SMART CITY STRATEGIES
CASE DESCRIPTIONS AND APPLICATIONS

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1. INTRODUCTION AND OVERVIEW

The following article will firstly (Section 2) discuss several different aspects of Smart City Strategies presented through various examples from cities all over the globe where such planning processes have been carried out and documented in scholarly writing through May 2017. Secondly, the case of the Municipality of Miskolc, Hungary will appear (Section 3) through the author's eyes, who led the process using the methodology of Applied Strategic Planning with city leaders in September through December 2016, to be implemented starting January 2017.

Smart City Strategies is a current topic in contemporary scientific discourse. A global phenomenon, the planning and implementation of such programs define the future of our cities and municipalities, thus shaping a new quality of life underpinning demographic progress. An overview of such projects and the case of Miskolc will help policy makers recognize trends and developments of the field.

Strategic plans are carried out in a program management framework designed to centrally manage and coordinate Smart City projects in order to ensure benefits by reaching objectives. Program management will consider project interdependencies to optimize budget, expenditures and deliverables. Program management will encompass tasks outside project scopes. The Smart City program for Miskolc requires strategic planning and monitoring, internal and external communications, financial resource mapping, and setting up infrastructures for program management.

2. SMART CITY CASE STUDIES

2.1. Dublin[1]

The city of Dublin is a prime example of smart development. In general municipalities, central government, city development and city maintenance companies will cooperate with civic organizations in order that culture will support the development and implementation of strategic programs. The study is a useful presentation of best practices:

"While there is a relatively extensive literature concerning the nature of smart cities in general, the roles of corporate actors in their production, and the development and deployment of specific smart city technologies, to date there have been relatively few studies that have examined the situated practices as to how the smart city as a whole unfolds in specific places.

In this paper, we chart the smart city ecosystem in Dublin, Ireland, and examine how the four city authorities have actively collaborated to progressively frame and mobilise an articulated vision of Dublin as a smart city. In particular, we focus on the work of 'Smart Dublin', a shared unit established to coordinate, manage and promote Dublin's smart city initiatives.

We argue that Smart Dublin has on the one hand sought to corral smart city initiatives within a common framework, and on the other has acted to boost the city-region's smart city activities, especially with respect to economic development. Our analysis highlights the value of undertaking a holistic mapping of a smart city in formation, and the role of political and administrative geographies and specialist smart city units in shaping that formation." [1]

[1] http://scholar.google.hu/scholar_url?url=https://osf.io/preprints/socarxiv/93ga5/download&hl=hu&sa=x&scisig=aagbfm3reguz4tzqdg4iruzt7aks-4umua&nossl=1&oi=scholaralrt

All hyperlinks herein were last accessed on June 20, 2017.

Figure 1.
Source: http://www.ecosystemmarketplace.com/articles/opinion-why-we-should-all-be-paying-close-attention-to-the-un-sustainable-development-goals/, June 20, 2017.

The case of Dublin shows the challenges faced in Miskolc, where all major players in the city needed to be coordinated and connected with relevant government bodies. The success of the planning process was highly dependent on improved internal communication of the shared goal of demographic progress, i.e. halting the decrease of population. This common purpose helped unite internal forces so far competitive.

2.2. Singapore[2]

Sustainability is a key criterion for the funding of smart city projects. In Hungary EU funding is vital for the commencement of these programs but also long term return on investment is required so that the lack of further subsidies will not cause shutting down such initiatives. In Singapore Design Thinking and Design Innovation are applied to foster project proposals. Design Synectics is vital for stimulating creativity [2].

[2] https://www.researchgate.net/profile/Kristin_Wood/publication/315619940_Design_Innovation_for_a_Smarter_Singapore_A_Case_Study_on_Smart_Energy_Innovation/links/58d627c0a6fdcc1bae77a589/Design-Innovation-for-a-Smarter-Singapore-A-Case-Study-on-Smart-Energy-Innovation.pdf

Singapore has been a forerunner in this field: “Nonetheless, as the economy is becoming more and more ideas-driven and diversified, Design Innovation (DI) has become a critical enabler for transformational change to solve problems, balance between the various priorities and interests, realise potentials, and create new value, user-centric experiences, creative communities, and new markets. Leaders in the public and private sectors are recognising that DI is more than aesthetics and themes, and good design represents good strategy.

Companies, communities, and economies are using Design Thinking and DI to raise productivity, unlock new opportunities for growth, and improve the quality of everyday life. Singapore, as one of the world leaders in DI, is also significantly exploring the possibility of DI contributing towards making the world a better and more sustainable place. For instance, Singapore has appreciated the 2030 Agenda for Sustainable Development, as shown in Figure 1, which was launched during the Sustainable Development Summit in September 2015.” [3]

The ideas developed in Singapore signify the success of design thinking applied in line with the sustainable development agenda of the UN. The same principle underlines the smart city motto of Miskolc, “Smart and Green”. The UN lists 17 goals for sustainable development:

2.3. Aalborg[3]

One of the major challenges in smart city development is the function of energy supply. There are two major directions in planning and controlling energy projects for smart cities. One initiative is the setup of Smart Metering for real-time control and communication based on current energy consumption data. Another initiative is the creation of a Smart Grid to encompass all consumers and producers to allow for optimized load balancing and energy supplies.

The city of Aalborg faces challenges of a market environment when designing such systems: “The contemporary energy system is faced with new challenges on the energy market. Both the rising share of renewable-based electricity (characterised by intermittent production) and increasing energy efficiency in buildings induce a reconsideration of the traditional role of conventional power plants coupled with district heating systems along with its impact on the energy system. Moreover, the price of electricity determined by the merit-order system additionally decreases the load factor of such plants, making them less competitive or even inflicting financial loss in operation. Research presented in this paper focuses on a novel approach towards conventional combined heat and power (CHP) plants coupled with district heating systems. It involves an analysis of dynamical performances of the district heating system – capability of energy accumulation and thermal inertia – in order to assess its potential to become part of ancillary services. It is concluded that the district heating system, i.e. network of pipelines can be considered as dynamical thermal energy storage in which excess energy can be stored during operation of the CHP plant.

A comprehensive analysis of dynamic behaviour of the district heating system has been performed by means of a mathematical model developed as a part of this research. The model is implemented on a theoretical case consisting of a simplified district heating system with three final users and the pipeline network of 9000 meters in length. The simulation has shown that the storage capacity of the network depends on the thermal load in the network and in such circumstances specific thermal capacity of the network amounts to 10.1 Wh/km. If the thermal load is decreased by 13% at peak the accumulation capability is decreased by 40%.

Moreover, the thermal capacity of the network increases up to 13.7 Wh/km as the pipeline length decreases to 1000 m which is characteristic of densely populated areas. The capability of energy accumulation is explored for different parameters such as external temperature, distance of the network and supply water temperature. It is shown that distance of final users from CHP plant has certain impact on the operation strategy as well.” [4]

The lessons learned for the Danish example will be applied towards strategies implemented in Miskolc both for Smart Metering, and also for Smart Grid.

[3] http://www.sciencedirect.com/science/article/pii/S0196890417303916

2.4. Ahmadabad[4]

The case of Miskolc, described in detail in the second half of this article covers the field of Smart Mobility as well. The example of Ahmadabad will help define a comprehensive framework for Environmental Impact Assessment (EIA) covering hard factors such as air, water, light and noise pollution, and also soft factors such as vulnerability and equity:

"The last two decades have witness controversial yet rapid development of the environmental policy agenda. It is considered more important to improve environmental performance and environmental awareness in decision-making. Nowadays Strategic Environment Assessment (SEA) is the most accepted term for the environmental assessment of impacts of proposed policy or plan, for ensuring full inclusion of environmental concern. SEA appropriately addresses the environmental, social and financial consideration at the earliest and appropriate stage of decision-making.

This work is an attempt to formulate SEA process which could be helpful in formulating a plan/policy for an urban transportation system, thereby ensuring that economic, social and environmental considerations are taken at planning stage itself. It was found out that the proposals should take the city's morphology into account before arriving at any decision. More stress should be given on decreasing the total passenger-Km by innovative land-use planning; concern should be towards controlling motorization and encouraging non-motorized movement in the city. The increasing trend to travel by vehicle will put an economic burden on the economically weaker section of society. Hence it is concluded that for long term sustainability there is a need of integrated land-use and transportation planning." [5]

2.5. Vienna[5]

The Smart City Framework Strategy of the City of Vienna aims at decreasing traditional transport through the use of commercial bicycles for the transportation of goods in urban areas:

"Although in Vienna the use of bicycles is more and more widespread, those for goods transport will be used in lower numbers to begin with. This work will be supported by secondary research and we will conduct interviews to compare the situation in other cities such as Budapest, Munich and Copenhagen. Later on these results will be shared with the City of Vienna to define the measures to encourage the commercial use of bicycles for goods transport." [6]

2.6. Columbus[6]

One of the most controversial elements of the smart city program in Miskolc is smart lighting. Various cases in Hungary show that the lessons learnt in one city cannot be directly applied in other cities. However the case of Columbus presents conclusions that are easy to adapt. The project definition focuses on energy and safety aspects, thus including Smart Living in the Scope:

"The purpose of this report is to develop a thorough proposal for the implementation of a smart street lighting pilot at The Ohio State University (OSU) that effectively improves safety and energy efficiency on campus. This proposed pilot would both improve the campus and serve as a test case for the City of Columbus' Smart City Team to demonstrate the implementation of smart street lighting for their own projects. To efficiently execute the project, we focused on four main objectives.

For our first objective, we researched how sensor components for smart street lights worked and what benefits they could provide. We then investigated relevant case studies to better understand the benefits acquired as a result of the sensors and the subsequent policy changes and/or project initiatives that ensued. We also constructed a simplified prototype of the proposed technology for this objective, which generated data samples that aided in making calculations that are currently not readily available elsewhere."

A research group of students evaluated the receptivity of the project:

"Our next objective was to evaluate the receptivity of the university to our proposed pilot by conducting a survey of the community. In analyzing how our project fit into OSU's sustainability goals, our team assessed to what degree the proposed pilot meets the needs of the Ohio State community. We then established the optimum area that would benefit most from the proposed technologies, by combining and overlaying datasets from various university departments. Our next objective was to determine the project's cost and feasibility."

[4] http://www.ijari.org/CurrentIssue/2017Volume1/IJARI-AR-17-03-103.pdf

[5] https://www.wu.ac.at/fileadmin/wu/d/ri/scm/WU_Cargo_Bikes_Final_Report.pdf

[6] https://kb.osu.edu/dspace/bitstream/handle/1811/80673/ENRAEDE4567_StreetLightingCP_sp2017.pdf?sequence=1

In the framework of the project, partnerships were established:

"Our team reached out to a variety of companies who are associated with the proposed technologies with cost inquiries to calculate an estimate, and then investigated potential funding routes. For our final objective, we further analyzed the relationship between this campus pilot and the Smart City projects to gain understanding of how this could help the city."

Beyond the initial objectives it turns out that traffic is also enhanced:

"Our findings confirmed that computer vision, dimming, and air quality monitoring sensors on street lights would be useful assets at OSU. These assets have been beneficial in other cities and can improve safety, energy efficiency, and traffic, while providing valuable data for the university. Our research indicated that, should the campus community support this project, it would help assist OSU's efforts towards meeting their established sustainability goals. In addition, with a cost totaling approximately $3,150, there are multiple routes of funding which could cover the expense of the project."

Finally, a valid point that has been emphasized in the Miskolc case, a more agile approach is needed through the use of pilot projects:

"Our group recommends OSU retrofit a sample of four street lights on West Woodruff Avenue between Schoenbaum Hall and Scott Hall with dimming capabilities on all four lights, and computer vision and air quality sensors on one of the four. Once the added-value of this project is realized, we suggest OSU consider expanding smart street lighting throughout campus." [7]

2.7. Stockholm[7]

Miskolc decided to place the whole smart city infrastructure on a single ICT platform operated by the municipality. However, the vision suggests an invisible operation of a sophisticated platform that will enable citizens to access city services with ease. The example of Stockholm provides an overall view of such operations:

"Modern cities operate in a force field of great challenges. The introduction of digital technology may facilitate the necessary transition management of cities but calls also for a new and intelligent use of a wealth of information for coping with great many urban challenges. This paper provides an exploration of the various challenges and tasks of an intelligent city (i-city) faced with unforeseen challenges and an unprecedented supply of 'big data'. Professional data management based on solid cognitive expertise in this area seems to be a wise strategy of a modern i-city."

The next generation data management approach after Big Data, called Open Data will allow decision makers create sustainable systems through revenues gained from the commercial use of municipal data. The case of Sweden underlines this approach as follows:

"The aim of this brief exploratory paper is to provide a sketch of the context and the force field of modern digital technology for urban areas. Our objective is to provide a positioning of Sweden – and in particular Stockholm – from the perspective of ICT use and digital technology use. Consequently, against the background of global and national ICT developments, the present paper will zoom in on Sweden and Stockholm as a reference case, so as to provide concrete and operational information in a benchmark exploration. At the end, some ingredients for a research and policy agenda will be offered."

The conclusion offers room for best practice development and benchmark setting:

"The conclusion may be drawn that Sweden is an advanced Internet-rich country, in which the top of the hierarchy is dominated by Stockholm. Clearly, this city may be seen as a role model for others in the use of Internet activities. It is a typical example of a leading i-city." [8]

2.8. Greece[8]

Tourism, if not planned and implemented strategically, will destroy the environment it was created for and within. Smart city strategies are crucial in communities dependent on sustainable development. The Greek example of insular communities faces such challenges:

"As an introductory chapter, the present paper aims to set the geographical ground of this book by shedding light on a very special region of the world, the Mediterranean region. The scope of the chapter is, firstly, to illuminate the specific attributes of this region, which render it one of the most intriguing but also vulnerable regions of the world; and identify the character of the region as a 'hot spot' in several respects.

[7] http://www.qip-journal.eu/index.php/QIP/article/view/788

[8] https://link.springer.com/chapter/10.1007/978-3-319-54558-5_1

Secondly, it aims to justify the type of cities considered within this geographical context, i.e. small and medium-sized cities and insular communities, usually lagging behind in terms of smartening up efforts; and having little opportunity to join a smart journey, as the public lights and related funding opportunities are usually shared by large, very successful, powerful and market attractive, smart cities that become examples on the global and the EU scene. “

The paper discusses cultural aspects of development in order to maintain communities. It is made clear that planning approaches should help mitigate risks in the regarding fields:

“Thirdly, the paper elaborates on the specific attributes and distinguishable rating of these cities in: economic terms (tourism, culture, sea trade nodes etc.); geographical terms (coastal and port cities at the cross roads of Mediterranean); cultural terms; etc. It reveals their development potential for both the Mediterranean and the EU context. A discussion follows on the emerging risks in the Mediterranean, which place at stake the sustainable future development of this type of cities and communities. Digitally enabled solutions, in conjunction with sustainability policies, appear as a full of promises path and an evolving policy direction for reaching inclusive, safe, resilient and sustainable end states within such a full of challenges new era.” [9]

2.9. Kansas City[9]

ICT is crucial for smart city infrastructures. The planned development in Miskolc requires broadband services on optical networks to allow for real-time data availability. The Kansas City case describes a relevant initiative:

“In February 2010, Google challenged US cities to compete for being the site of its first attempt at building ultra-high-speed fiber-to-the-premises (FTTP) network, promising speeds up to one hundred times faster than pre-existing broadband services. More than 1100 cities applied. Kansas City, however, was announced as the winner of the competition. This paper explores the rollout of Google Fiber in Kansas City from three different perspectives.” [10]

3. PLANNING AND IMPLEMENTATION – MISKOLC

3.1. Overview of the planning process

The Smart Miskolc operation model is aimed to help improve quality of life in the city in order to turn around negative demographic trends in the city. The Smart City Program encompasses municipal projects at the city development strategy level. One overall objective is the implementation of smart solutions. The other overall objective is to perform green and sustainable development.

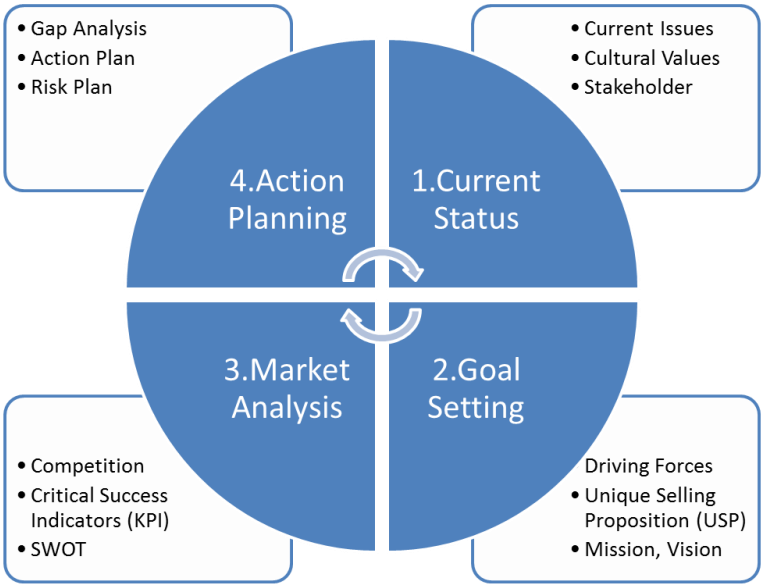

Figure 2.

[9] http://www.sciencedirect.com/science/article/pii/S073658531730182X

The development of the Smart Miskolc strategy follows the methodology of Applied Strategic Planning[10] in line with Lechner Center[11] recommendations following the steps what you can see on Figure 2.

The Smart Miskolc planning workshop was executed on September 29-30, 2016 after 3 months of preparation. As a result of the process, the following projects were identified in accordance with the objectives of the municipality:

1. intelligent camera system
2. GIS in city management
3. smart grid
4. smart metering
5. MIS in city management
6. tourism app
7. public problem reporting
8. virtual communities
9. medical system integration
10. e-payment for city services
11. e-ticket for transportation
12. intelligent traffic control

As a further outcome of the planning process 28 new project ideas were generated including a reshaped e-bike project. Project proposals based on these ideas are under way.

3.2. Smart City management in Miskolc

As proposed, a new Smart Miskolc Program Management Office (program office) would be set up to coordinate 40 Smart City projects for the period of 2017-2019 according to the Project Management Body of Knowledge (PMBOK) [12] methodology:

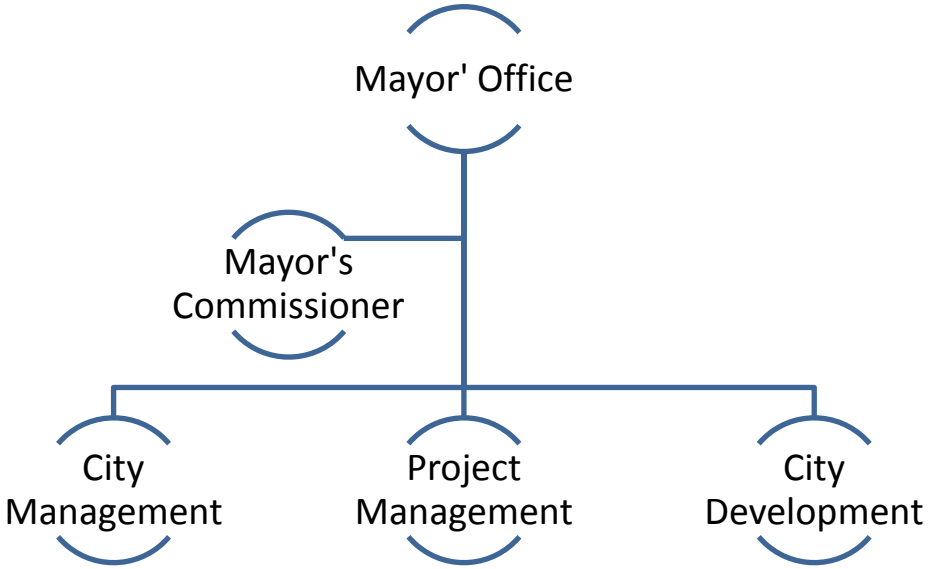

Figure 3.
Proposed organization for smart city program management in Miskolc

[10] http://polgariszemle.hu/archivum/54-2010-augusztus-6-evfolyam-4-szam/397-strategiatervezes-a-gazdasagfejlesztes-szolgalataban

[11] http://okosvaros.lechnerkozpont.hu/hu

[12] https://www.pmi.org/pmbok-guide-standards/foundational/pmbok

Program Management as opposed to Project Management performs central and coordinated management of project clusters in order to realize strategic goals and benefits of the program.

Program management will consider project linkages to optimize project deliverables and expenditures:

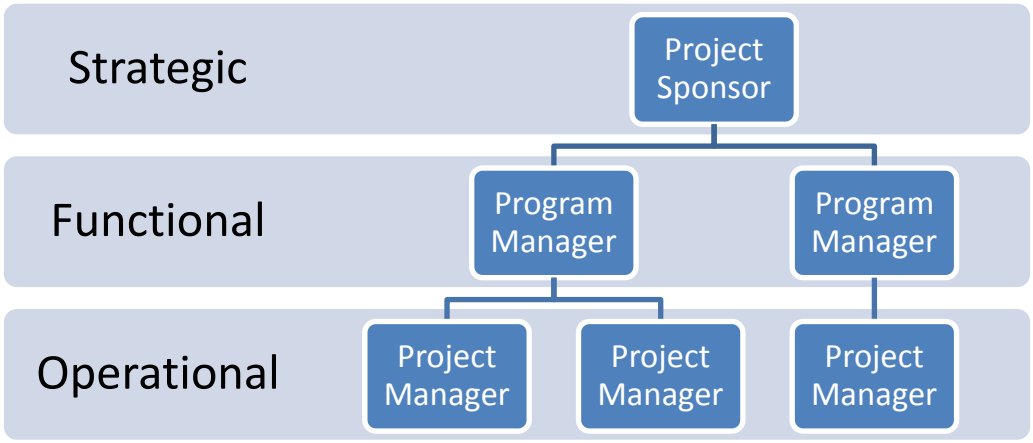

Figure 4.
Proposed levels of authority to coordinate across organizational structures in Miskolc

In this case the project sponsor is the mayor's commissioner, and program management functions will be executed by his/her staff. The objective is to coordinate across around 60 different companies of the city.

Programs will include subtasks beyond the scope of project concerned. In the case of the Smart Miskolc program such subtasks are:

- annual strategic planning process initiation and maintenance
- internal and external program communication
- initial resource map and continuous financing
- setup of program management infrastructure and staff

Responsibilities of the program office:

- program management consulting, training, skill development
- staff, infrastructure and software support
- program management methodologies, guidelines, procedures

Human resources for the program office required:

- 2 Back Office (program coordinator)
- 5 Front Office (program manager)

The program office is led by the Mayor's Commissioner for Smart City Program Management. Smart city development projects are implemented within the city management organization, and the municipality assigns tasks to be fulfilled within the annual plan of operations.

3.3. Planned partnerships in Miskolc

A partnership plan will define the involvement of stakeholders during the planning process in order for citizens to communicate their needs and proposals for the development, to know each other's opinions, to provide useful information for planning, and to explore opportunities for collaboration.

The partnership and education plan only lists stakeholders at this stage. A more detailed elaboration is part of the communication plan. Implementation of the plan will consider best practices from Homo Regius City Services model used in Szolnok. [13]

[13] http://www.homoregius.hu/szolgszolnok.php

The planning workshop has identified several stakeholder groups but interests, expectations, and opportunities have not been explored yet. Assumption and opinions regarding this have been included in a SWOT analysis. Actual need will be explored in each segment in 2017 to define tools and activities necessary for engagement. Some stakeholder groups will overlap, but this redundancy is included intentionally, as several management areas are involved and synergies will be created in this way.

1. College students
2. Youth groups
3. SMEs
4. Miskolc University
5. Corporate and public institutions
6. Secondary schools
7. Takata, Bosch
8. Tourism and hospitality industry
9. Civic organizations (bikers)
10. Users (residential, corporate)
11. Internal partners (corporate, institutional)
12. Central government
13. 14-25 age group
14. Large enterprise
15. Teachers
16. Citizen groups
17. Business partners
18. State organizations
19. MVM, Elmű
20. Startups
21. Researchers
22. Visitors

3.4. Smart City vision in Miskolc

The vision is to create a Smart Miskolc modus operandi where through improved quality of life demographic trends will be overturned. The smart city program will embrace city projects at the municipal development level in order to meet two strategic objectives:

1. implementation of smart solutions
2. development of green and sustainable environments

Keywords of the vision:

experiences
mobile
accessible to all ages
sustainable
environmental
inviting
all ages
convenience
needs
services
automated
self-improving
quality of life
self-sustained
safe
natural
green
jobs

Key concepts of the vision:

1. sustainable/environmental/green
2. convenient/accessible/natural
3. automated/self-improving/self-sustained

The novelty of the approach in Miskolc is the envisioned invisible network of smart solutions with increased convenience levels for specific demographic segments such as students and retired citizens. Such an approach is new in the sense that the proposed infrastructure is to be hidden to create a sense of easy access and smooth operations. This approach is intended to appeal to various demographic segments, such as young and senior citizens.

3.5. Smart City program principles

Smart City program principles are in accordance with the overall objectives and strategic goals based on a shared vision. The central element of the concept is that the support (ICT) infrastructure should remain invisible.

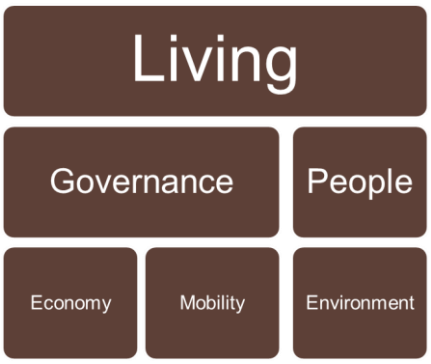

Figure 5.

Two dimensions of overall objectives are starting smart&green projects.

Accordingly, strategic goals will cover four areas of operation:

1. smart environment
2. smart mobility
3. smart economy / governance
4. smart people / living

3.6. Implementation risks

The following risks have been deemed important to consider during implementation. These threats were identified as most relevant in terms of impact, probability and detectability by municipal management:

1. Population loss due to migration
2. Communication breakdown with central government
3. Lack of European, central and local funding
4. Fast depreciation (e.g. IT)
5. High number of not sustainable projects
6. Not realistic user expectations
7. Decreasing competitiveness of region
8. Low value add by enterprises
9. Aging population
10. Lower investment due to global trends
11. Leakage of support to other cities
12. Unemployment and social problems to slow integration
13. Loss of graduate students due to migration
14. Changing regulations in higher education
15. Enterprises in critical conditions due to economic changes
16. Lack of product development, shrinking markets
17. SMEs lack capital for R&D
18. Production infrastructures available in industrial parks
19. Innovation potential unused due to lack of funds, institutions or infrastructure

Each project plan will include its own risk plan with predicted impacts, perceived probabilities, and planned actions. Multiple dimensions of risk planning will be evaluated to define a mitigation plan in order to avoid, minimize or defer political, environmental, social, technological, environmental and legal threats.

3.7. Monitoring and success indicators

The monitoring system set up will be in accordance with the recommendations of the PMBOK methodology. The following actions will be taken to ensure project success:

1. joint and coordinated resource management
2. support of best practices and benchmarking
3. establishment of standards, procedures and templates
4. project risk planning and management at the program level
5. central configuration management
6. implementation and operation of project management software
7. communication at the program level
8. mentoring for project managers
9. control of project status, time and cost
10. quality assurance at the program level
11. change request processing at the program scope level
12. checking project reports against strategic goals

Each project plan will include a set of KPIs with name, definition, expected change, unit of measurement, source, and frequency of reading. The methodology defines indicators at the strategic, functional and operational levels. For each KPI, a set of thresholds must be indicated for both lower and upper control limits.

4. CONCLUSION

Creating a Smart City operational model for the Municipality of Miskolc in Northern Hungary is aimed to help turn around negative demographic trends in the city. The Smart City program integrates current local projects at the level of strategic development. Strategic goals are implementing smart solutions, and building a green and sustainable environment. Such programs encompass tasks outside project scopes. The Smart City program for Miskolc requires strategic planning and monitoring, internal and external communications, financial resource mapping, and setting up infrastructures for program management.

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