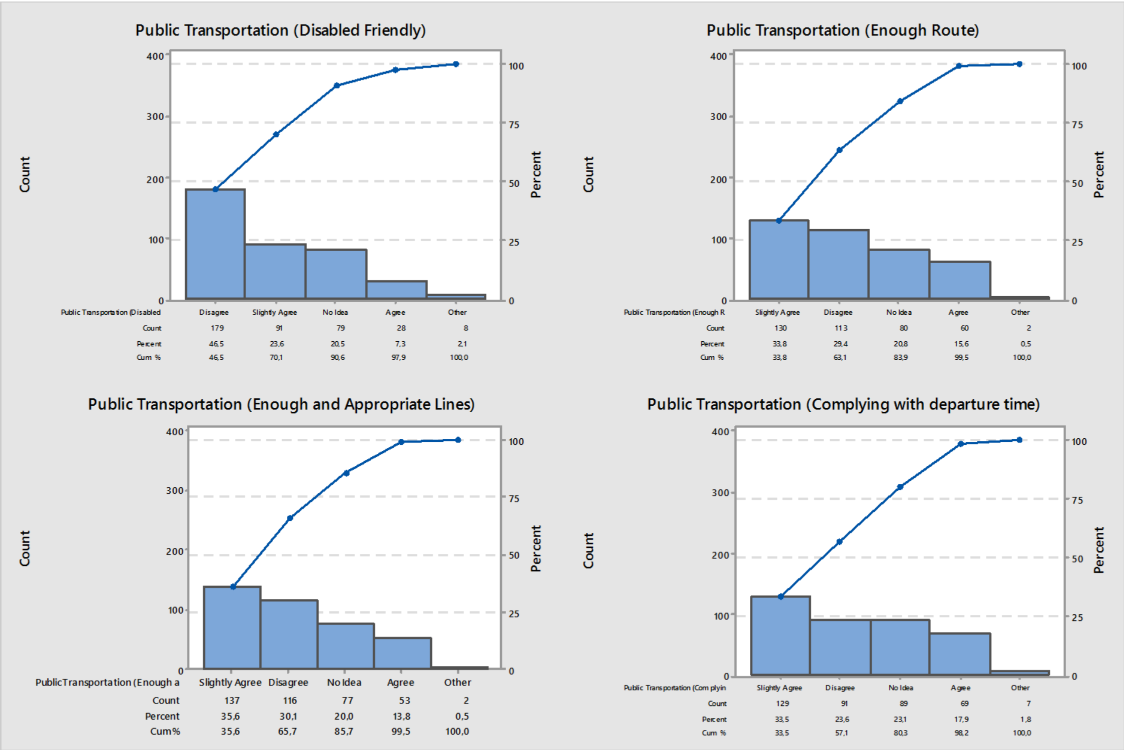

Figure 39: Perception of Public Transportation-2

- **42 %** of participants disagree that travel duration is acceptable in public transportation.
- **51 %** of participants agree /slightly agree that travel price is acceptable in public transportation.

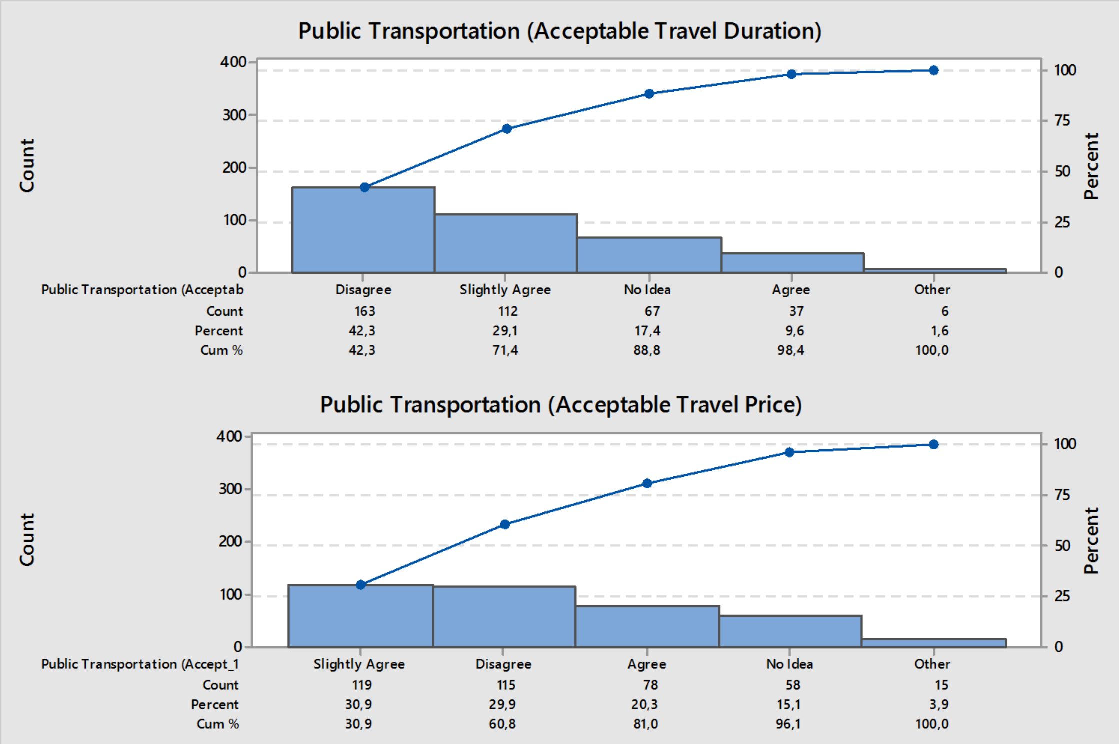

Figure 40: Perception of Public Transportation-3

Survey Question-4: Can you evaluate the following applications?

Applications: Google Maps, Yandex, IBB Traffic, IGO, Sygic GPS, Moovit, Mapsme

To measure the satisfaction of participants for navigation application, 7 application have been asked to the participants.

- **60 %** of participants are satisfied, **31 %** of participants are slightly satisfied with Google Maps.
- **43%** of participants are satisfied, **22 %** of participants are slightly satisfied with Yandex.

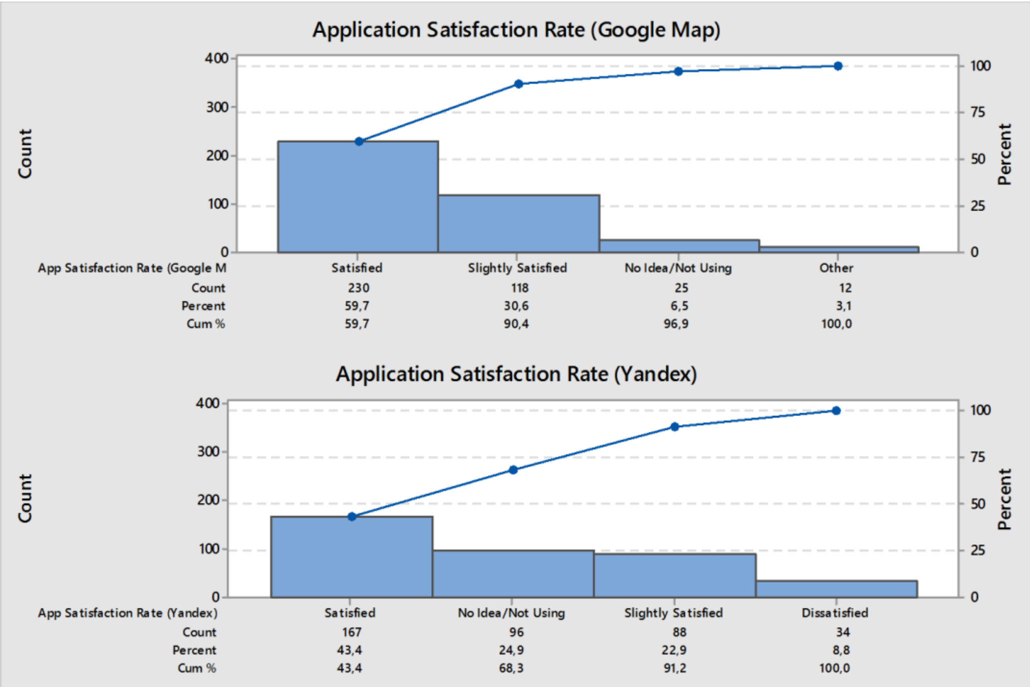

Figure 41: Application Satisfaction Rate (Google Maps and Yandex)

– **21 %** of participants are satisfied with IBB Traffic, **54,5 %** of participants are not using or don't have idea about IBB Traffic.

– **43%** of participants are satisfied, **22 %** of participants are slightly satisfied with Yandex.

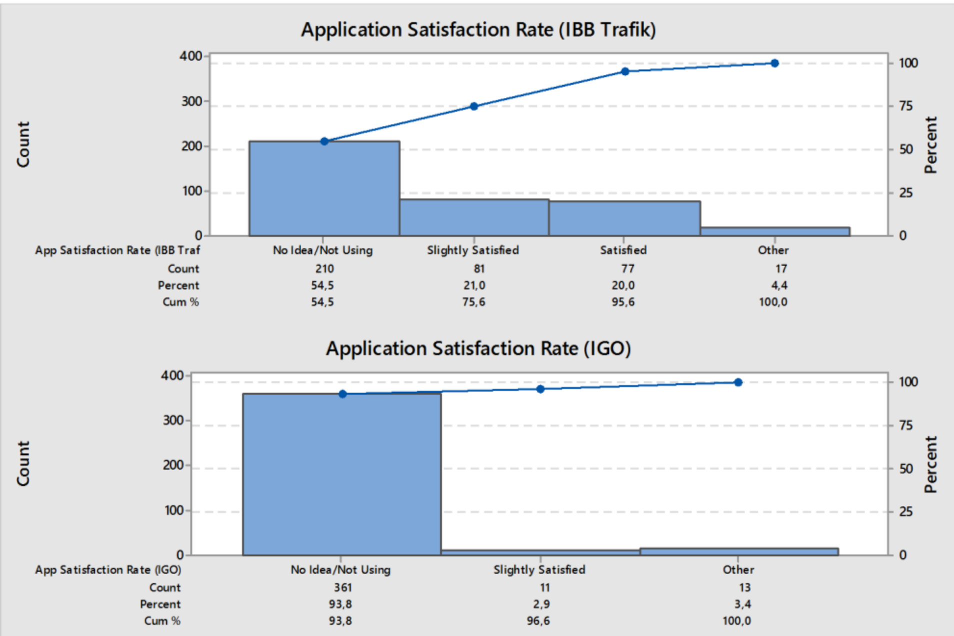

Figure 42: Application Satisfaction Rate (IBB Traffic and IGO)

- **93 %** of Participants don’t use or don’t have idea about Sygic GPS.
- **82 %** of Participants don’t use or don’t have idea about Moovit.
- **90%** of Participants don’t use or don’t have idea about Mapsme.

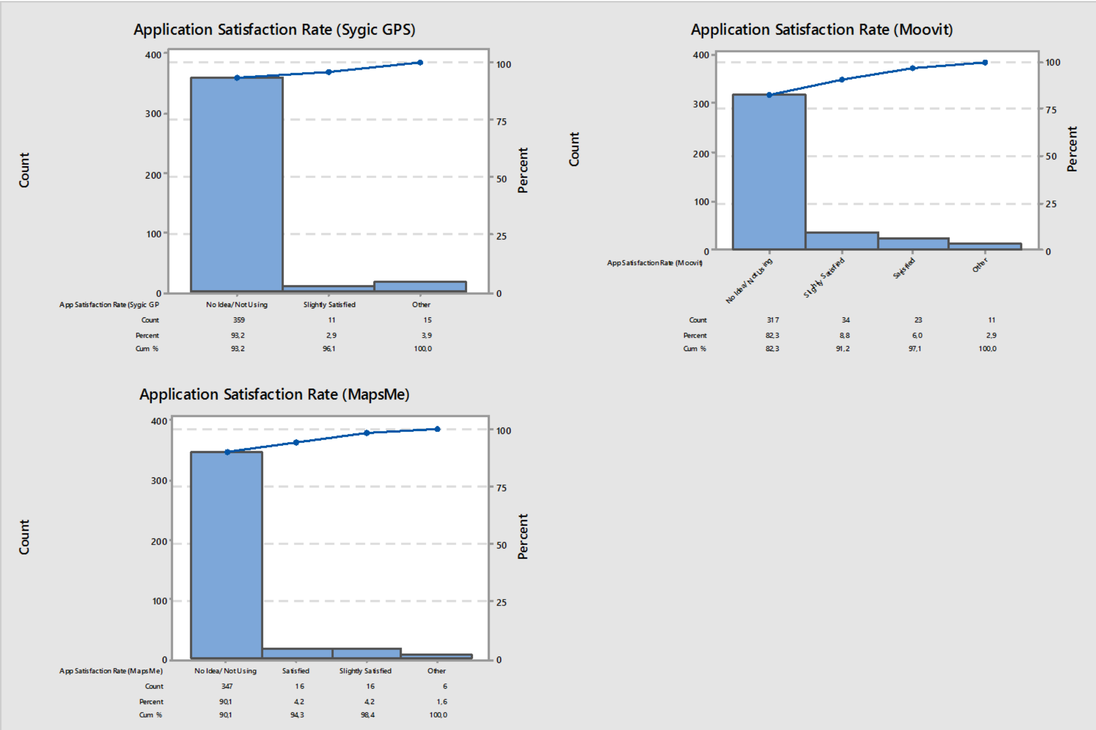

Figure 43: Application Satisfaction Rate (Sygic GPS and Moovit and Mapsme)

3.4.2 Hackathon Results

In Data Driven Mobility Hackathon, we have identified the main problem statement as given below;

Problem Statement
People are not following traffic rules
People don't want to use public transportation
People don't want to use public transportation
On going maintenance on the roads
Traffic accidents
Traffic lights duration
Lanes are getting narrowing in some areas (bridge attachment...etc.)
Safety of pedestrians
Not friendly roads for riding
Lack of notifications for weather conditions and accidents
Too many cars on the road
Lack of precautions for special events (sport events…etc)
Lack of number and capacity of Parking Lots

Table 4: Problem Statements identified in "Data Driven Mobility Hackathon"

We have elaborated root causes and aligned with the main challenges shared by Istanbul Metropolitan Municipality, we have proposed a "all in one" planning tool which is "Society Centric Dynamic Journey Planning by using real time data". This tool will enable to plan journey of for companies, civilians and local authorities.

3.4.3 Interview Results

As mentioned in "Interview Design" section, 2 interviews have been conducted with private companies from logistics and FMCG sectors.

Below you may see the comments and finding of companies

Logistics Company:

- Interview has been conducted with Head of E-Commerce Logistics.
- They are the logistics supplier of one of biggest marketplace in Turkey.

- Their business model is “Pick up Drop Off”. They are working with sales points as delivery point.
- They are responsible for order delivery from marketplace to sales points, therefore “on time delivery” KPI is applicable only for this process.
- Sales Points are responsible for the rest of operations and KPIs.
- According to this model, they are not distributing orders to the customers address directly, they deliver orders to the sales points and customers are receiving their orders from there.
- In this way, they are providing a distribution method, which is enabling mobility within a defined zone. It has a direct impact on sustainability and cost efficiency.
- “Pick up Drop Off” is a win-win business model for companies, customers, and 3rd parties for time efficiency as well, since in Istanbul address information are not consistent and accurate.
- They have been working on new distribution model for different vehicles and different methods.

FMCG Company:

- Interview has been conducted with distribution team of company
- They are one of the biggest FMCG company in Turkey.
- Their KPIs are customer satisfaction, quality of service level, on time delivery rate, cancelled order rate due to distribution related issues
- They are planning distribution via a route planning tool and using their knowhow and experience. There isn’t any integration between route planning tool and real time data providing systems.

- Main challenges are traffic congestion, prohibited zones and hours for distribution, road maintenance.
- They have been working on some distribution and storage models, which won’t be affected from traffic congestion and prohibited zones and areas.
- They are suggesting developing logistics and transportation model based on sharing economy and systems, such as common warehouses and vehicles which are used by different companies.

4. CONCLUSION

Urbanization is rapidly increasing. *World Urbanization Prospects Report_2018" of United Nations, Department of Economic and Social Affairs*, estimation and projection for 2050, share of the urban population will become more than **60%** across the world.

According to the 2021-TUIK data, Istanbul is the most crowded city in Turkey with **15.840.900** population. In accordance with the projection of TUIK for 2023, Istanbul population will reach **16,3** million due to education, job opportunities and many other reasons to move from rural to urban areas.

This population increase brings not only economic opportunities but also challenges which have direct impact on quality life. Routine activities of civilians such as going to work, -school, shopping, meeting family and friends and other social activities create mobility, traffic congestion and environmental pollution implicitly. In addition to this, to meet the consuming expectations, private companies are creating mobility due to logistics and distribution activities in Istanbul.

This dilemma entails development of an operating and governance model for cities, which is driving governments and local administration to undertake a mission as *"Creating and sustain a better life"* in urban areas. In line with this mission, an adequate urbanization planning, including also policies and strategies, should be developed based on main sustainable development dimensions, which are related to economic, societal, and environmental.

To ensure the economic sustainability in urban areas, making sure the achieving objectives of existing and high performance resulted business area is highly critical. In addition to this, stimulating local economy by optimizing development and introducing new business areas are playing crucial role.

Societal sustainability is related to social norms, conditions, relations and integrations, which are complementary dimensions for quality of better living.

Environmental sustainability is one of the critical challenges of urbanization since it is affected directly by consumption of the growing urban population.

To ensure the sustainability of the management of these dimensions and challenges mentioned above, urbanization operating, and governance model should enable an effective transformation of the lives in cities. “Real Time” performance management is playing highly critical role. “Allocating and managing resources effectively”, “providing required services on time with expected quality”, “monitoring and analyzing of service performance” and “planning and taking necessary actions on time and accordingly” are some of the main objectives of governments and local administrations.

At this point “Technology” is becoming one of the main and important pillars. Problems needs and the required actions to “create a better life in urban areas”, Cities must be smarter, thus this situation brings the “Smart City” concept, including smart living, smart people, smart environment, smart governance and smart economy as components. These components are developed via “Smart Technology” and containing the relevant and sustainable solutions for challenges we are facing due to urbanization. Adding digital intelligence to the existing urban systems to protect environment and reduce pollution, sustain and improve economic growth by creating new opportunities such as entrepreneurship and providing new way of doing business and make people life easier, interactive and connectable.

Creating a “Smart City” should be considered as a transformation project and managed accordingly. Under this transformation, achieving the goals and the overcoming the challenges are depending on the design of the project. Even though the components and the dimensions of “Smart City” concept has a worldwide standard definition, the meaning of this definition may be changed from city to another city due to culture and human behavior differentiating, technology maturity and capability of the related countries and cities. Therefore, components and dimensions of Smart City concept should be well analyzed, relations and the meaning of the components should be well defined and configured based on the needs and expectations of “To Be” Smart Cities.

In a Smart City transformation, citizens of the city are playing critical role, since the success of execution is depending on the capability of people who will use new implementations and adapt the changes.

Another critical success factor is a top-down vision and strategy of the countries and a model to ensure execution between government departments and local authorities. Budget and resource allocation, commitments and performance monitoring is highly crucial to achieve this transformation.

As a result, transforming a city from “conventional” to “smart” required an integrated and holistic program and project plan, including all interdependencies, risks, success, and challenge factors. To initiate a successful program and project, understanding the relations between smart city components, determining the impact of these components on the program, designing the city by focusing on the prominent and critical of them and making all benefits and results visible are playing highly crucial role.

5. SUGGESTIONS

Suggestions have been developed according to the pain points, feedback and comments of participants who have contributed interviews and surveys.

Transforming a conventional city to a Smart city is a challenging case depending on the capabilities of technology, infrastructure, and people mostly.

Although there are sufficient investments on technology, if citizens are not capable to use and adapt the changes, this is not considered as an achievement.

On the other hand, infrastructure related topics and capabilities are crucial success factors and prerequisites to accomplish this transformation successfully. Before initiate this transformation critical infrastructure issues should be solved.

To optimize mobility, citizens should be incentivized to use public transportation via different programs. Before that, main problems of transportation such as hygiene, timing. should be solved. For car drivers, who'd like to use public transportation, number and capacity of parking lots should be increased, experience of using parking lots should be improved.

Logistics and distribution are one of the highly critical part of mobility. Most of the warehouses and logistics centers are in city center. Zones are not defined specifically. In parallel, prohibited zones and hours should be defined accordingly.

Planning is the key point of improving stakeholders' experience and this begins with journey planning. **"All in One"** solutions and tools, which enable to plan private companies and civilians' routes on the other hand plan maintenance activities of municipality or other local authorities, can be a sufficient and permanent solution for mobility. This tool can enable to increase "shared economy".

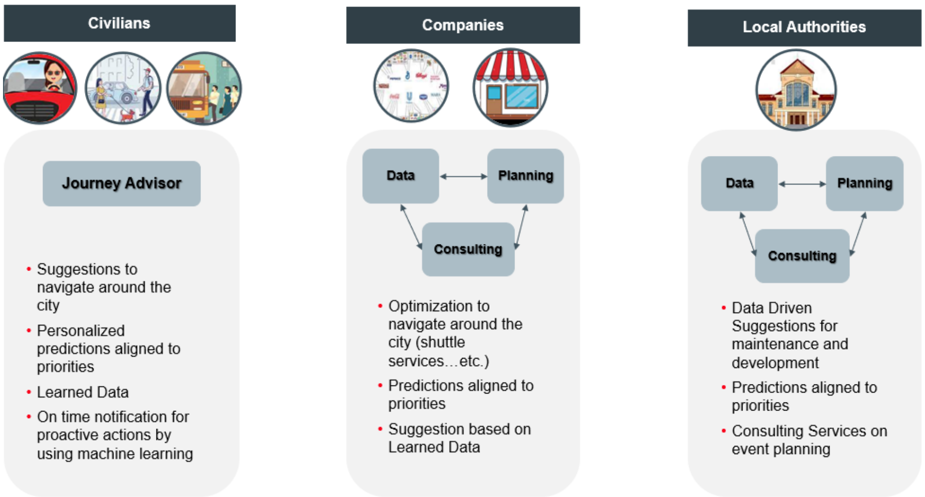

Figure 44: Proposed Solution “All in One” Planning Tool

Suggestions given above are mostly related the daily and routine times. For special events and emergency situations, mobility should be managed in line with a special plan.

In addition to the general suggestions, specific recommendations per topic have been developed as given below.

Vision and Mission

Smart City Transformation should be conducted in line with a clear vision and mission. And should be linked to the country smart city vision. Vision should be communicated to respective stakeholders. Referring to Istanbul Metropolitan Municipality news and reports and based on the interview with municipality team, vision and mission has been set for Smart City transformation. Referring to 2020-2023 National Smart Cities Strategy and Action Plan, there is currently models for maturity assessments and monitoring the progress. Revised version of vision will be shared within 2022.

Stakeholder Management

Stakeholders should be defined clearly, and assessment should be conducted to categorize them. Based on the interview with Metropolitan Municipality, stakeholder analysis has been performed and shared within the scope of Smart City Strategic Plan in 2022. Private Companies, who are not only impacted from but also have a direct impact on mobility, should be the strategic stakeholders. To involve citizens for being part of solution developments, some incentivization programs can be developed accordingly.

In addition to traditional Stakeholder Management, different personas can be defined according to the need, income level. Solutions can be personalized accordingly. “Experience” and “journey” concepts can be adapted to smart city transformation.

To be proactive and understand the need and pain points per stakeholders, we are recommending creating persona’s and conducting citizen journey analysis.

Please see an illustration for citizen journey below.

Persona: Student, using public transportation daily	Going to the Bus Station	Waiting for the Bus	Get on & Travel	Arrival & Get off
Purpose / Motivation	Not walk to much, Arrive station on time & safe	Get on the Bus on time Not effected from the weather conditions	Pay Akbil quickly Find an available sit Not get stuck in Traffic Travel safe & hygienic	Get off the Bus Arrive school on time & safe
Touch Point / Channel	Road between home to station (Walkability)	Bus Station Timing Information Table Other Passangers	Bus Akbil / Stop Button Sits Other Passangers	Bus Station Other Passangers Road between station to arrival point (Walkability)
Need	Nearest Bus Station Safe Walkability	Available Sit in Bus Station Working Timing Info Table Conditions protecting her from Weather Conditions	Available Sit in Bus Working Akbil Point Enough akbil in her card Hygienic & safe conditions	Reaching Stop button easily Get off easily Safe Walkability
Experience	Walking from home to station took long time But safe due to the sufficient traffic lights	She found an available sit during waiting the bus and she could wait under closed station and protected from the rainy weather She could check the arrival time via timing table	Bus didn’t arrive on time Akbil account is not enough She didn’t find a sit and travel standing Bus air conditions weren’t working	She couldn’t reach out to Stop Point and missed the station Road was safe and short from station to arrival point
Pain Point	Loss of Time	-	Loss of Time Didn’t have alternative for payment Unproper travel conditions	Loss of Time
Emotions				

Figure 45: Illustration for a Citizen Journey for using Public Transportation

These journeys should be conducted per persona, therefore defining personas correctly is highly important. To create personas, capabilities, social status, education and being foreigner. should be taken into consideration.

Identify Improvement Areas for Opportunities

Critical step of transforming a city is “Capability definition”. According to the Capability Model and Maturity Framework developed by Deloitte *(2015: Smart Cities How rapid advances in technology are reshaping our economy and society)*, there are 7 capability dimension **data, technology, skills and competences, innovation culture, attractiveness, and public and private ecosystem, project and solutions**. They have defined government, business, knowledge partners, citizens, or other users as main stakeholders. Right after setting vision and strategy, required capabilities should be defined according to ***people, process and technology*** perspectives.

Once capabilities are defined, maturity analysis should be performed to provide input for roadmap. Purpose of this analysis is to identify the GAP to reach out target state from the current state.

To determine the pain points of stakeholders, feedback collecting mechanism should be created. In Istanbul, “Beyaz Masa” and “Istanbul Senin” applications are the main feedback management mechanisms for citizens and based on the research and the interview with Metropolitan Municipality, there are a lot of comprehensive surveys to collect feedback of citizens.

Strategy and RoadMap:

Strategy and Roadmap should be developed aligned with country vision and strategy.

Roadmap should include the phases of transformation, prioritized projects, resource allocation, risks and interdependencies between projects and initiatives. Istanbul Metropolitan Municipality has already a roadmap and projects.

We are recommending creating appropriate phases for city transformation. According to the provided phases in Deloitte Smart Cities: How rapid advances in technology are reshaping our economy and society Report (2015), smart city transformation is following the below steps.

Figure 46: Phases of Smart City Transformation

Initiatives and milestones of each category, which have been used in maturity model as a topic, should be planned in line with these transformation phases.

<u>Operating Model</u>

Operating Model is a bridge connecting vision and strategy and execution. This model is including business structure, governance, accountabilities, ways of working, capabilities and skills.

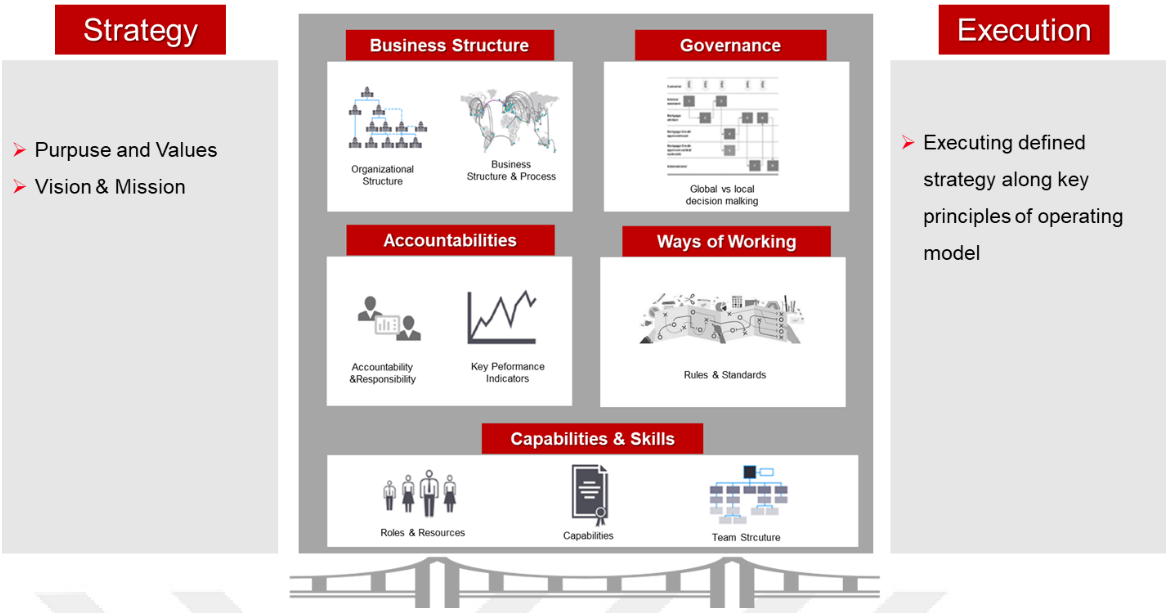

Figure 47: Operating Model (Adapted from Operating Models developed by Bain Company and EY Parthenon)

To operate strategy and conduct execution in a Smart City;

- Main processes and activities should be defined
- Required organization should be designed,
- Roles and Responsibilities should be defined,
- Key Performance Indicators and Accountabilities should be set,
- Ways of working with respective stakeholders and related departments should be defined,
- Required capabilities and skills should be identified
- And last but not the least, governance model should be build to define decision making rights clearly.

Communication

To communicate Smart City Initiatives, status of project and changes of current applications sufficient mechanism should be developed. Periodic communication plan should be developed, and communication tools and mechanism should be customized in line with Personas, also by considering the foreigner who lives in İstanbul. Training or additional Notification should be the part of communication when necessary.

Review and Monitoring

Performance of transformation projects, performance of current smart city solution should be monitored and measured in line with the Key Performance Indicators. In addition to strategic, operational and financial KPIs, appropriate KPIs to measure "adaptation of citizens to the smart city solutions" should be part of monitoring.

Big Data is highly critical to review and monitor performance and identify new opportunities for improvement. Therefore accuracy of the data should be ensured by respective departments of municipality and government.

Design of transformation, projects, operating model, technology should be reviewed via proper mechanisms periodically.

REFERENCES

- ALBINO V., BERARDI U. and DANGALICO R, (2015), Smart Cities: Definitions, Dimensions, Performance, and Initiatives, Journal of Urban Technology, 2015, Vol. 22, No. 1, 3–21, http://dx.doi.org/10.1080/10630732.2014.942092
- BRCIC D., SLAVULJ M., ŠOJAT D. and JURAK J., The Role of Smart mobility in Smart Cities: Conference Paper · May 2018, University of Zagreb Faculty of Transport and Traffic Sciences, Croatia
- CAN, D. (2019), Mapping Out Smart City Initiatives in the Turkish Context, Published Dissertation: Middle East Technical University, The Graduate School of Natural and Applied Sciences
- COLUMBUS, OH; 1993 Dissertation Abstracts International: Section B: The Sciences and Engineering, 54(8-B), 4103.
- Delivery Hero: Quick Commerce: Pioneering the Next Generation of Delivery (2020)
- Deloitte Smart Cities Report (2015) How rapid advances in technology are reshaping our economy and society
- Demograpy: Encyclopedia of Life Support System edited by Yi Zeng (222-225-226-227)
- https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en
- Future of Mobility: Arthur D. Little
- GALPERINA L.P., Anna, GIRENKO A.T. , MAZURENKO V.P., The Concept of Smart Economy as the Basis for Sustainable Development of Ukraine
- MOHANTY S. P., (2016), Everything You Wanted to Know About Smart Cities
- MOURA F. and SILVA J (2019, January), Smart Cities: Definitions, Evolution of the Concept and Examples of Initiatives

- OZSUER O (2017), Akıllı Şehir Uygulamaları ve İstanbul Örneği, Published Dissertation: Istanbul University, Institute of Social Sciences
- TAEWOO N. and THERESA A. P. (2011), Conceptualizing Smart City with Dimensions of Technology, People, and Institutions
- T.M Vinod Kumar, Smart Environment for Smart Cities_2019- (1-53)
- TUSIAD E Commerce Report (2019)
- VILLA R., MONZON A., Mobility Restrictions and E-Commerce: Holistic Balance in Madrid Centre during COVID-19 Lockdown.
- World Urbanization Prospects: The 2018 Revision, United Nations, Department of Economic and Social Affairs
- "The Outstanding Success of E-Commerce, Changes in Consumer Behavior, and Digitalization" published by TUSIAD in 2022,