UNIVERSIDAD DE CANTABRIA

FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

MÁSTER EN EMPRESA Y TECNOLOGÍAS DE LA INFORMACIÓN

CURSO ACADÉMICO

2016 - 2017

TRABAJO FIN DE MÁSTER

SMART CITY: DESARROLLO DE UN MODELO CONCEPTUAL PARA LAS CIUDADES EN LA ETAPA DE DESARROLLO

Autor

Saidqosim Saidosimovich Mukhtorov

Director

PhD. Pedro Solana González

Santander, 2017

UNIVERSITY OF CANTABRIA

FACULTY OF ECONOMIC AND BUSINESS SCIENCES

MASTER IN BUSINESS AND INFORMATION TECHNOLOGIES

ACADEMIC COURSE

2016 - 2017

MASTER´S FINAL PROJECT

SMART CITY: DEVELOPING CONCEPTUAL MODEL FOR CITIES AT THE STAGE OF DEVELOPMENT

Author

Saidqosim Saidosimovich Mukhtorov

Director

PhD. Pedro Solana González

Santander, 2017

ABSTRACT

Nowadays high-growing cities confront multiple challenges to meet objectives regarding quality of life and socio-economic development of a region, hence governing cities and managing its services have become an actual topic. The opportunities that give us technologies could be applied as a solution for a different problems and challenges, and transforming the way of managing capabilities and resources of cities efficiently and adequately.

The term "Smart City", which is in trend last decades, could be solution for challenges that face cities nowadays. We can explore diverse practices of Smart City, that are being developed, with different priorities according to critical factors that are solving numerous different issues and problems.

In this master thesis we brought the experience of Asian cities in building Smart Cities and with learnt lessons we proposed our Smart City conceptual model for city in the developing stage. To pursue our objectives, we deeply analyzed the current city through data collection, and data analysis, identifying needs by emphasizing weaknesses and threats.

RESUMEN

Hoy en día la gobernanza de las ciudades y la gestión de sus servicios se ha convertido en un tema de interés y gran actualidad. Debido a que las ciudades de alto crecimiento enfrentan múltiples retos para alcanzar los objetivos de calidad de vida y el desarrollo socioeconómico de una región. Las oportunidades que nos ofrecen las tecnologías podrían ser aplicadas como una solución para diferentes problemas y retos, que permitan transformar la manera de gestionar las capacidades y los recursos de las ciudades de manera eficiente y adecuada.

El término "Smart City", que está en tendencia las últimas décadas, puede ser una solución para los desafíos que enfrentan las ciudades hoy en día. Podemos explorar diversas prácticas de ciudad inteligente, que se están desarrollando, con diferentes prioridades de acuerdo a factores críticos que están resolviendo numerosos problemas.

En Este Trabajo Fin De Máster abordamos la experiencia de las ciudades asiáticas sobre la construcción de ciudades inteligentes y en base a las lecciones aprendidas en los proyectos Smart City propusimos nuestro modelo conceptual de ciudad inteligente para una ciudad en la etapa de desarrollo. Para perseguir nuestros objetivos, analizamos en profundidad la problemática actual de la ciudad a través de la recopilación y análisis de datos, identificando las necesidades y haciendo hincapié en las principales debilidades y amenazas hincapié en las debilidades y amenazas.

ACKNOWLEDGEMENT

I want to express my deepest thankfulness to all those people, who were supporting me and directly has contributed to make this master thesis possible. First of all, I want to thank my parents, my dear sisters Gavharkhon, Zarrinakhon and Takhminakhon, who always supported me. Every single day spent in Santander, during almost eleven months they were praying for my health and success. I want to say, that I am proud being the son of ***Saidosim Mukhtorov*** *and* ***Uguloy Mukhtorova****, due to their priceless advices and support, that always tried to explain me values of life, open my eyes wide and distinguish black and white.*

Furthermore, I have to thank all professors and teaching staff of University of Cantabria, who have helped me during taking master course in Enterprises and IT. It wouldn't be enough space here to list all of them, but I want to particularly mention: Pablo de Castro, Emilio Placer Maruri, Mónica Castro Fuentes, Rocío Rocha Blanco, Francisco Javier Lena Acebo, Adela Sánchez Santos, Andrea Pérez Ruiz, María Elena García, especially to Pablo Díaz Jubete. A big thank to ***Pedro Solana González****, my supervisor, for his professional guidance, advices and recommendations, which made possible to perform this master thesis work. Again, thanks to all community of Santander, because it is the city which introduced me the term "Smart City", and I was inspired to dedicate my thesis topic to this topic. Thanks to all my friends and groupmates, especially to Flor Sarai Licona, Lorena Gutierrez Herrera, Borja Leon, Javier Alejandro Cuartas and Estuardo Paredes Andrade, which made this journey unforgettable for me.*

And of course I am thankful to my dear wife Rukhshonakhon and my lovely daughter Samirakhon for being always with me, filling my life with love.

I want to dedicate this work to my dear hometown – Khujand!

Sincerely yours

Saidqosim Saidosimovich Mukhtorov

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF IMAGES

LIST OF CHARTS

CHAPTER 1. GENERAL CONTEXT OF THE WORK

1.1. Introduction

In the first report provided by United Nations Development Program (UNDP), Human Development Report, 1990 emphasized the importance of human in socio-economic development. "*People are the real wealth of a nation. The basic objective of development is to create an enabling environment for people to live long, healthy and creative lives. This may appear to be a simple truth. But it is often forgotten in the immediate concern with the accumulation of commodities and financial wealth.*" (UNDP, 2010). So the main objective of today's society shouldn't be accumulating of wealth and pursuing high economic growth rates just in numbers, but rather to invest main efforts for seeking solution for: *How should we build up our communities and adapt the environment, that enabling people live healthy and happier, have a peaceful and safe life, and how we can guarantee high quality of life?*

Nobel laureate and professor of economics at the Stern School of Business at New York University, A. Michael Spence in his paper emphasizes the importance and role of governments in well-being (mostly considering quality of life) and marking that gross domestic product (GDP) and Economic growth rate indexes during several years is not proper and real indicator for evaluating and measuring development and growth (Spence, 2016). This thought was mentioned before in other works and brought in a good example of Japan. The practice shows that during last decade (from 2013) the average growth of Real GDP was estimated to 0.84%, however many scientific economic journals, including Economist Intelligence Unit's ranked Japan in quality of life above of France and Germany and just four places behind the United States, despite being 15 places behind the U.S. in terms of income (Dolan, 2013).

Thus, in this thesis work, we will follow the idea of considering human being as the main source of development and growth, whereby governments of country, region, city, town or any kind of community should invest main forces for increasing living conditions and quality of life.

Therefore, high growing population and urbanization with increase of ecological pollutions pushes cities and their governors to redesign management style using new approaches for better satisfaction of the need of population and increase quality of life. According to UN´s World Urbanization Prospects, the Revision 2011 it is expected that between 2011 and 2050, the world population is expected to increase by 2.3 billion, reaching to 9.3 billion. When, the population living in urban areas is projected to gain 2.6 billion, reaching 6.3 billion by 2050. By the regions it is expected, that half of the population of Asia will live in urban areas by 2020, while Africa is likely to reach a 50 per cent urbanization rate only in 2035 (UN, 2011). Though primary, we are expecting fast increase of population and urbanization in Asia, that means all these countries soon will face numerous challenges and lack of resources for maintain a good level of satisfaction of their population and provide stable high-quality services. Or another example can we be how in a growing world, today, cities consume 60-80% of energy worldwide. So cities are responsible for large shares of greenhouse gas (GHG) emissions. Though, low urban density, could consume more energy for electricity and transportation. There are many more questions and challenges, that could make governors of the cities to think, for changing the approach of managing city's

infrastructure, services and resources. Therefore, we can see now how big players of Asia, like China, Japan, India, South Korea, Singapore, Indonesia etc. are investing in *Smart Solutions*.

Current development stage is forced by the *SMART* strategies, where technology is the main vector and the essential input to adapt to the new emerging digital world (De Castro, 2015). Upper mentioned issues and problems will bring innovation, new technology and new approaches, together with the concept of Smart City, to overcome all possible challenges, that cities might face during the growth, development and expansion. Attaching the label of Smart to cities, gives number of tools to adequately use all the related interconnected information to better understand city's life, for making new decisions and control different operations, with optimal use of limited resources (IBM, 2009). In this sense the important role of ICTs during the implementations of similar project, since they enable a digital platform from which an information and knowledge network can be created. So the better flow of information and systematic approach in such platforms are necessary for understanding way the city is functioning. Proper data analysis will be essential for city administrators and stakeholders for making new policies and regulations for quality life improvement.

Another reason that makes Smart City so actual and attractive topic today, is that the global market for Smart City solutions has estimated to achieve $408 billion by 2020 (Department for Business, 2013). Forecasted number is a huge, and for many technological and innovative companies such as: IBM, Siemens, CISCO, NEC, Telefonica, Microsoft, Huawei or ZTE, is a real big opportunity. Therefore, in upcoming chapters we can see the engagement of these companies in defining and seeing their own vision of Smart City models.

Further we are going to analyze practices and experiences of mentioned above countries as an example study, for developing our conceptual model for a small city of Khujand, Tajikistan. We think there is no big difference if the community is organized as big city, small town or even villages, the fact is that the sustainable development is possible, when cities or even rural zones develop relatively equally, it means that we should not forget the nearby located villages to the city.

1.2. Justifying the topic of the study

During last two decades the label of *"Smart City"* has become very popular and used in many scientific researches and studies. Personally for me this was a new term, which I have explored for myself in one of the Smart Cities in North of Spain, Santander, particularly more profoundly in the Smart City Demonstration Centre in Fundación Santander Creativa and from the classes of prof. *Pablo de Castro*. This motivated and pushed me to dedicate my final thesis project in this topic, in example of application this concept for my hometown Khujand, Tajikistan. After review of this term and real case studies, I noticed that, even in my city today, getting started for planning smart solutions for better performance of public services. Even we have got some of them already in action, that are covering some small areas, but more importantly is going very slowly. Searches done in Google (tags: Smart City Khujand, Khujand intelligent city etc. in English, Russian, Tajik languages) not found any relative results and materials. Hence, I considered this topic to be very actual and valuable, especially in our occasion. And hope, that it will have a practical use for our government.

1.3. Objectives of work

The general objectives of this thesis work are the study of the Smart City concept and designing a conceptual model of Smart City for cities in the development stage, in particular in case of Khujand city, Tajikistan. The named city was selected because of good acquaintance with city´s policies on socio-economic, political and environmental dimensions or simply because, it is my hometown. It was an interesting aspect to see how Smart City concept can fit to city in a transition economy stage, especially in a city with a slow economy. The fact of existence and developing of some smart solutions or the implementation of some elements of a Smart City under different projects, shows, that chosen strategies are not adequate, not comprehensive. Thus, our forces will be directed to the problem analysis and finding adequate integrated solutions, that in future make this system accessible for enhancements. Considering all these aspects we can say, that our work is valuable and has a special place in today city´s development.

We will go through the questions that help us to understand why we need Smart City and how to take way to the smartness? What should be the core components? How to start and implement? Within all these research questions we are going to answer on the assumption of the Khujand case study.

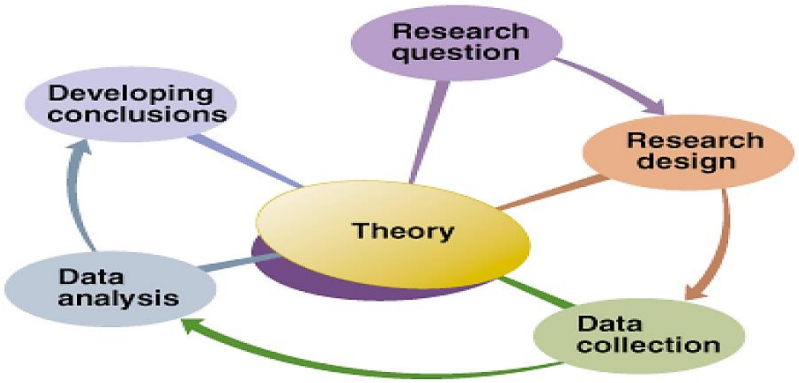
Specific objectives are:

1) Defining term of a Smart City, comparing relative terms and distinct visions by reviewing literature.
2) Analyzing past and present experiences of building of Smart Cities, selecting relatively similar cities to the object of our study.
3) Defining and prioritizing the problems and issues of the city, emphasizing Strength, Weaknesses Opportunities and Threats (SWOT) of Khujand city.
4) Proposing solutions and conceptual model of Smart City, especially for cities in transition economy and at the stage of development.

CHAPTER 2. METHODOLOGY

In this chapter we are going to explore the methodology of this master thesis work. The methodology is based upon conceptual model designing. For current work we will make a deep analysis and review of real project cases or pilot project of Smart Cities. We will use deductive reasoning, which means we will go smoothly from putting research questions, main goals to literature review, developing research design, collecting and analyzing the data and come to the certain conclusions.

Figure 1. Used methodology in thesis work



Source: How to build a good conceptual model, Jim Goes, January 2002

Generally current work's structure designed from Figure 1. Research questions is given in specific objectives (1.3). In order to design our conceptual model for Khujand more properly, we should find relatively close object (similar city) for study and further analysis. Some characteristics for finding objects for study: similar needs and problems, quality of life, geolocation, level of knowledge, technological progress and population.

Because of lack of Secondary Data (already collected data), we had to make a questionnaire to collect data from the hand. Therefore, we used several approaches: we developed a survey in Google Form, (www.bit.ly/2ghq2ww) and spread it among our citizens through mass email, social network (Facebook Communities: "I LOVE KHUJAND" and "KHUJAND IS MY CITY") and by spreading info papers in the public places for ads. The problem that we realized is that using Internet survey, we were restricting the number of respondents, because it was only for Internet users. Then, we decided to take the same questionnaire with face to face approach. That in this method results were a bit surprising for us.

The generated data, and some already gathered secondary data will be analyzed in order to provide a full map of city. And finally conclusions will be built on all above mentioned parts.

CHAPTER 3. LITERATURE REVIEW

The objective of this chapter is to review of the existing literature in relation of Smart Cities, with the purpose of theory investigation and identifying the nature of Smart City term for further analysis in this work. In spite of thesis limits we will bring some relevant Smart City concepts with definitions, of course all available literature will not be mentioned, but anyway some of them, which were reviewed will be brought additionally in bibliography.

Also, we will review classification of available relative concepts of Smart City into different dimensions, which was brought in work of Nam and Pardo (2011). Thus way, we can understand where, in which direction we should develop our conceptual model of Smart City. This will give us clear ideas and guide us to choose adequate decisions during decision making.

3.1. The concept of the SMART CITY

As this term does not has clearly identified definition in many papers it comes with different meaning, and understanding the word of "SMART" in the context of cities based in the different visions of authors. Thus, there are a lot of studies, where this term comes with various names and definitions. Here we can bring some examples of relative terms to Smart City, that were introduced in literatures as a key for innovative solution to urban problems "Intelligent City", "Ubiquitous city", "Knowledge City", "Wired City", "Digital City" "Information city", "Smart community ", "Learning city", "Sustainable city" (Cocchia, 2014) further in the upcoming section we´ll give broad explanation. These are all different meanings of Smart City brought in literature for defining the cities of future, where is the main forces are put for sustainability and efficiency use of all kind of resources in cities and reaching citizens satisfaction by increasing quality of life.

Many more definitions were identified by many researchers, but we got here the most cited ones. During our review of literature, we have found an interesting concept view of a term "Smart City" from perspective of Asians, that could fit to our own vision of a "Smart City". It was found in a publication of Moe Thuzar in Regional Outlook. She defines this term as a cities of the future with sustainable urban development policies where all its residents, including the poor, can live well and the attraction of the towns and cities is preserved (Thuzar, 2012). We strongly agree that any kind of initiatives should be supported through adequate and rational policy making. And according to her view the key indicators of identifying the smartness of city are:

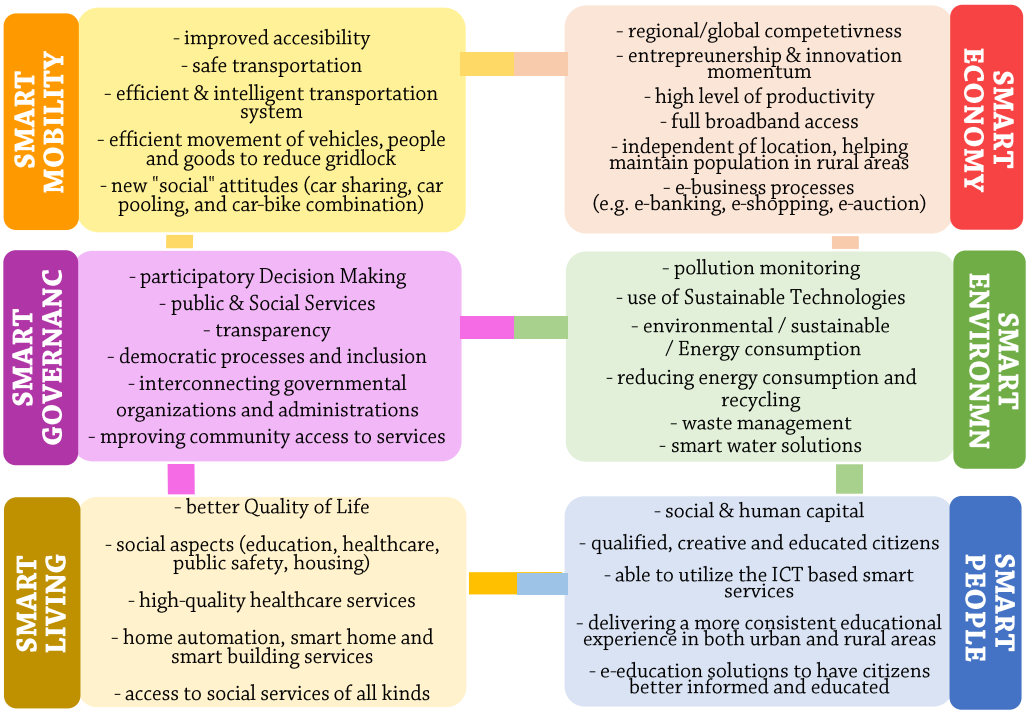
- high quality of life;
- sustainable economic development through investments in human and social capital;
- traditional and modern communications infrastructure (transport and ICT);
- smart management of natural resources through participatory policies.
- being social oriented and having environmental goals (Thuzar, 2012).

Table 1. The most cited Smart City's definitions

DEFINITIONS	SOURCE
"A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance."	(Caragliu A., Del Bo C., Nijkamp P., 2009)
Well performing city in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.	(Giffender, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., Meijers, E., 2007)
"A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizen."	(Hall, 2000)
"Smart City is defined by IBM as the use of information and communication technology to sense, analyze and integrate the key information of core systems in running cities."	(IBM, 2010)
"… a certain intellectual ability that addresses numerous innovative socio-technical and socio-economic aspects of growth. These aspects lead to Smart City conceptions as "green" referring to urban infrastructure for environment protection and reduction of CO2 emission, "interconnected" related to revolution of broadband economy, "intelligent" declaring the capacity to produce added value information from the processing of city's real-time data from sensors and activators, whereas the terms "innovating", "knowledge" cities interchangeably refer to the city's ability to raise innovation based on knowledgeable and creative human capital."	(Zygiaris, 2012)
Smart Cities use technology for more efficient delivery of urban services to its citizens, which directed to improve Quality of life of and transform the relationship between local entities, businesses and citizens facilitating a new way of living the city.	(Telefonica, 2015)
"The phrase Smart City is defined as the ability to integrate multiple technological solutions in a secure fashion to manage the city's assets – the city's assets include, but not limited to, local departments information systems, schools, libraries, transportation systems, hospitals, power plants, law enforcement, and other community services."	(Musa, 2016)

According to Giffender R. et al (2007) we analyze what's included to these six main components of Smart City model and why this is the most used idea in the context of many research works and for city's smartness assessment. We think, that these six factors cover all aspects of the city's life, and could emphasize city's level of development and condition. Moreover, they are interrelated to each other e.g. *Smart Mobility* initiatives, can make a better *environment* or *Smart Government* policies leading citizens to be *Smart People* and *living* healthy life. All together they bring better quality of life, and as we have indicated people as the main wealth of nation, they we'll be cause of sustainable economic development (Figure 2).

Figure 2. Six key components of Smart City



Source: Issues paper on Smart City and infrastructure, UNCTAD, 2016, pg.11 (draft)

SMART Mobility – Makes city's movement faster and safe by efficiently use of resources and proper transport system planning. Ideas forwarded to traffic reduction, easy of parking, freely movement of citizens.

SMART Governance - Turns governance citizen-friendly and cost effective by providing online services to bring about accountability and transparency, especially using smartphones to cost reduction of services and providing services remotely, without physical attendance at municipal offices. Another character is works as a platform where public employees or city mayors will have opportunity to listen their citizens and obtain feedback. Gathered data could be used for real time monitoring and on time to identify city problems or incidents.

SMART Living – Bettering quality of life through innovative approaches, smart services, which depends from the developing of the rest SMART components. E.g. Smart Health, Smart Home etc.

SMART Economy- Supporting economy using ICT, opening of innovative companies, startups and creating a friendly environment for starting business by adopting new policies and creating platforms for fundraising etc. This element pushes economy developments towards electronic commerce and new ways of payment, which will provide financial transparency and control.

SMART Environment – In many context SMART comes as "*green*" or "*sustainable*". Adoption of ICT and innovations helps to reduce human's negative footprints. Key element "*Green energy*", reduction of CO2 emissions, pollution reduction, reutilization of materials. Making city livable place, where it's citizens can have healthy way of living.

SMART People – Integral part of cities, is its citizen's, they as final users of all the outputs should be brought at the center. Upbringing and giving a proper education are the main factors here. Given a chance for creating city, that they want to live in and hearing their voices is the future part during urban planning.

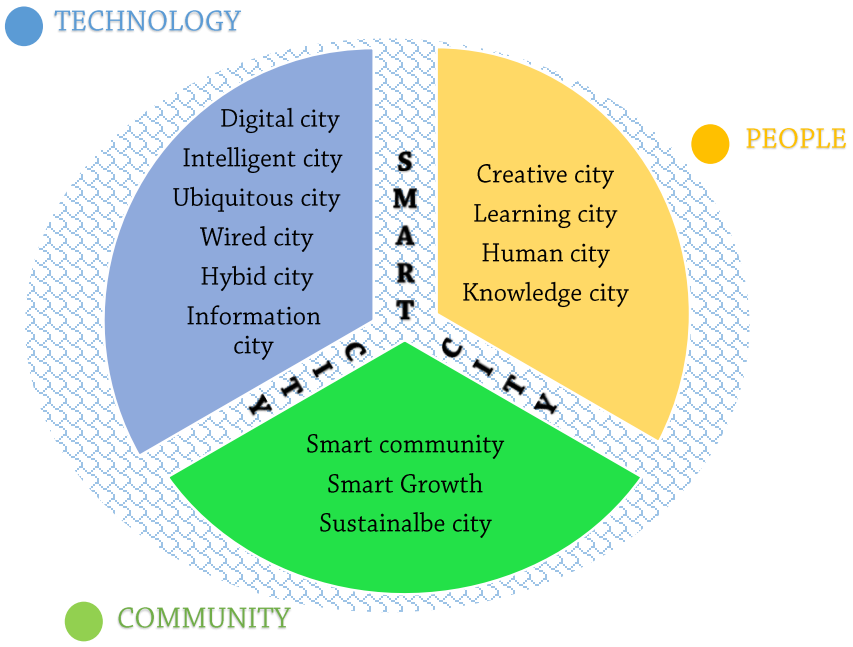
As we mentioned above, that there is no standardized or universal definition of Smart City and the concept varies from city to city and country to country. It's all depending on the level of development, willingness for changes and reforms, readiness of the citizens and of course availability of all types necessary resources, including qualified personal. It is obvious, that definitions brought above could not fit for any type of city, and neither in case of Khujand city. What say in Europe and West would have a different connotation in East, and it was hard for me to find out a proper definition of a Smart City for cities in just development stage.

3.2. Dimensions and frameworks in Smart City

From concepts it became clear that, many "smart" features in cities all together gives to a city, this modern label of a Smart City. Nam and Pardo et al (2011) in their research, after study has classified upper mentioned relative labels of Smart City into three main dimensions: technology, people and community.

In my vision some of these relative labels could be defined as a stages of the transformation city into Smart, it's kind a path to be done for being a "smart", because to have a well-developed Smart City, you should pass through vary stages from digitalizing and interconnecting city´s services to building community with smart and knowledgeable citizens, those will be able to use new innovative approaches and in parallel contribute to increasing people involvement through informing and sharing with gained experiences.

Figure 3. Dimensions of Smart City



Source: Conceptualizing Smart City with Dimensions of Technology, People, and Institutions., (Nam and Pardo, 2011)

3.2.1. Technological dimension

If we´ll see each of this dimensions one by one, we can observe the different perspective of a Smart City. From the technology perspective, city with a huge presence of ICT technologies considered as a Smart City. Here the cores of the Smart Cities are infrastructures of hardware, software and network. Rapid development of intelligent-acting products and services, artificial intelligence and machine learning promotes technological point of view in Smart Cities.

Cities leading their strategy in technological direction or digital cities identified ICT as the main actor and their mission is to an environment, where information sharing, collaboration, interoperability and seamless experiences easily accessible for its citizens (T. Nam., T. A. Pardo., 2011).

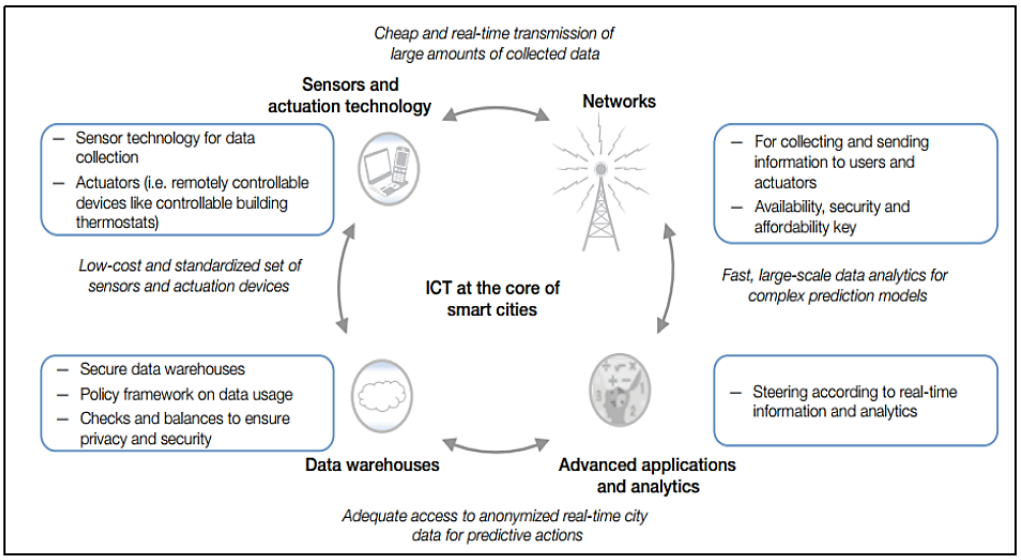
One of the most cited technological concepts is a "Digital city", *"a connected community that combines broadband communications infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses"* (Yovanof, G. S., Hazapis, G. N. , 2009).

Here we can emphasize the real value of ICTs inside of a Smart City, the power of Internet, Internet of Things[1] (IoT), smartphones, that has the ability to capture and share information in a timely manner. Even if a city is well equipped to respond to a given situation, if the information is not provided and shared quickly specific problems, such as traffic congestion or utility outrages, may not be solved rapidly. In real-time provided information and accurate knowledge delivery, could prevent problems

[1] *IoT - objects embedded with sensors and the ability to communicate, sharing data with people and other objects.*

before the situation goes out of control by taking right decisions and actions. Therefore, digital city or a Smart City can be understood as a "predictive city" (Dam, 2013) where specific events and incidents can be predicted resulting in an improved quality of life, and enabling citizens to be more informed about the situation, so they can make an educated decision as to the next course of action.

Figure 4. ICT components in a Smart City



Source: Issues paper on Smart City and infrastructure, UNCTAD, 2016, pg.29 (draft)

3.2.2. Human dimension

In some Smart City concepts, the people overcome technology and the main goal here is creating safe and sustainable environment for living, where the core factors are "affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism or open-mindedness, and participation in public life." (V. Albino., U. Berardi., R. M. Dangelico., 2014) Hereby, mainly issues and problems of the cities find their solutions via creativity, human capital, cooperation among relevant stakeholders, and bringing all together to build their own city. Human dimension is based on citizens, diversity, education, learning and knowledge, all they are considered as key drivers in smartness of the city (Cocchia, 2014).

3.2.3. Institutional dimension

And the last dimension Institutional it is based on governance and policies. This part has the most important role in maintaining the idea of Smart City afloat, because policies are changing day by day and it is very important to adequately analyze the problems and make smart decision making. Government-citizen´s relationship and the cooperation between all the stakeholders is one of the important duty of the city, that bring governor and citizen together (V. Albino., U. Berardi., R. M. Dangelico., 2014). I think, this is fundamental for Smart City and this way, how starts the initiative of citizens to become a smart part (smart people) in their communities. The core factors are: public-social services, providing process transparency via e-governance, service-oriented approach (Cocchia, 2014).

CHAPTER 4. STUDY AND ANALYSIS OF RELATIVE SMART CITY MODELS

In this chapter we will study real cases of Smart City, for further evaluation and concept designing. For this work we will select Smart Cities (prototypes and actual) with similarity to Khujand city, according to common needs and problems. We will make a review of different cases and the main tasks will be analyzing their plan and identifying core components of Smart City.

As we mentioned above, the concept of a Smart City means very different things to different cities. It varies from the implementation of smart parking or smart traffic control solutions to the enhancing efficiency and effectiveness of city's public services through the use of ICT. A simple explanation of it, each Smart City project could be realized from different starting point, with a different socio-economic situation, cultural distance, geolocation, level of technological development, experience and knowledge of citizens, maturity of infrastructure and so on. Therefore, it's hard to implement homogenous plans of "Smart City" to dissimilar cities around different countries. So, we have decided to see how other city's "Smart Solutions" with similarity in needs works.

In addition, we should take into account one important characteristic, classification of Smart Cities projects in terms of Brownfield (enhancing cities infrastructure by adding Smart Solutions) or identified as a Pan-city by Government of India (2015) and Greenfield (new created city) strategies. Most projects can be classified as Brownfield projects, but there are as well Greenfield projects like Masdar, Songdo or Fujisawa. Thus, we think the appropriate Smart City projects for our study should be projects classified as a Brownfield. Because we are interested in a transformation of existing urban community to a Smart City.

The target case studies we selected from Asian countries like India, China, Singapore, Malaysia, Indonesia, because in our opinion, this will be more relative and adequate practices for our city profile. Mainly we have focused in the Indian Smart City Vision, due to its similarities conditions with Khujand city. If we talk about the readiness of Asian capital cities and urban centers towards being a Smart City, after our reviews and analysis, we got a positive statement. And more importantly the Smart City market in the region has enormous potential for growth, and regional market for Smart City is estimated to reach $260 USD billion till 2020[2]. In 2016, according to Junipers Research´s list of Smart Cities Singapore ranked the first, leaving behind Barcelona, London, San Francisco and Oslo[3]. Further we will go more in detail about Singapore´s Smart Nation Programme. Another successful cases we can bring from "Smart City Asian-Pacific Awards" (SCAPA), where numerous Asian cities were awarded: Taipei, (Taiwan) for the best transportation system, Beijing (China) for best education system, Cheongna (South Korea) for city administration, Saensuk (Thailand) for social services and vary cities in Philippines for citizen's safety due to its "National Operational Assessment of Hazards" (NOAH) (see Figure 5).

[2] http://smartcitiescouncil.com/article/asia-smart-city-market-expected-reach-260-billion-2020
[3] https://www.juniperresearch.com/press/press-releases/singapore-named-global-smart-city-2016

Figure 5. IDC Smart City Development Index, 2016 Winners

Source: IDS Asia, Smart City Awards, http://www.idc.asia/microsites/smartcity/awards.html

4.1. Review of Smart City projects in Asian cities

4.1.1. Smart City: India vision

In India, shifting to cities of a record 91 million people was observed from 2001 to 2011 (NEC, 2015). Therefore, these cities face numerous challenges of urbanization, from city security to public services. Last years the Government of India paying a special attention for Urban Development, hence Ministry of Urban Development (MoUD) has adopted Smart City Mission Program, with the purpose of transforming cities to livable and friendly, importantly reach sustainability and create a "Smart India". The program is based in "competition" approach, thus municipalities of cities are challenging with other regions by providing their Smart City Projects. According to current project about 100 cities around India will be financed for Smart City initiative projects. Recently the Government of India has published the list of 20 cities, which was selected through project plan evaluation, all 20 will be firstly financed (thehindu.com, 2016).

Figure 6. Smart City´s list of 20 in India

Source: http://www.thehindu.com/news/national/list-of-first-20-smart-cities-under-smart-cities-mission/article8162775.ece

Indian Government has prepared "Smart City guidelines", where emphasized the core elements and areas of the city for improvement. During proposal´s evaluation prioritizing and identifying the needs and problems of the city was one of the important factors, that cities were obliged to show. The interesting fact in this city's competition is active and large scale participation of citizens in preparation of comprehensive Smart City projects.

All above mentioned cities are standing at the stage of development, after review of these cities profiles, we found needs and city problems possibly matching with Khujand, e.g. Pune city which we are going to see in the next paragraph. Thus, I think, we can consider their experience and knowledge useful for this research paper. Such projects could be a good lesson for cities with big urban problems during transition stage, expansion and civil growth.

Figure 7. Smart City components according to Indian Ministry of Urban Development

Source: Smart City Guidelines, Ministry of Urban Development of India, June 2015.

Government has identified the core infrastructures for enhancement: sustainable environment including adequate water supply and smart solid waste management, no-break and regular electricity supply, efficient mobility and public transportation, digitalization of services and wireless connectivity, e-Governance in all possible municipal offices and spread citizen´s participation, safety and security in the city´s streets and more importantly healthcare and education (Government of India, 2015). According to this statement, we ensured, that observed problems here are likely seen in the case of Khujand.

4.1.1.1. Pune Smart City project, Winning Proposal

We have decided to describe one of the won proposals by Indian MoUD, and we have selected Pune city, where is the main idea is directed to *"Putting Citizens at the center"* (Pune Municipal, 2016). Pune taking 9th place in ranking of most populous cities in India and takes 101st place in the world by its population and it is one of the fastest growing cities in the Asia-Pacific region. Additionally, we should emphasize that current city holds the status of "Hosts IT and automotive companies", including friendly environment for startups, especially tech startups. That's why from 811colleges in the city, more than 30% of the student graduate major of IT.

The main feature of Pune´s Smart City winning proposal is, that these project were designed with close engagement and collaboration of citizens. All the problems and issues of the city, identified priority fields for future development, designing and proposing solutions, these questions were brought during

this program through active participant of citizens in group discussion Hackathons, workshops, web-conferences and door-to-door campaigns.

Figure 8. Pune's citizen engagement in developing Smart City model

Source: own elaboration, info taken from Pune's Municipal Corporation, Smart City presentation, 2016

From this collaboration there was decided to prioritize following sectors:

- ***Enhance Physical infrastructure*** – use of new technologies or enhancement of existing infrastructure using Smart Solutions for urban sustainability, mainly consider projects about transport, water supply, sewerage and smart buildings.
- ***Affordable Housing*** – the basic need of shelter for poor (40% of population), according to projects it is planned to build 20.000 houses in the next 10 years, taking into account all buildings will be equipped with the new technologies.
- ***Citizens care*** – the happiness of citizens, the most important for city governors, thus providing transparent and multi directional flows of information is key element during citizen-government relations. Therefore, for work efficiency and proper understanding, taking feedbacks and questioning was proposed to create centralized customer center where all complaints and criticizes, enquiries, suggestions, billing information and payments will be registered.
- ***River Water cleaning*** – City is located on the confluence of two rivers. The question of waste management here is essential. Garbage dumping, industrial waste water and open defection on the riverside are the main causes of water pollution. There were adopted special project for cleaning and beautification of the nearby zone.
- ***Transformation into Startup Zone*** – Special attention into Smart economy, born of many tech startups and innovative policies within creating business friendly environment. Increase of employment, especially young talented population, that could strengthen city's competitiveness among other cities and bettering attraction of foreign direct investment.
- ***City mobility*** – Soon in the city will be functioning Metro, BRT, Feeder system. Increase of average speed in the city by creating transit hub, which will provide smooth intermodal interface during change of route connections. Also city's government wants to call citizens to healthy way of living and for sustainable green environment to spread initiative of bicycling and walking as a preferred means of transport.

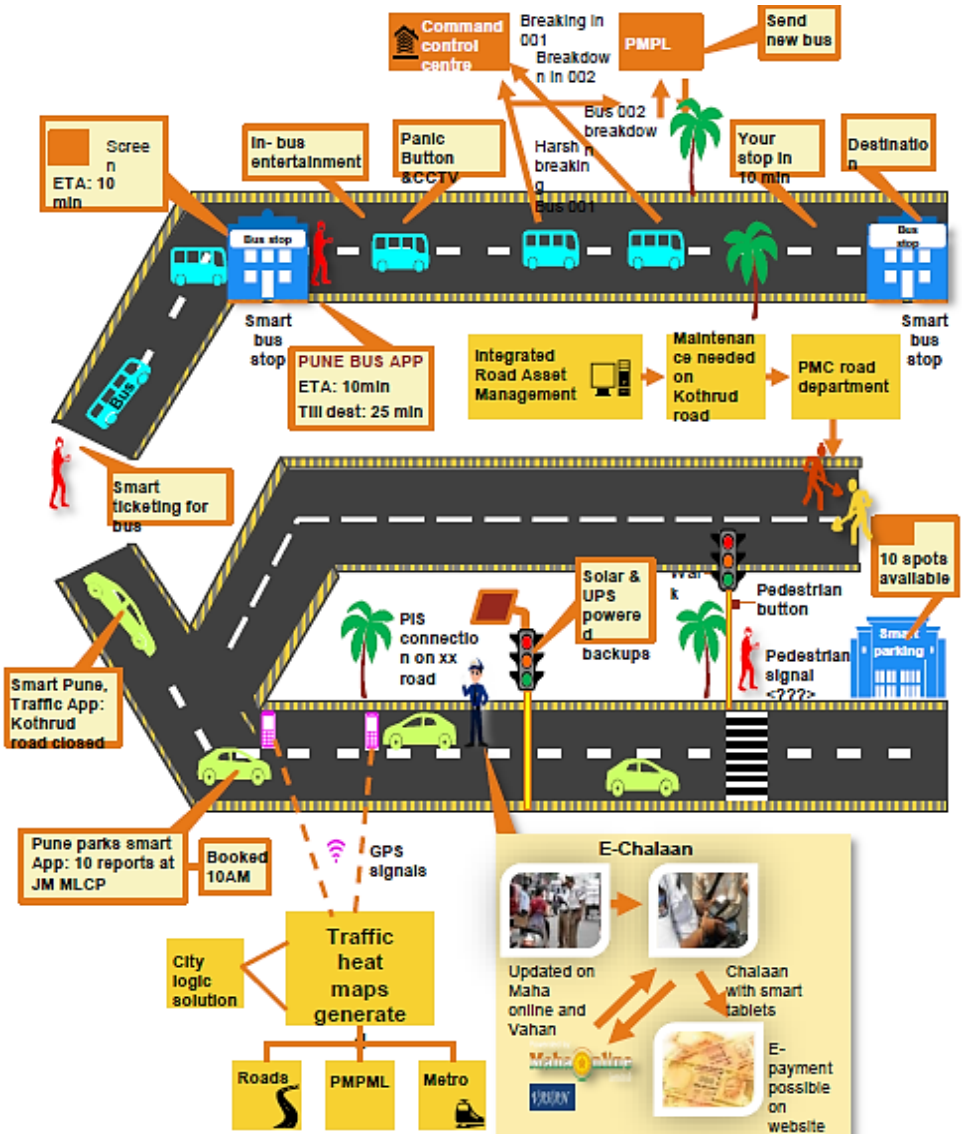
Solutions

Proposed series of tasks in order to improve availability, reliability and passenger comfort:

Smart Pune Public Transport System

- Vehicle health monitoring system across ~1080 buses with intelligent kits and back-end maintenance management system
- Real-time tracking of 100% buses by installing GPS and setting up a central control room, to monitor driving quality and service levels
- CCTV surveillance and panic buttons on buses to improve security
- Public information system (PIS) bus guides and LED screens showing Estimated Time of Arrival (ETA) and other critical information across all bus-stops and buses, with mobile app and website providing real-time information
- In-bus entertainment through Wi-Fi in all buses (Pune Municipal, 2016).

Figure 9. Smart Pune Public Transport System



Source: Pune's Municipal Corporation, Smart city presentation, 2016

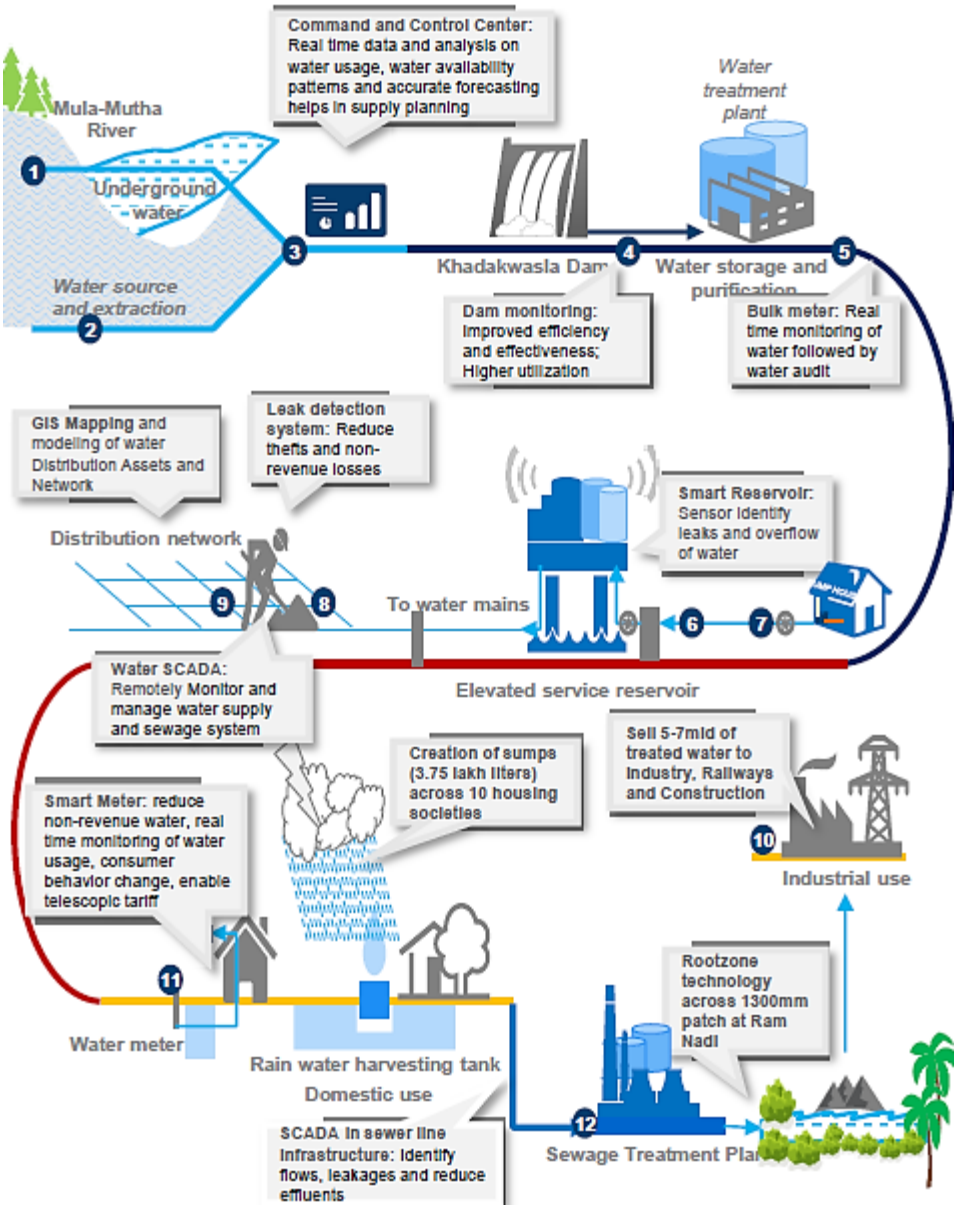
Smart Pune Traffic Management System to reduce congestion and CO2 emissions

- Adaptive traffic signals across 295 signals with central command center, also equipped with 'pedestrian buttons' and PIS
- Smart parking across 7 Multi-level-car-parks, with PIS and real-time mobile app
- Private bus aggregators as rBus and Shuttl to provide premium bus options
- Intelligent road asset management to improve road condition (using GIS)
- Traffic mobile apps and online portal with live and forecasted traffic
- Traffic analysis using CCTV feed and mobile GPS (Pune Municipal, 2016).

"Smart Water" solution to provide efficiency distribution of pure consumable water to citizens

- Smart bulk metering at 8 Water Treatment Plants, 58 elevated reservoirs and 328 DMA's across 6 zones with Supervisory Control and Data Acquisition (SCADA), followed by water audit across 2500 km pipeline
- Helium leak identification system to reduce internal water leakage drastically
- 100% smart metering across 42,650 commercial connections
- Smart meters for domestic consumption along with revised telescoping tariffs through "give-up-water subsidy" campaign to accept smart metering and revised telescoping tariffs
- 24x7 water supply to the city through 5 pilot DMA's which includes 2000 domestic, 300 commercial and 2000 slum connections.
- Comprehensive GIS-based customer survey to increase the number of recorded connections from 150,000 to 400,000
- Develop a suite of web, app and call-center based solutions to address 37,000 grievances annually
- Setup an ICT enabled separate billing and recovery department for water with world class customer service and improved collections (Pune Municipal, 2016).

Figure 10. Smart Water System in Pune



Source: Pune's Municipal Corporation, Smart City presentation, 2016

4.1.2. Singapore's Smart Nation

Singapore is a highly developed city-state, where it's economy relies on R&D, skillful workforce and well put policies by its government. Also it ranks first position as a highest living standards in Asia. Today Singapore stands in the top of many different rankings, including at the top Smart City rankings. Being a state inside of a city, push them take a way for being not just a Smart City, but one of the leading "Smart Nations". Launched in 2014 "Smart Nation" program, aimed creating a city in which people are happy. And today this program completely transformed city's way of working. After long review of different future city's prototypes, in our opinion the program developed under the "Smart Nation" is so

close to the ideal Smart City of the Future, and this because of strong collaboration between government, academia and private sector (highly developed tech enterprises).

The key characteristics of Smart Nation is its method of integration among different Governmental agencies, by not being just physically integration, instead allow data integration between these agencies. Every new initiatives towards for being smarter is oriented to better serve citizens. Special attention to e-Government or as recently saying Government 2.0[4], where taken citizen-centric approach for reviewing and formulating policies, systems and processes through its Municipal Services Office (Sang Keon Lee,Heeseo Rain Kwon,HeeAh Cho,Jongbok Kim,Donju Lee, 2016).

Table 2. Singapore Smart nation's 6 Smart dimensions

Smart City Project	***Smart Economy***	***Smart Mobility***	***Smart Government***	***Smart Living***	***Smart Environment***	***Smart People***
Singapore "Smart Nation"	- Government Electronic Business - National trade platform - Trade-FIRST - CleanTech Park - Business smart services	- intelligent transport system - self-driving cars - express monitoring & advisory system - vehicle recovery system - "your speed sign" - parking guidance system - bus info. system - efreight@ Singapore	- e-Gov2015 - iGov - Government Cloud - OneMap - Integrated public services - Cube (Social Network for governmental agencies)	- emergency medical service - tele-monitoring healthcare - smart health assist - CrimeStopper - early flood warning - fire safety - biological threats - smart buildings - real time CCTV - J-eyes	- air control and water pollution - smart metering - smart waste management - public hygiene - Intelligent Energy System	- FutureSchools @Singpaore - e-citizen - e-visitor - SingPass

Source: own elaboration, information taken from International Case Studies of Smart Cities: Singapore

Installation number of different sensors, vigilance cameras and set of new technologies widely across of the city, tracking from cleanliness to traffic. Fully equipped with sensors and perfect coverage of wireless connectivity allows city to detect when people are smoking in unauthorized zones, when throwing litter at the street and even from buildings. Smart parking, road sensors and phased traffic lights making Singapore transport system one of the best in the world. City's government actively using ICT to improve traffic and possible Singapore is one of the ready places to allow self-driving cars into its streets. Further all generated data goes to the analysist, where using machine learning data will be processed and analyzed for necessary knowledge extraction and providing real-time situational awareness, which will help making adequate decisions. Singapore's government in favour of Open-Data initiatives, that are making city's generating data available to the public, companies and agencies, where they getting benefits from collected data, for new service creation or products or just simply provides tools for transparency and control.

In a fact we can talk a lot about Singapore's Smart Nation Program, but we'll see few of its smart solutions in a sectors of Smart buildings and Smart healthcare especially for elderly care.

[4] *use of Web 2.0 tools to promote online collaboration between Government and citizen.*

Under the Smart Nation vision Singapore paying a special attention to a rapidly ageing population. The idea is to give them an opportunity to live independently in their own places with their own support network. Singapore's Prime minister Loong said *"integrate sensors, apps, remote monitoring, to help our seniors to age in place, to connect with other seniors, and to stay in touch with their children and their grand-children, and their caregivers"* (CNBC, 2015). Already few public hospitals are practicing a tele-health rehabilitation system, patients just sitting at home wirelessly sending real-time data through sensors attached. This way wasting time by waiting your turns, or visiting hospitals can be eliminated.

Smart building initiatives also getting fast popularity in the city. Within this program Singapore wants to make its buildings smarter and importantly greener through application of IoT sensor technology, innovative building material and ubiquitous wireless connections. Over last 5-10 years these technological innovations are changing urban landscape. Launched "*Green Mark Scheme*" by Building and Construction Authority is pushing buildings towards environmentally-sustainability (asiagreenbuildings, 2015). After replacing of almost old buildings by skyscrapers, buildings focused on improving accessibility and energy efficiency. One of the Singapore' Smart buildings vision is when buildings equipped with sensors, which will detect places and areas with massive people gathering and according to that more cool air will be directed to that zones for making it cooler, and for places which are empty and not occupied there will no need to blow cool air. This approach could safe electricity and at same time provide comfort for the residents.

More complex solutions are pilot projects in the buildings, "living and breathing", while saving energy, the future buildings will be able to convert carbon dioxide into oxygen. Or solar painted building with solar technology could self-sufficiently provide green energy to the whole building. We should emphasize, that even though proposed ideas should appear in 2050, but they are happening at the moment. Dr. John Keung, CEO of Building and Construction Authority said *"… integrate more and more such sustainable practices for our buildings, through our Green Mark assessment system… I think we are going to be able to get there quite soon – we probably don't have to wait till 2050"* (asiagreenbuildings, 2015).

Chapter 5. Designing model of Smart City for Khujand

This chapter is going to be a practical and valuable part of this thesis work. Here we are going to provide full information about the city and we'll describe the current situation of socio-economic environment, living condition, quality of life, educational and healthcare system, public services, technological progress etc.

The main question here is: Is it adequate to transform city with low economic growth into Smart City? We will try to find out, is there really need for a Smart Solution in Khujand? Through profound analysis of city's: problems and issues, possibly threats incoming in future, on another hand by contrasting city's future opportunities and its features, which might promote the development of Smart City. It will be briefly explained in SWOT analysis (5.2.2. SWOT analysis. Further, we will gather information on What is already have done and planning to do in the city? (regarding smart solutions) and we will try to get some feedbacks and opinions from our citizens.

At the end of this chapter we are heading to prepare strategic planning of conceptual model of Smart City, also by prioritizing modules of our model for improvement quality of life in parallel with starting of efficiency and effective use of city´s resources.

5.1. Overview: actual situation, problems and issues of the city

Table 3. Khujand city profile

CITY PROFILE	
Country **Province** **Coordinates**	TAJIKISTAN SUGHD 40°17′00″N 69°37′00″E
Area **Elevation**	39.96 sq.km 300m
Population **Density**	175.400 4,242.5/sq.km
Area code **Postal code**	00 992 3422 735 700
Official page	www.khujand.tj
Education	University - 4 Secondary schools -48 Kindergarten -31
Healthcare	Hospital – 15 Medical center -7 Private medical center - 21
Culture	Public Library – 11 Private Library – 10 Theatre -6 Concert hall – 5 Museum – 3 Historical places - 10

Sources: own elaboration, information taken from www.khujand.tj, www.en.wikipedia.org/wiki/Khujand

Khujand is the second largest city (after Dushanbe, capital) in Tajikistan and one of ancient cities in Central Asia with 2500 years old history. It is the administrative center of Sughd Province, which located in the North of Tajikistan, and borders with Uzbekistan and Kyrgyzstan. Occupies area of 39.96 sq.km and Sir Darya river splits its territory into two left/right banks.

Figure 11. Khujand map

Sources: taken from Google Maps

Today, the city is standing just at the initial stages of development. During last decade, city has achieved a lot, and day by day it's changing. We are living the time, where the city is rebuilding and completely changing its look, from post-soviet into modern (see Image 1.). The modernization of city is going rapidly, especially in city center almost all old type buildings are waiting for demolition. And new, high-rise buildings and constructions will replace them, which will consume even more energy. We have to mention also steady but slow economic development and job creation of a region, although for an economic crisis and high devaluation of a national currency. The Free Economic Zone of Sughd, located also in Khujand has a significant contribution in attracting of foreign investment.

Table 4. Population and Net income per capita of Khujand in period of 2010-2016

YEARS	2010	2011	2012	2013	2014	2015	2016
Population *(in thousand persons)*	160,8	163,4	165,4	167,4	169,7	172,7	175,4
Net income per capita *(in US dollars)*	900	1,006	1,130	1,308	1,356	1,206	-

Source: own elaboration, taken from Regional Sughd statistical report, 2016, pg.

Brought data in (Table 4.) shows the average level of Net income (calculated as PPP from gross regional product) it's below around 4% of countries index. From our calculations of the average population growth speed by **1.4%** during last 6years, in 2020 the population of Khujand is expected to reach 185.4 thousand of person. This number will bring more complexity to the infrastructure and public services of the city. Each day, with the increase of city's population, rapidly increasing car owners, so this factor is bringing much more problems, making our roads more intensive, car incidents and increase of CO2 emission.

Image 1. Project of high-rising buildings in the city center

Source: Photo taken by the author

In one word, day by day maintaining city´s resources and infrastructures becoming more complex, there is a necessity to solve these problems through efficient-effective approach and today use of ICT, innovative solutions give us such opportunities to overcome current stage of city´s development.

One of the most spread problems among our citizens its city's public services. Post-soviet habits and inherited form of management together with irrelevant relationship of public workers towards citizens, makes our daily life tough. As a citizen of this city, realizing how bureaucratic system inside of almost all public service providers is widening and making citizen´s lives annoying with it's never ending queues, redirecting people from one place to another to solve their problem, do not accepting visitants, and the worst part of it, which finally all these actions will promote corruption. Weak system of management and control with poor interrelation (interconnection) between different public institution, agencies and departments has created a perfect environment for development of corruption and illegal acts. These weaknesses bore many multiple problems, from which will benefit only public employees, using their official status for proper interest by violating law and norms of ethics. Thus, lack of effective control with inadequate approaches in public departments, gives a great opportunity for unethical employees *to emerge unscathed*. And we must say, that today existence of corruption at small, medium and large scales in mostly all spheres of our life, not only in public institution or agencies, just paralyzing normal way of living, it's like a spreading of cancer, especially for cities with the low level of income it's a death sentence.

In this spite, nowadays already worked out some smart solutions for overcoming problems mentioned above, and society starting benefiting from them. The transparency, that we are needed in our governmental structures and public institutions could be obtained through proper use of ICT and heading Government 2.0 initiative. We became witnesses of one big step into smart governance, when in 2012 Tax Committee of Republic of Tajikistan has started to accept electronic reports on revenue and taxation rolls (taxcommittee, 2016). If the law about "E-signature" was signed on 30th July of 2007, just after long 5 years, we have seen a real usage of some E-signed documents. Purposeful use of ICT in Tax Committee, was the base for creating new type of services, smart services.

So, in fact providing new electronic services of Tax Committee has highly impacted on the quality of the service and agency started to receive lot of positive feedbacks from business holders. Due to this big change there was replaced and reorganized the whole structure of agency, providing more effective and efficient performance of employees. Importantly the issues of citizen's big queues and redirecting around were solved, as well the new approach brought transparency and control in employees' activities.

Figure 12. E-services provided by city's Tax Committee

E-Services of Tax Committee
secured personal area - eToken, digital certificates
online consulting regulatory framework
online tax declaration
electronic invoicing
online reporting
review of acts

Source: own elaboration, info taken from www.andoz.tj

This project was realized and financed by World Bank with 18mln$ and last until 2017, and today we see the effects of reforming taxation system into smart governance committee, some real facts are: if in 2014 Tajikistan was ranked on index of tax payment 184 position in the report of "Leading Business", then in 2015, this indicator was changed to 169, also the spending hours of payers for preparation necessary documentations and reporting were reduced from 224hours to 209hours annually, still not significant results, that we were expecting. This is because not 100% of tax payers are able to proceed all the processes of taxation operations via electronic services. The system reformation in period of time is getting better and better, recently there were added some new services: electronic invoicing for VAT payers, general electronic statistical reporting and electronic tax statistical reporting (WorldBank, 2015). Unfortunately, we could not find any recent reports about the satisfaction of the users of this smart service, and how does it changed the way of leading a business, therefore this question we put in our questionnaire, that we have taken.

Another component of Smart City, which is in the phase of implementation is "Smart meters" in city's electricity infrastructure. Project on "reducing electricity lost" in Khujand, valued around 22mln. € and financed by European Bank of Reconstruction and Development has started in the 2015 it's planned to finish in 2017. In announced tender for implementation of this project two Chinese companies, ZTE and HEXING Electrical Co Ltd has won and in 2015 already mutual agreement was signed (Fayzulloev, 2015). Current project consists of two components. The first component installation of electronic meters, setting of equipment and development information system for billing and payment, setting up call-center for client support. The second component partial rehabilitation of the high-voltage distribution network, including the supply and installation of equipment. Around 100thousand of electronic smart meters are going to be installed in city, and approx. 75thousands of them are already installed.

Image 2. Implementation of Smart meters

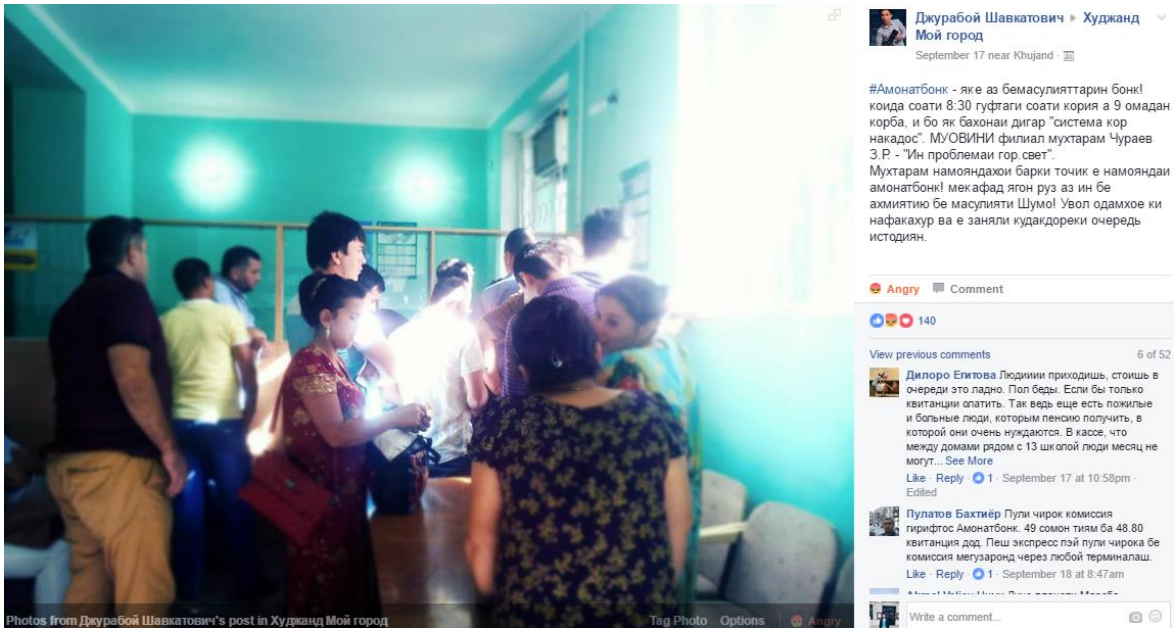
Source: Photo taken by the author

So this reformation will bring us following advantages: overcome fraud, reducing electricity lost, remote control, efficiency use of human resources through a billing system. Of course any changes despite of its pros has its own cons like: hundreds of job lost, change way of life, unreadiness of citizens and poor performance of interrelated supporting services in this case postal service and banking for billing.

In Russian Energetic Forum held Ufa, Bashkortostan, the delegation of Tajikistan paid special attention on innovation in sphere of electric grid, in particular Smart Grid. After review of pilot project of Smart Grid in one of the nearby neighborhood, where they have seen how the system fully monitors electrical load and manages electrical grids. So the important question of "what are the ways of reducing electrical lost?" is very actual and Smart Grid as a proper solution could be suitable in regions with high electricity limitation, fraud and lost (digital.report, 2016).

Going back to the reforms in sphere of electricity, the big problem here is citizen's readiness, that are faced with different challenges e.g. billing processes. Before, collectors were going door to door charging for electricity use, after installation of smart meters, bills are coming by post and citizens are obliged make a payment during a week in only one State Bank "Amonatbank" (National Saving Bank), which can support clients in its 4-5offices in a city. This bank had a problems during providing services, poorly responding for the clients and long lasting queues, because it collects all types of payments related to the state: bills, fees, fine, charges, pension payment etc., and after charging for collection of electricity bills the quality of services even more has felt.

Image 3. Queue in bank for payment electricity bill



Source: "Khujand my city", Facebook community, author Djuraboy Shavkatovich.

Current bank has started to provide Internet-Banking service in order to support clients from online channel and thus way reducing physical attendance in offices, in another word redistribution of services. But this service is rarely used by simple citizens, many factors here can be considered: unawareness, fear, fraud, distrust, but mostly because lack of knowledge. Or another startup the first

National e-wallet "Tezpardokht" ("Quickpayment") available on Android and iOS was introduced by Amonatbank for facilitating payment methods. Unfortunately, payment for electricity bills in this services is not available yet, it just serves as medium internet payment, charging mobile phone and home phone balances and etc.

In general trust for the bank system in the country is lowering. It's been few years, that our banks have started to issue debit/credit cards, with this people started to use Visa or MasterCard for online purchase. But it was just a beginning, when tariffs for card services were low. In recent years, after issuing local cards (none Visa), tariffs for Visa and MasterCard went high. Another reason is bankruptcy of two biggest national banks. All these factor affects to the national economy and for development of e-commerce. Last year tendency shows, that people use cards only to receive their salary and immediately to withdraw total amount of card, these makes a big queue in the ATMs (see Image 4.).

5.1.1. Education system review

Today, the education system is critical and essential factor of development, we emphasized the importance of human in economy, in development of country in introduction. Our higher education admission system has faced issues of corruption, inadequate testing, and lack of transparency in the past – closing door of opportunities for many young people, especially girls. So that´s why should be a special attention on education. The competitiveness of city or country depends on how much its economy is "smart", and the relative term of "innovative economy" could be applied here, because educated citizens form a real innovative economy.

Image 4. Queue for ATM

Source: photo taken by the author

One big step we can observe in educational system in our region. This is "National Test Center" (NTC), and Unified Entrance Examination (UEE) of it, that is aimed to standardize testing practices,

reduce corruption and make higher education admission more user friendly, providing to youth more equitable access to higher education. Project funded by *Russian Education Aid for Development (READ)* – 4.1mln USD, *World Bank* - 2mln USD and *Open Society Foundation* – 1.5mln USD and supported by the Government of Tajikistan and Ministry of Education. Thus way all university entrant's processes, starting from fulfilling application to taking final test exam for entrance are taken. As all these processes are processed electronically, and this reform had a great impact on our education system. One of the main advantages are providing transparency and adequacy evaluation, during examination for entrance.

Before NTC selection and responsibility for student´s admission through internal designed exams were under control of universities, and that was chance for university personal, especially for persons who were the heads of departments, chiefs of examination centers to manipulate entrants and extracting individual benefits, using their power and position. Corruption and personal biases existed on a large scale, impairing equality of access and fair competition for students. It was widely acknowledged that the admission system needed radical reform. Thanks to UEE of NTC in 2014, 52,500 applicants, from which 17,500 females were registered, that is 30% more that in 2013. The result was shocking passed 30,000 applicants by successfully taking entrance exams and 41% of them were girls in compared 34% in 2013 (WorldBank, 2015).

More importantly is that in city´s educational life more and more organizing activities which supports the idea of Open Data and spread Distance Education. One of the pilot projects in sphere of education and ICT conducted by the "Center of ICT" with the support of Ministry of education and science of Republic of Tajikistan, financial support of Institute of Open Society of Soros foundation and by technical support of TCELL. Professors and instructors from different universities were involved in this project, and result of the project is shown in portal called Open Education Resource (www.oer.cic.tj) here brought more than 25different full courses in Tajik and Russian languages. This kind of events and projects could promote us take course to the smart community and smart nation.

5.1.2. Healthcare policy

In terms of healthcare, sadly there are many problems in different aspects, including managerial and organizational sides and even in a quality of provided services. We observed the poor presence of ICT in the sphere of healthcare, traditional system of a leading in operational processes, as well in medical records, registration and issuing of receipts. This show how the information flow in such institutions organized chaotically, that brings problems during medical history review or identifying patient´s treatment plan. The technical park in hospitals slowly refreshing, there were aids from international organizations with renewing equipment and machinery for diagnostics and other tools.

What about the private health sector, that relatively developing last years, the things are here differently a little bit, foreign and local private investment brings innovations and quality services to the citizens. But there comes a question about the money, and from our city review it was clear that, a big share of citizens, they just cannot afford themselves to attend private hospitals or clinics.

This year one of the leaders in telecom TCELL, (part of the TeliaSonera group), together with USAID and Mercy Corps has started the pilot project "mHealth" in one of remote regions, where there is no access for basic healthcare needs. The project was financed by USAID, MercyCorps was responsible for

program and content and TCELL provided technical support. The target group of mobile health service are people with lack of basic medical knowledge, pregnant and young mothers. The frequently asked questions like changes in health conditions, temperature, hygiene, diet, breast feeding and etc.

5.1.3. Citizens safety

One of the main attributes of having a good quality of life, its citizen's safety. Especially at the time when risk of terroristic acts is comparable to last years is higher and high level of citizen migration makes the current question actual. Talking about the public safety in the region, we wanted to study city readiness towards different type of risks including calamities (e.g. earthquake, avalanche, flood, fire etc.), terrorist acts and different types of criminal acts like hooligans, theft and vandalism. According to the past experience, that happened last years, unfortunately we did not see quick response and correct actions from the side of appropriate structures of city to the accidents. There are many factors, like electricity limitation during winter and lack of lightning at the streets, weak connection among local police and defense agencies for information sharing, more importantly absence of vigilance cameras at the streets etc. From 2014, Ministry of Internal Affairs has started to issue biometric internal citizen's Identification Document (ID) in a place of old internal passports. New digital ID cards will facilitate citizen's identification due to the available electronic data stored on it, (e.g. fingerprint, unique number, name, photo etc.) also this card will be useful for future use of different e-Government services.

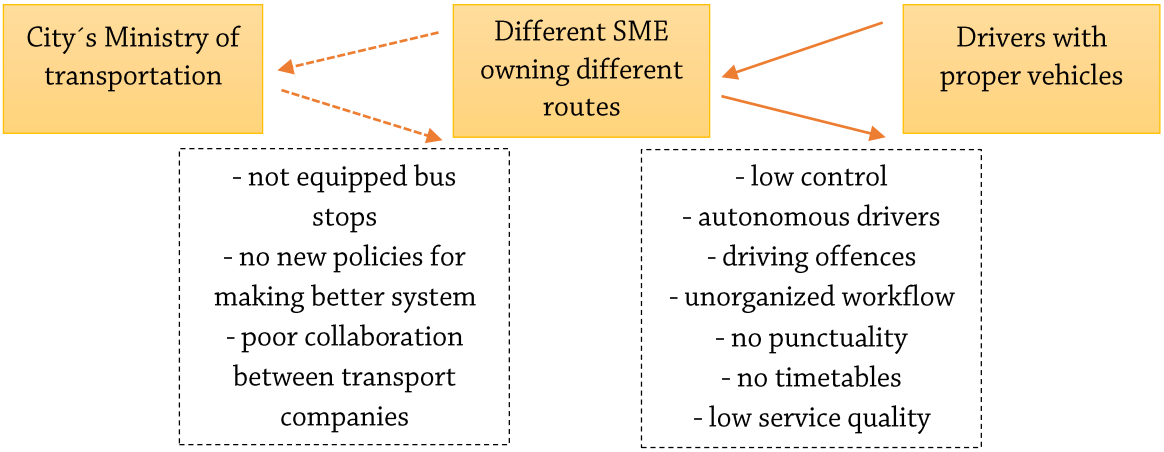
5.1.4. Mobility in the city

Being mobile is one of the characteristics of cities, that impact on overall rankings as well to the quality of life. It's obvious for us, that during last year the road intensiveness is growing and the city becoming slower. Statistics show that during last years the number of proper vehicle holders reached to 85units for 1000 people, about 4 years ago this indicator showed 78units.[5] It's visual, that during last year number of cars at the streets increasing, needs to shrink city's road infrastructure, there is more traffic and traffic jams. To all these including increase of road accidents and driving offence, additionally corrupted road officers, which are rarely taking responsibility and making adequate decisions, making the current situation more complex. Because of less control and absence of vigilance cameras, there is inefficient use of workforce (road officers) which even promotes corruption. Traditional system of identifying driver offences, where is not considering the factor of human error and giving fines (as a bribe) makes easy way to deal with road officers. Thereafter, being corrupted of road officers makes weakens the authority of police in general and further this factor affects negatively to the persuasion of drivers, making them brave enough to infract road rules.

More importantly, the problem of public transportation issues. Absence of centralized public transportation makes the problem solving hard. In order to understand the full picture, we wanted to explain public transport system in the region. (see Figure 13 Public transportation system.)

[5] Regional Statistical Report of Sughd, Khujand, 2016, pg.413

Figure 13 Public transportation system



Source: own elaboration

Around approximately 896 mini buses inside of city serving population for transportation. Unfortunately, the level of service in these public transport so low, and so inconvenient type of a transport, the fact of cheapness (0.12€ one way) of service not covering weaknesses of a system. Overloading of a transport, unknown timetable, long-uncontrolled stops, crazy driving and other problems seen here because, of low control, absence of centralized management and feelings of being owner of proper business for drivers. Sometimes even decision done in a low level by the drivers affects to the situation, e.g. when drivers just decide to have a rest or to change their rout.

Image 5. Bus stop, city center

Source: Photo taken by the author

About few years ago all traffic lights in the roads were changed to LED traffic light. We couldn´t find more information about this LED traffic lights, but the output is positive, the timers are aware pedestrians and drivers in order to understand time limits. Unfortunately, there is no any smart system (software) behind, that could manage the road intelligently depending on intensiveness of the traffic.

5.1.5. Environmental review

Even though Khujand city is famous for its landscape and mountains, green nature and fresh air, there is no special attention to keep this cleanness and healthy environment. Industrialization and economic growth that are leaving own negative affects to the environment. In addition, bad habits of the urban people garbage dumping, not sorting of waste, throwing waste around at the streets and in the river. That's why the big problem is that very low level of garbage recycling. Including because of lack of garbage bins and low servicing of garbage trucks, not collection on a time. Thus, often observed fullness of bins and in result garbage dropped just at the streets, gathering of homeless cats or dogs nearby and the worse set the fire garbage. Unfortunately, this picture is seen at mostly parts of the city and out of the city, which negatively influence for the environment.

Located along of the city river Sir, is another environmental and also safety problem. Pollution of water in this river may bring high negative effects, because irrigation of planted area made from this river, impacts for fishing and importantly during summer time in a swimming period. About the safety of people, especially children, river has a dangerous for swimming zones, and each year during summer on average 10-12people are drowning (avesta.tj, 2014).

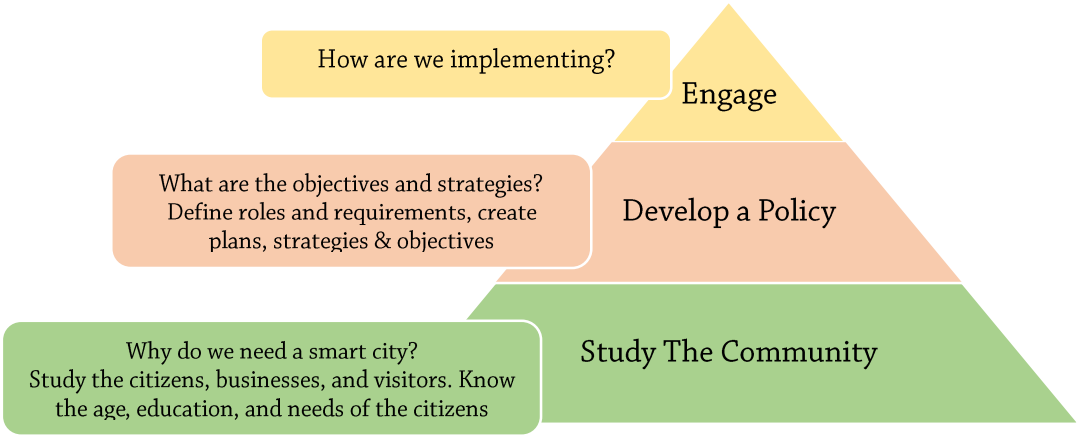
Another key topic here is taking care of public parks and gardens. The city is famous for its beautiful and green nature, full of many parks and gardens of the flowers and trees. In this aspect we have detected a problem of proper and efficient use of water and labor force. The process of watering in the parks and gardens mainly done manually, also inappropriate approach of watering, where is not considered the climatic conditions. Result is high cost of servicing public parks and gardens, inefficient use of resources and because of human factor errors drying of plants and flowers.

5.2. Prospects for transformation into "SMART CITY"

In this chapter we are going to emphasize main ideas about how ICT and innovative approaches could rise city´s services performance and make the place livable for its citizens. Therefore, here we will do deep analysis about current situation, in order to understand to main figure (citizens) analyzing gathered data from questionnaire, according to identified main problems and issues, develop appropriate solutions for Smart City conceptual model. At this stage we are going to split our recommendations into different phases of bringing city to the smartness. The following part done based on Smart City roadmap (Musa, 2016) where clearly brought all stages of city´s developing a Smart City project. (see Figure 14.)

In a fact, we came to conclusion that, this roadmap model is fits well to our work and focusing in this idea, we had done our logical chain in this step of the thesis work by putting questions for research and further developing solutions.

Figure 14. Smart City roadmap



Source: Smart City Roadmap, Musa. S. January 2016

5.2.1. Research and analysis

The made review of Khujand city (5.1.) clarified the current situation in the city and gave us an important information, which can be valuable for answering to the question How to act during developing conceptual model of Smart City and what should core components of it? First of all, we thought we should evaluate the readiness of city and its citizens to the changes, to technological changes. The key questions here: Does city's infrastructure favorable for new innovative changes? What to do and how to start? Citizens readiness and knowledge level? Citizens possible reactions? And why should we a special attention to the citizens, by putting them into the center?

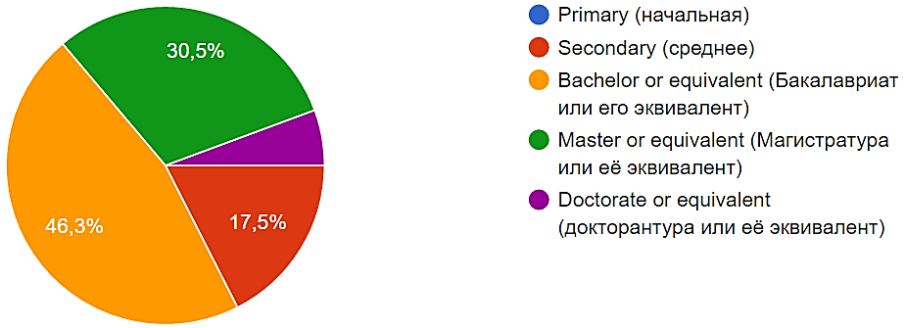
As we have indicated humans as the main factor of today's development of the country's economy (1.1) and what concerns to the Smart City, humans are integral part of it. Hence firstly we wanted to analyze citizens of Khujand, because they as part of this community will be those persons whom will be oriented these services.

According to the statistical data from Ministry of Communication in the country from 8.7million people 3.8million are mobile internet users, each 100 people own 78 mobile phone (not indicated smartphone) and from these 78mobile owners 48 persons are users of internet mobile. Unfortunately, during our research we faced problems with data collection about Khujand city. We couldn't find relative information according to our requests from city's statistical agency. Therefore, we wanted to collect data from first hand and for that we have prepared a questionnaire.

For data collection we used online source and physical contact with respondents. First we are going to analyze data collected from Google Survey Forms. On the last checked date 20.01.2017, totally 177 Khujand citizens filled out form that we have prepared. In questionnaire we brought basic questions like: gender, age, education; and more relevant questions about: using devices, use of internet, Smart City vision and satisfaction level about some smart services or some other changes.

109 (61.6%) responders were male, another interesting fact is that about 51,4% are citizen aged in range of 18-25years old and the last indicator showed that education level of respondents. Nothing surprising were observed here, as the big share were young people, thus 46.3% are bachelor holders.

Chart 1. Education level of respondents



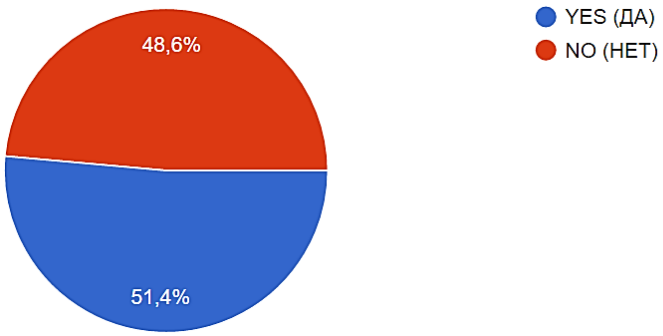
Source: own elaboration, chart generated in Google forms

One and one questioning in comparison, where 80 people were engaged, 55 (68.75%) responders were male, and here we intend to ask elder ages, thus 60% aged in range of 26-35years old. As in online questioning mostly, about 43.7% or 35 citizens are Bachelor degree holders.

Following questions about electronic devices, also not surprising data are seen here, 98.3% of total online responders are holders of mobile phone, 165 i.e. 93.2% of them holders of Smartphones. After with 77.4% leading laptops, third come PC's with 53.1%. Same questions were asked in the streets of Khujand, 100% were holders of mobile phones, 68 of 80 i.e. 85% use Smartphones and only 42% laptop users, and 32% PC's users. Due to spread of mobile devices, in both cases about mostly usage of internet, leading mobile internet users with 92.3% (7.7% cable internet users) in online questioning and 65% from 80 citizens are as well mobile internet users and the rest 35% are not using internet at all.

What about being familiar with smart solutions and in particular with Smart City, 91(51.4%) people said yes, in compare during face to face questioning only 6 people i.e. 7.5% said yes. We think positive answers in online survey, is the result of momentary searching for "Smart City" in the internet.

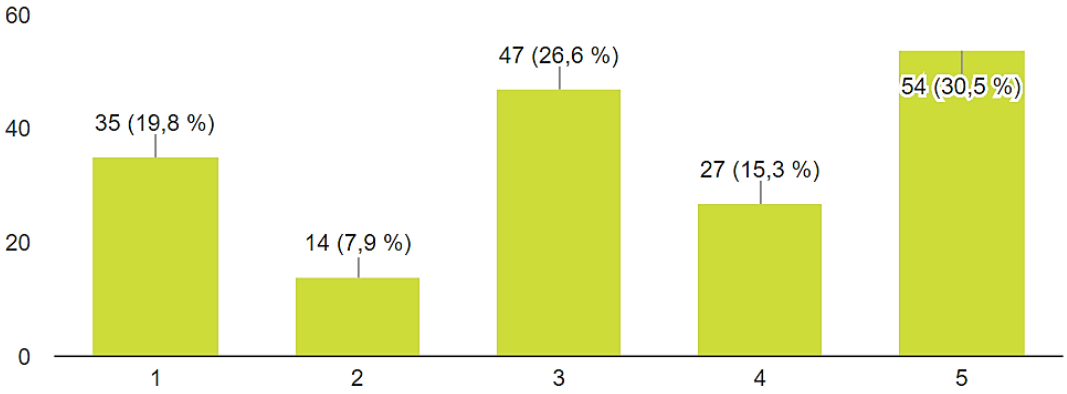
Chart 2. Are you familiar with "Smart City" term?



Source: own elaboration, chart generated in Google forms

Or another key question was about measuring citizen's satisfaction towards some changes that are happening and innovative services. We have asked about how our citizens are satisfied with new smart meters for electricity and the results were a little bit surprising. Online results were more or less equally only 35 persons i.e. 19.8% were strongly dissatisfied, when at street around 81% or 65 from 80 persons were strongly dissatisfied with this change. What we have learnt from here, and decided, that youth are not engaged with problems of billing, payments for electricity, thus it is not so impacted in the feelings of online respondents.

Chart 3. How satisfied are You with implementation of digital meters?



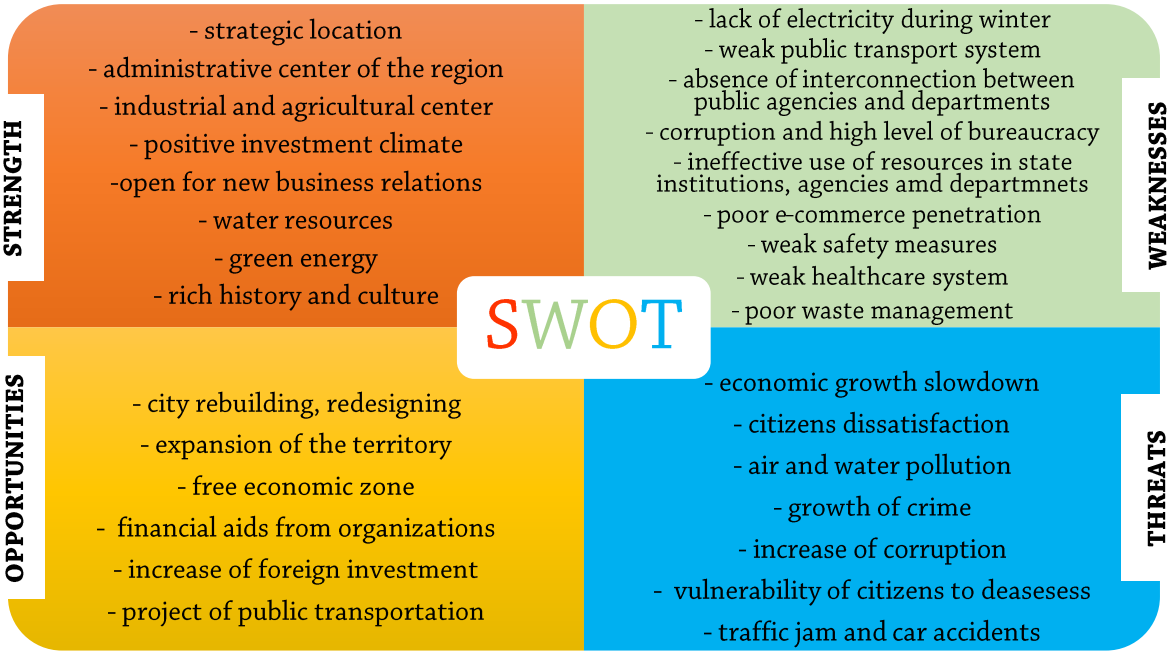
Source: own elaboration, chart generated in Google forms

Many other similar experimental questions brought us to idea that, we should classify online and offline respondents - to more friendly to the innovations and changes rather than (online respondents, mainly youth), second group- laggards, where were asked people of middle ages at the streets. The rest of chart will be brought in appendices.

5.2.2. SWOT analysis

It became clear that each city has a different needs and problems, and before starting planning and designing Smart City's components, we get to know very well the object of study. Based on detail review of city profile done (5.1. **Overview: actual situation, problems and issues of the city**) we have conducted SWOT analysis. We have identified weak sides that should be improved through implementation of Smart Solutions.

Figure 15. SWOT analysis of Khujand city



Source: own elaboration

What should we really emphasize from SWOT analysis brought above is that, current city´s condition is unfavorable and our made offline questionnaire approved that. The big holes and weaknesses in governmental agencies and departments harmful for our citizens. The government should immediately react to this *threat*, otherwise corruption and bureaucratic approaches negatively impacting to city governor's status. Other problems like inefficient use of resources, safety and mobility, healthcare issues could be solved through appropriate implementation of purposeful projects, where identified *opportunities* in analysis could be a key to successful implementation. For example, fast city rebuilding of high-rise buildings, is a chance for implementation of energy-efficient (green-energy) projects.

5.2.3. Prioritizing the needs of city

From our analysis of city's infrastructure and citizen readiness, we came up to the following conclusions brought here below. Thus, we have proposed several modules, which were prioritized depending on urgency. But before these modules these aspects must be overviewed:

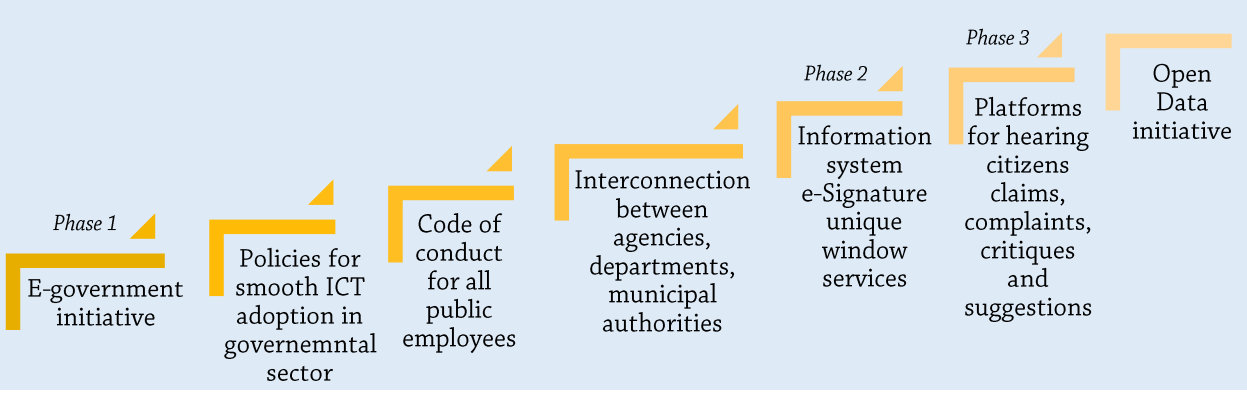
- real need for infrastructure renovation;
- making equally accessible all the services among citizens;
- adopt new policies, which will direct for citizen satisfaction;
- strengthening public-private partnership;
- reducing internet cost and fastening speed of connections;
- supporting innovative tech startups and software developers.

All these enhancements will be a basement measures in order to put first step for our planned set of modules.

5.2.3.1 Module 1. E-government

One of the important parts of this paper is prioritizing identified needs of Khujand city for further planning Smart City model and creation map of actions. Of course the basic services of city's administrative agencies and departments must be increased. The biggest issues that are right now alarming is the existence of corruption even in the small and medium scales, additionally annoying bureaucratic system. Just only these issues are lowering citizens' satisfaction and making them unhappy. In fact, when starting from little problem like renewing passport, or use of state notarial service has so many fictitious barriers. We are talking about only civil relations, not business relations, where the situation is even more tough.

Figure 16. ***Module 1.*** *E-government, priority-driven sector*

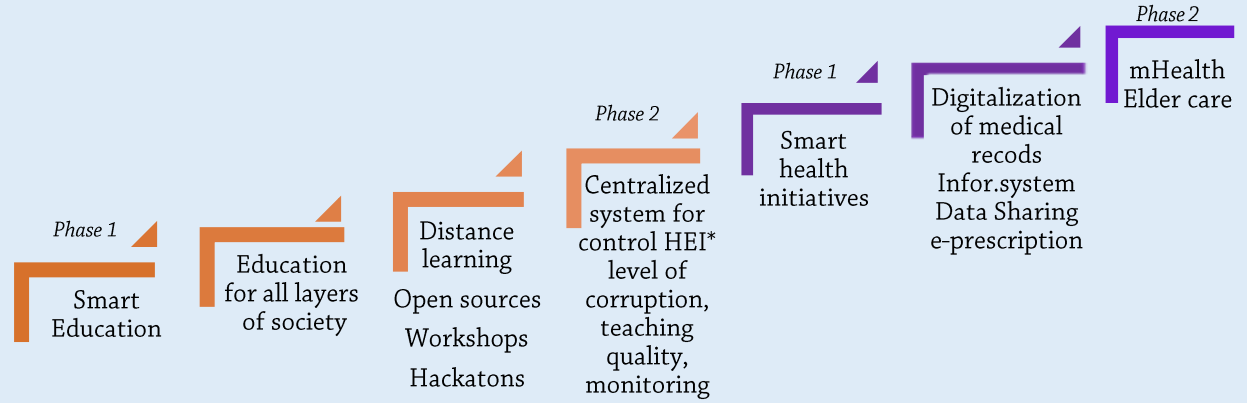


Source: own elaboration

5.2.3.2. Module 2. Smart education and Smart Health

Following the upper mentioned problem is the question of education and health. Only educated and healthy nation could be part of Smart community. All Smart City initiatives are oriented towards its citizens, so it is essential that, citizens should have enough skills and competence for being able to use new innovative approaches. Public health services also need reforms, in terms of use innovative solutions. Inappropriate approach of leading organizational and desks works in hospitals and clinics. Importantly problems reaching hospital by the citizens lived outside of the city.

Figure 17. ***Module 2.*** *Smart Education and Smart Health initiatives*



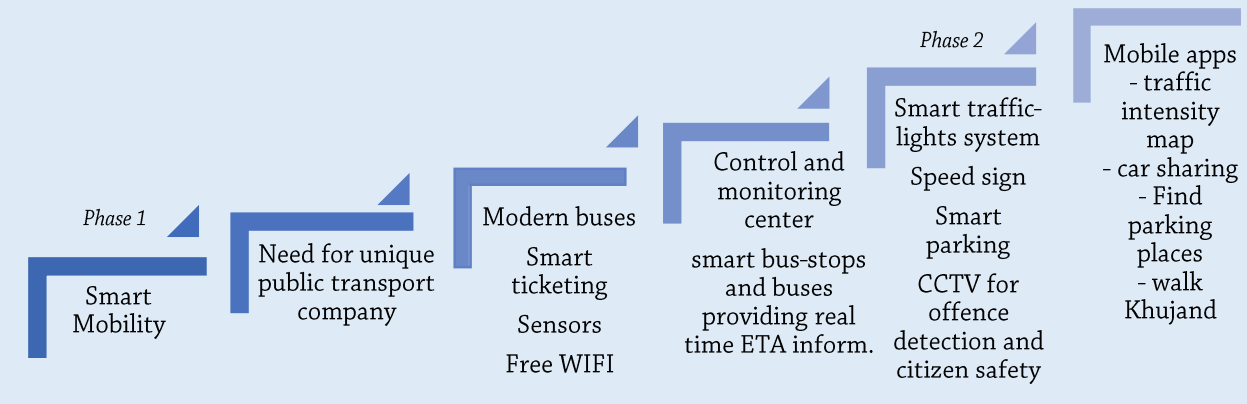
Source: own elaboration

5.2.3.3. Module 3. Smart mobility

City's transportation system is another prioritized sector for improvement. Need of smart infrastructure for public transport and systematic approach for centralized control and regulations. Year by year city becoming slower, main factor is increase of vehicles in the roads. Thereafter, problems with traffic and public parking places are seeing. Difficulties for finding mini-bus for different routes, especially in the evenings, being late because of not corresponding to the timetable, travelling uncomfortably in the full vehicle and feeling unsafe, when drivers making driving offences.

We think that, one of the effective approaches of lighting road loudness is to promote social movements on bringing citizens together in platforms, where fellow travelers could find cars, or to enhance car sharing services. Another direction is to call citizens start walking, at same time it's healthy. Walking or bicycling is the most "*green*" and healthy way to travel around city, especially when we talk about small city. Therefore, there should be a special attention to improve walkability in the city. Application of new services: putting signs about distance between places and how long it will take, developing offline walking city map, making walking as an interactive quest, putting QR codes with useful information, this way travelling could be interesting and bring joyful.

Figure 18. ***Module 3.*** *Smart mobility vision*



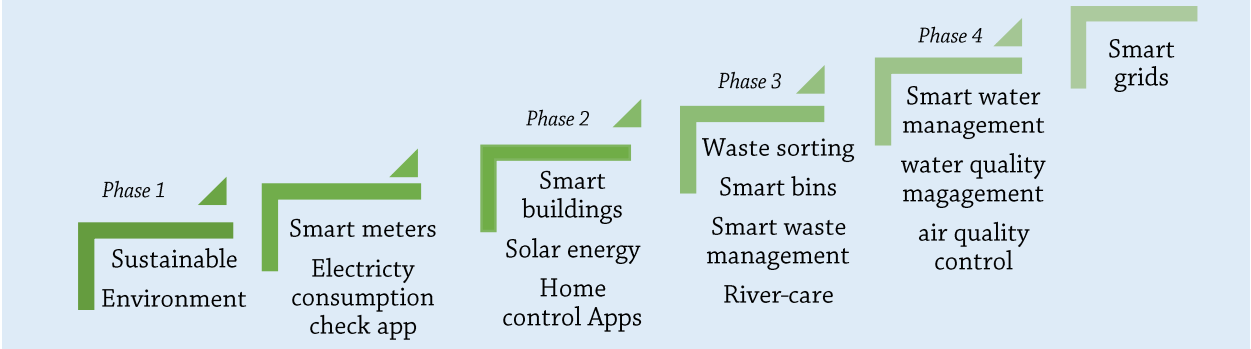
Source: own elaboration

5.2.3.4. Module 4. Sustainable environment

This module will be directed to obtain sustainable environmental development. After implementation of "reducing electricity lost" project in Khujand, the electricity is providing stable 24 hours. But still because of big energy consumption, nearby located villages and towns still have electricity limits. Therefore, the energy consumption must be reduced in the city, for adequately distribution of electricity in the region. One of the opportunities that we brought in SWOT it was city's face changing, so we have to use this chance and design all new high-rise building taking into account efficiency use of energy. Here smart buildings solutions could be appropriately applied. Where sensors attached in the buildings will help in adequate use of resources, e.g. adjustment lights in the rooms and air-conditioner and more importantly smart heating systems. As the main problem of electricity during cold winter period, where electricity consumption rises rapidly. Even though the whole electricity in the country is *green energy* generated by Hydro Power Stations, it makes sense to implement solar technologies in that new constructions as well.

The second part of this module is smart waste management and river-care. The obligatory task here to inform, better to teach society to start thinking about environment. Social movements and social ads necessary, which will be directed to build eco-friendly habits to our citizens and dropping bad habits of polluting our surroundings. Especially, starting waste sorting is really important, recycling is the key for sustainability. Nor for a long future also we need to think about to enhance *senses* of the city for air quality control, temperature, humidity etc.

Figure 19. ***Module 4.*** *Solutions for sustainable environment*



Source: own elaboration

CONCLUSION

We think, however, there are vary definitions of Smart City, different visions and frameworks, the main idea is bettering people's life. As we have said, population of country must be considered as the wealth of country and well-being of nation must be prioritized than accumulation of economic wealth. Today, ICT and innovative solutions provides wide range of possibilities to start changing our way of life, while thinking about sustainability.

Many scientists and researcher still believing that, there is no real or perfect Smart City of the future. The things are changing today, and of course the bright future of Smart Cities are seen in a papers and also in pilot projects, living labs etc. This is not simple, and not just bringing and providing to the city high presence of ICT and adding just the label of "Smart". More importantly is to integrate all this features of Smart, that ICT today makes available, to improve different scopes of life in cities, like it was dimensioned in Six Smart directions Giffender R. et al (2007). This will make clear, what to improve and focus on strategic issues of cities.

Hence turning a regular city, especially the one, which stands in the beginning stages of development is not a simple task. As we have identified a lot of challenges and barriers for achievement principle and basic features of Smart City.

The important lesson learnt is that it is not adequate to implement homogenous plans for Smart City. Therefore, we dedicated most part of our work for identifying key issues and understanding the current situation. Undoubtedly, case review, helped us a lot for better directing us and clarifying important aspects of Smart Cities.

Conducted investigation on actual situation in Khujand and identifying problems and challenges made us clear to map SWOT analysis. Strategic location and being the industrial center makes Khujand investment environment favorable, when from another side bureaucratic system in agencies and corruption hits to this statement. The last one also negatively impacts on citizen attitude towards city's government and politician. Also we should emphasize the low level of digitalization of economy, slow penetration of alternative payments, and simply building a trust for usage of these smart services.

Study of Smart City definitions and it´s different frameworks, review of existing Smart City projects and analysis of all possible city´s challenges and problems during development helped us to come in following conclusions:

- New policy making ideology, that will lead city to adopt innovations and support smooth implementations of future planned smart projects;
- Citizens are key for any aspects of development, cities are containing of citizens, thus quality of life in the city is the factor that directly impacts on performance of each inhabitant;
- Putting citizen to the center and their involvement– of course, this will take a long time, especially according to the culture that we are inheriting;
- Support innovative economy: enhancement of banking, e-commerce, methods of payments;
- Electronic services must be first of all prioritized;
- Paying a special attention on education, spreading ICT courses among youth;
- Collaborative economy initiatives, platforms that can bring citizen together for problem solving;
- City's governors must visit some pilot projects on Smart City.

We think upper mentioned recommendations are valuable for making first steps to shift towards digital city. Corruption and bureaucracy according to our vision is the tough challenge, therefore electronic-government initiatives we have marked as an urgency. Practice shows that, well adoption ICT and successful implementation of smart solutions, without right policies and without willingness to accept changes will be not bring expected output. It's actually makes the situation worse, by increasing costs and not appropriate use of possible capabilities and ignoring innovative approaches.

We believe, that our designed conceptual model, could change workflow and living conditions in Khujand, especially in case of following our recommendations and sequentially implementation of modules. Thus, efficiency and effective performance of public citizen - oriented services, will be the key element of Smart City, which will introduce to our citizen about Smart Solutions.

Also we came up to another interesting idea that, city must trace along path for being a Smart City, that will take long period of time and in our case first stage for Khujand is take a route towards Digital city.

Of course cities like Khujand, it's not full of opportunities for MNC to invest in Smart City, but the object of this master work is to provide information to the city's government about possibly opportunities to transform city to the Smart Community. And according to our evaluation and full city review Khujand city has a good chance to receive grants from financial institutions for its future Smart City projects.

In addition, I want to say, that I am planning to enhance this work, and dedicate my future research on topics about Innovations and Sustainable Development, whereas Smart City will be an important object for study. Furthermore, basing in this thesis project, I am going to publish series of papers in local scientific journals in mother language, with the hope to reach government's ears.

BIBLIOGRAPHY

1. asiagreenbuildings, 2015. *http://www.asiagreenbuildings.com/*. [Online]
   Available at: http://www.asiagreenbuildings.com/9063/singapore-fast-development-smart-buildings/d
   [Accessed 25 12 2016].
2. avesta.tj, 2014. *www.avesta.tj*. [Online]
   Available at: http://avesta.tj/2014/07/15/s-nachala-plyazhnogo-sezona-v-sogde-utonuli-16-chelovek/
   [Accessed 5 January 2017].
3. Caragliu A., Del Bo C., Nijkamp P., 2009. Smart Cities in Europe. *3rd Central European Conference in Regional Science*.
4. CNBC, 2015. *http://www.cnbc.com*. [Online]
   Available at: http://www.cnbc.com/2015/04/21/singapore-studies-to-get-smarter.html
   [Accessed 20 12 2016].
5. Cocchia, A., 2014. Smart and Digital City: A Systematic Literature Review. *R. P. Dameri and C. Rosenthal-Sabroux (eds.), Smart City, Progress in IS,*.
6. Dam, R. v. d., 2013. Personal Communications. *ITU Telecom World,* Issue IBM Institute for Business Value.
7. De Castro, P., 2015. *Aanálisis prospectivo de nuevas oportunidades de negocio derivadas del desarrollo de la concepción SMART*. Madrid: s.n.
8. Department for Business, I. a. S., 2013. *The Smart City Market: Opportunities for the UK ,* London: Ove Arup & Partners Ltd.
9. digital.report, 2016. *Digital.report*. [Online]
   Available at: https://digital.report/umnyie-elektroseti-mogut-poyavitsya-v-tadzhikistane/
   [Accessed 05 12 2016].
10. Dolan, E., 2013. *Ed Dolan´s Econ Blog: Growth and Quality of Life: What Can we Learn from Japan?*. [Online]
    Available at: http://www.economonitor.com/dolanecon/2013/02/15/growth-and-quality-of-life-what-can-we-learn-from-japan/
11. Fayzulloev, B., 2015. *Asia-Plus*. [Online]
    Available at: http://news.tj/ru/news/v-khudzhande-budut-ustanovleny-elektronnye-elektroschetchiki
    [Accessed 2 12 2016].
12. Giffender, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., Meijers, E., 2007. *Smart cities, Ranking of European medium-sized cities,* Vienna: s.n.
13. Government of India, M. o. U. D., 2015. *Smart Cities: Mission Statement & Guidelines,* s.l.: s.n.
14. Hall, R., 2000. *The Vision of A Smart City ,* Paris, France: s.n.
15. IBM, 2009. *www.ibm.com*. [Online]
    Available at: http://www-03.ibm.com/press/us/en/pressrelease/27791.wss
    [Accessed 10 12 2016].
16. IBM, 2010. *Smarter thinking for a smarter planet,* s.l.: s.n.
17. Musa, S., 2016. Smart City Roadmap.

18. NEC, 2015. *Smart Cities: Shaping India's Future, Smart City Concept In India.* [Online] Available at: http://in.nec.com/en_IN/blog/smart-cities-shaping-indias-future.html#sthash.gODn5ND0.dpuf

19. Pune Municipal, 2016. *Pune Smart city winning proposal.* [Online] Available at: http://smartcities.gov.in/writereaddata/SmartCities_Pune.pdf [Accessed 20 December 2016].

20. Sang Keon Lee,Heeseo Rain Kwon,HeeAh Cho,Jongbok Kim,Donju Lee, 2016. *International Case Studies of Smart Cities: Singapore,* s.l.: June.

21. Spence, M., 2016. *Global Governance: A. Michael Spence on how governance improves countries' well-being.* [Online] Available at: https://www.weforum.org/agenda/2016/03/a-michael-spence-on-how-governance-improves-countries-well-being?utm_content=buffer6cea4&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer

22. T. Nam., T. A. Pardo., 2011. Conceptualizing Smart City with Dimensions of Technology, People, and Institutions. *The Proceedings of the 12th Annual International Conference on Digital Government Research.*

23. taxcommittee, 2016. *www.andoz.tj.* [Online] Available at: http://www.andoz.tj/images/materiali_andoz_tj/GLAVNOE%20MENU/3_nalogoplatelshikam/2_elekronnie_uslugi/3_elektronnaya%20sistema%20otchetnosti/Kompl.doc-2016-June.rar

24. Telefonica, 2015. *Smart Cities: La transformación digital de las ciudades.* s.l.:s.n.

25. thehindu.com, 2016. [Online] Available at: http://www.thehindu.com/news/national/list-of-first-20-smart-cities-under-smart-cities-mission/article8162775.ece

26. Thuzar, M., 2012. Urbanization in Southeast Asia: Developing Smart Cities for the Future?. *Regional Outlook*, January.

27. UN, 2011. *World Urbanization Prospects: The 2011 Revision,* New York: United Nations Department of Economic and Social Affairs/Population Division.

28. UNDP, 2010. *Human Development Report 2010, The Real Wealth of Nations: Pathways to Human Development,* New York: Communications Development Incorporated.

29. V. Albino., U. Berardi., R. M. Dangelico., 2014. Smart cities: definitions, dimensions, and performance.

30. WorldBank, 2015. *WorldBank.* [Online] Available at: http://www.worldbank.org/en/results/2015/05/04/higher-education-admission-reforms-to-provide-greater-opportunity-and-equity-for-tajikistans-youth

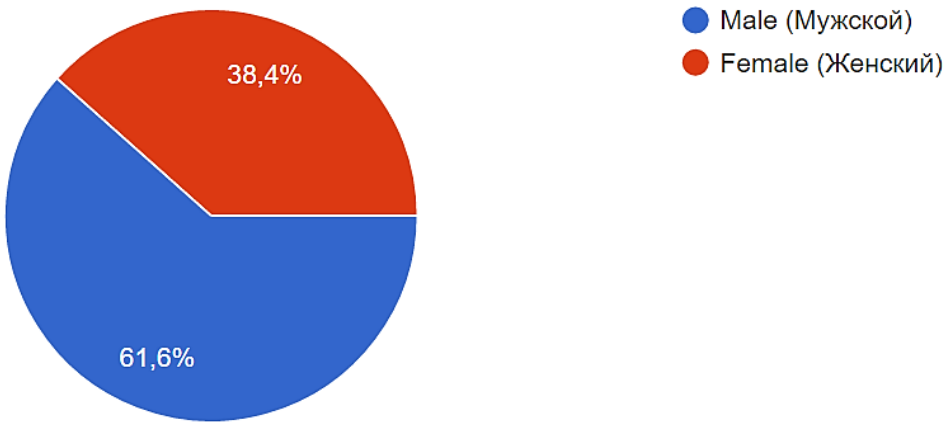
31. WorldBank, 2015. *www.worldbank.org.* [Online] Available at: http://documents.worldbank.org/curated/en/633431468178160631/text/102178-RUSSIAN-AM-P127807-OUO-9-Box394824B.txt

32. Yovanof, G. S., Hazapis, G. N. , 2009. An architectural framework and enabling wireless technologies for digital cities & intelligent urban environments.. *Wireless Personal Communications, 49(3),.*

33. Zygiaris, S., 2012. Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystem.

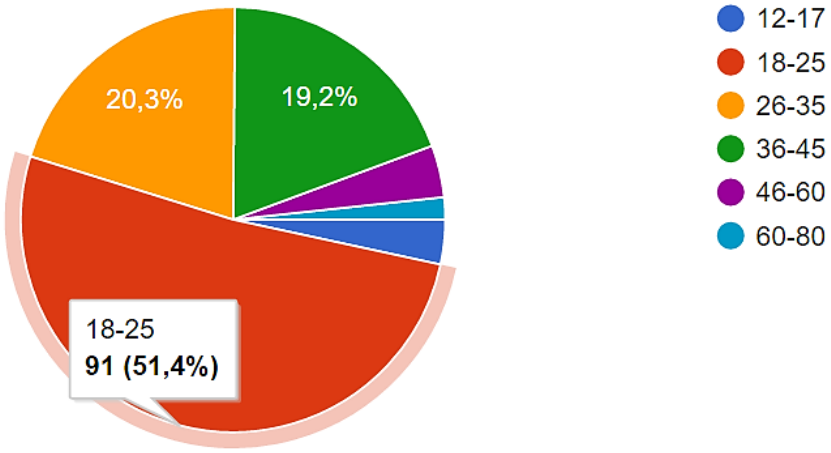
APPENDICES

Chart 4. Citizen's gender engaged in online survey



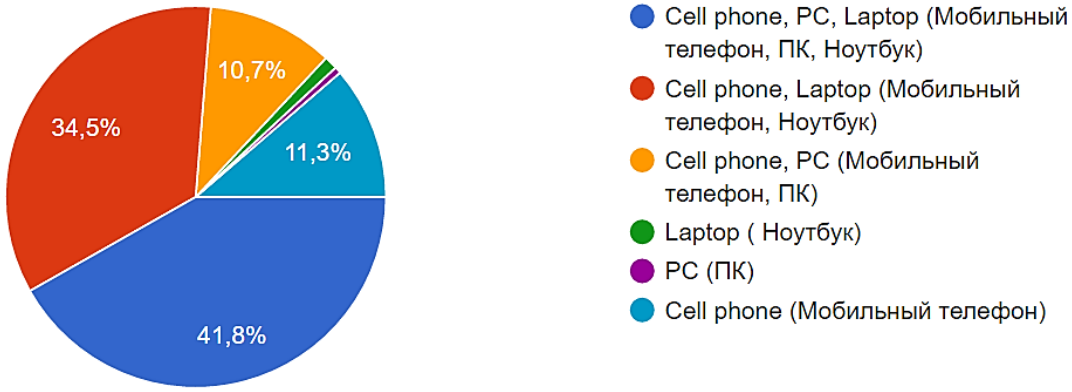
Source: own elaboration, chart generated in Google forms

Chart 5. Citizens' age engaged in online survey



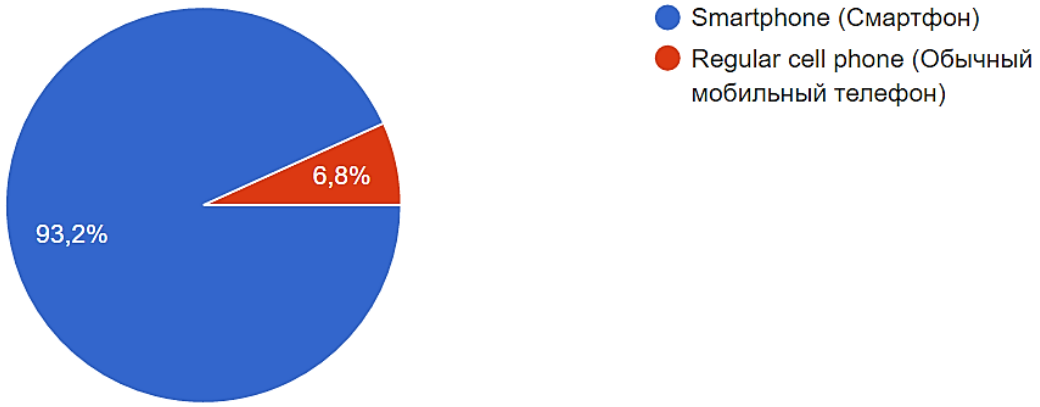
Source: own elaboration, chart generated in Google forms

Chart 6. Using electronic devices



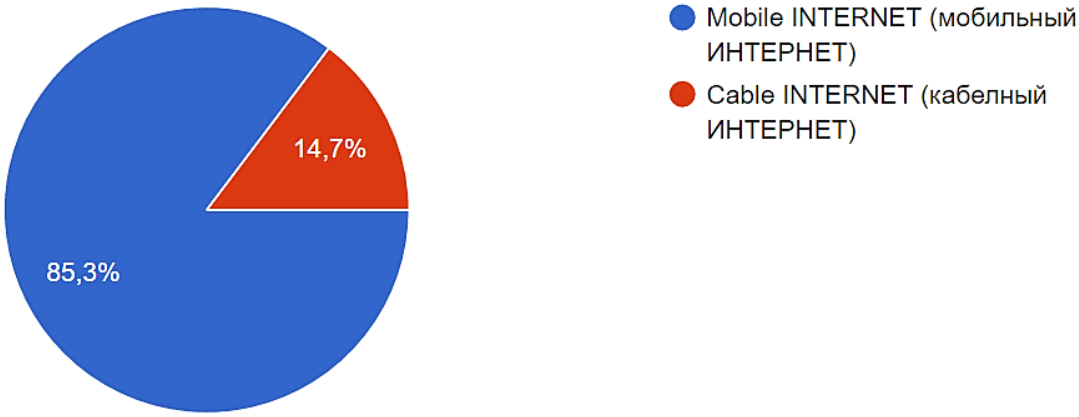
Source: own elaboration, chart generated in Google forms

Chart 7. Smartphone vs Cellphone



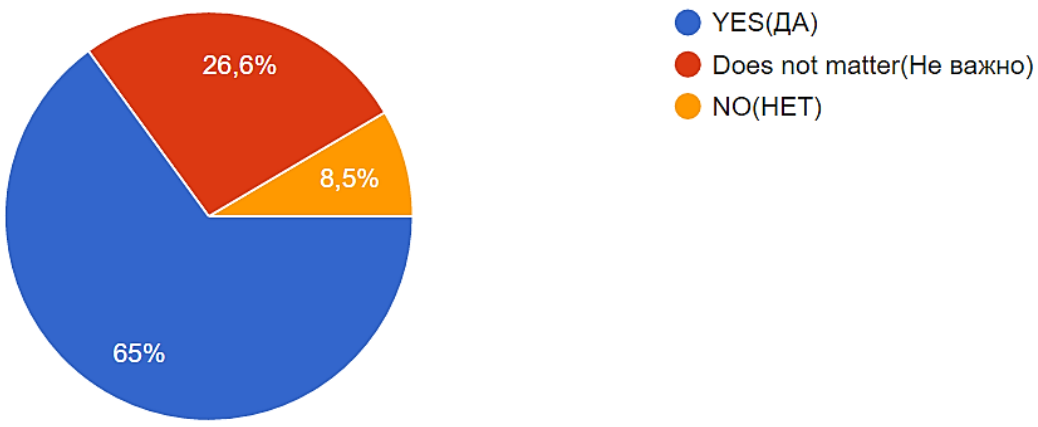
Source: own elaboration, chart generated in Google forms

Chart 8. Cable internet vs Mobile internet



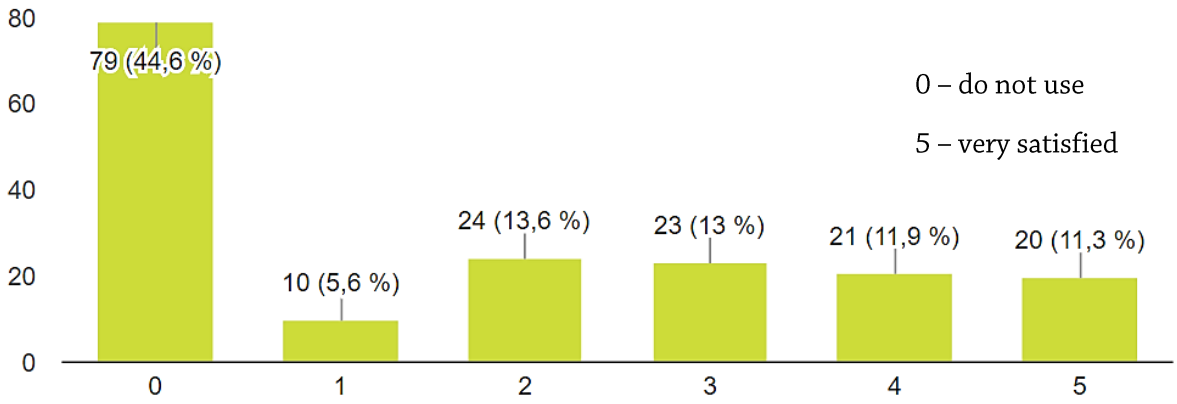
Source: own elaboration, chart generated in Google forms

Chart 9. Are you in favor of the initiative of E-Government?



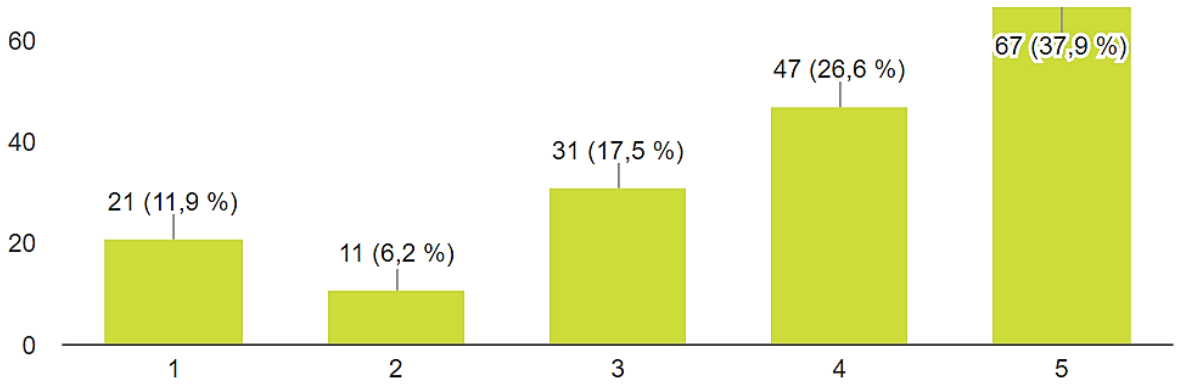
Source: own elaboration, chart generated in Google forms

Chart 10. How satisfied are You in use of Electronic Services of Tax Committee?



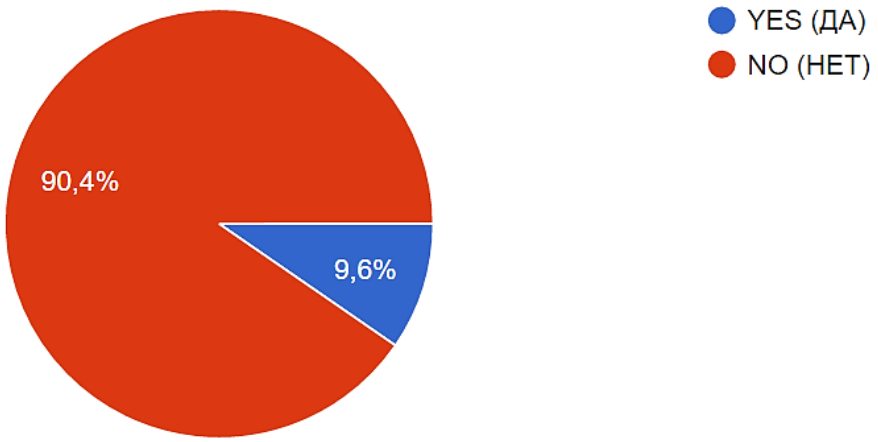
Source: own elaboration, chart generated in Google forms

Chart 11.What is your position about E-Learning?



Source: own elaboration, chart generated in Google forms

Chart 12. Have you heard about service of TCELL "mHealth"?



Source: own elaboration, chart generated in Google forms

Table 5. Offline survey results

1		SURVEY FOR KHUJAND CITIZENS					
2		Male	Female				
3	Gender	55	25				
4		12--17	18--25	26--35	46--60	61--80	
5	Age		12	48	15	5	
6		Primary	Secondary	Bachelor	Master	Doctorate	
7	Education		32	35	13		
8		cell phone, PC, laptop	Cell phone,PC	Cell phone, laptop	Cell phone	Laptop	PC
9	Devices	9	14	17	40	-	-
10		Smartphone	Regular				
11	Cell phone	68	12				
12		Cable	Mobile	Don't Use			
13	Internet	48	4	28			
14		YES	NO				
15	are you familiar with	6	72				
16		YES	Does not matter	NO			
17	E-Government						
18		0	1	2	3	4	5
19	E-tax service satisfaction	12	1	3	3	21	30
20			1	2	3	4	5
21	Digital meters satisfaction		55	10	7	5	3
22			1	2	3	4	5
23	Your position about E-Learning		8	13	20	6	33
24		YES	NO				
25	mHealth of Tcel	0	80				
26							

Source: own elaboration