# ASSESSMENT OF THE FEASIBILITY OF CREATING A "SMART PARKING" PROJECT FOR GOVERNMENT AGENCY "PARKING OF THE CAPITAL" IN MINSK

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CONTENTS

# GENERAL CHARACTERISTIC OF THE WORK

Master's thesis on the topic: ASSESSMENT OF THE FEASIBILITY OF CREATING A "SMART PARKING" PROJECT FOR GOVERNMENT AGENCY "PARKING OF THE CAPITAL" IN MINSK.

The present master's thesis is composed of an introduction, three chapters, a conclusion, a list of references including 37 titles and 2 appendices. The paper is presented on 107 pages.

Keywords: BUSINESS PLANNING, SMART PARKING, DIGITAL TRANSFORMATION.

The object of the research: is the parking paid market for drivers in Minsk city.

The subject of the research: is the external and internal marketing environment of the projected, its analysis, risk analysis.

The main goal of the research: to prepare the business plan for smart parking project and evaluate the feasibility of current service digital transformation.

Research methods: quantitative and qualitative research methods such as questionnaire and observations.

The thesis has mainly practical importance. The results of the study can be used directly by the government agency "Parking of the capital" to invest digital transformation of paid public parking in Minsk city.

Field of application: Marketing, Business planning, Strategic management.

# INTRODUCTION

A business plan is a document that uses new products, services and goals, tasks, sources of income, as well as management models and other details that are important for all types of business activities.

Talking about startup the purpose of the business plan is to show the real chances of implementing a business idea.

The business plan for opening a new enterprise is one of the constituent documents that determine the development strategy of the company. At the same time, it is based on the general concept of the company's development, in more detail develops the economic and financial aspect of the strategy, gives a feasibility study for specific activities. The business plan covers one of the parts of the investment program, the implementation period of which is usually limited to one or several years (often corresponding to the terms of medium– and long–term loans), which allows a fairly clear economic assessment of the planned activities.

The main goal of developing a business plan is a detailed description the company's proposed activities related to the development of new goods and services (opening new business areas, financial recovery, etc.), for the coming year, the definition of the main financial indicators for the next period (6 years), taking into account the level target market demand; assessment of available resources and definition need for additional external financing. However, this goal not the only one.

As other equally important development tasks business plan can be as follows:

– assessment of the degree of viability of a business idea;
– reducing the risk of opening a new business or business line;
– attracting the interest of potential investors (sponsors, creditors);
– gaining planning experience, determining prospects new business development.

Business planning allows you to solve such pressing problems as:

– to determine the degree of viability and stability of the company in the future,
– to reduce the risks of entrepreneurial activity;
– specify business prospects with the help of qualitative and quantitative indicators;
– attract attention and interest, provide support from company investors;
– to help gain experience in planning, to develop a perspective view of the enterprise and its working environment.

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Every component of a business model is being questioned and needs to be validated. The main hypothesis is – the business model of the digital transformation of service is viable. To prove it or reject we have to work out and test some subhypotheses:

- there is a consumer market for the services offered;
- consumers need to consume services planned to be provided;
- consumers are ready to pay a certain price which makes the business profitable.

The structure of the Master thesis includes: introduction, basic the part presented in three chapters – theoretical and practical, conclusion, list of sources used and appendixes.

The first chapter – the theoretical section includes issues related to the study of theory information technologies used for the digital transformation process and analysis of data and basic concepts of business planning.

The second chapter will consist from industry analysis and marketing research.

The third chapter will consist from marketing, implementation, production, financial plans and risk analysis.

Research methods: methods of theoretical analysis of the financial condition of the company, investment design, applied software in the field of investment analysis and business planning were used in the work.

## EXECUTIVE SUMMARY

The purpose of this business plan is to provide marketing analysis and all necessary financial calculations for successful digital transformation of paid public parking service in Minsk.

These days there are many free internet services as google and Yandex maps and free mobile applications that provide some information about public and privet parking with ability to book and pay for privet parking, but there is no service like that for public paid parking. This days government hires stuff of people that control public parking places through walking around parking zone and giving paper bills to drivers or also some place have machines for transmit payment for parking in a parking zone.

We want to create mobile application as part of global e–government infrastructure, which will result in the formation of a unified state data model built on the principle of interoperability with a single data entry based on the introduction of advanced information and communication technologies. In this system every citizen will have confirmed registration, that will be used in MA (mobile application) Smart Parking.

**Business idea and service description.**

In each public paid parking zone will be chosen and placed 3 video cameras. One camera will be installed in the beginning of parking zone, second camera will be installed in the end of the parking zone and third wide angle one will be installed in a middle of the zone Infront of parking line. When car goes through firth camera, this camera tracks car's number, middle camera can track where this car is parking exactly and third camera will track car's number again when car leaves smart parking zone. All video will be sent to computing center and processed through analytical model.

The general logic of the system operation under the Pilot Project is planned as follows:

In normal operation, the video analytics system receives data (video traffic) from VHN and analyzes it. Using built–in algorithms, the system must calculate the entire parking space and divide it into conditional (logical) places based on the size of a typical parking space.

As free parking spaces are occupied, the video analytics system should detect a change in state and automatically recalculate the number of free and occupied parking spaces. At the same time, regardless of the actual position of the parked car, the system must nevertheless calculate based on the total parking space and the total ability to place vehicles (cars) on it.

The system should transmit information about the availability of free and occupied parking spaces, interacting with users' mobile applications, as well as to the Web application.

System users (vehicle drivers) using information about free parking spaces should have a function that allows using built–in maps or by transferring information to third–party mapping applications (Yandex, Google and others) to build a route to a free parking space. The advantage is the use of built–in maps, and the use of functionality that allows you to rebuild the route (offer another free place nearby) if at the moment (during) the car is moving, the selected parking space is occupied by another driver. If possible (optional), the system should test the functionality that does not allow choosing a free parking space if the system knows that it has already been

selected by another driver (a route has been built to it), or to inform the driver that this place has been selected by another user.

The system user (vehicle driver) should be able to pay for the use of paid parking (occupied parking space) using a mobile application. As payment methods, the functionality (interaction protocol) of ERIP, the functionality of mobile payment systems, incl. using a linked bank card, or an existing payment system from the subscriber's mobile phone account by sending an SMS message in a format agreed with the cellular mobile telecommunications operator.

The technology stack of smart parking solution can be broken down into 4 measure layers (hardware, connectivity, middleware and applications and 14 components:

- The Hardware level includes video cameras.
- The connectivity level enables devices to communicate with other devices and to cloud via wireless and wireline network.
- The middleware – the platform/storage/analytics level includes important functionalities such as Connectivity and normalization, etc.
- Applications level runs integrations into other business systems and host applications.

# CHAPTER 1
# THEORETICAL BASIS OF SMART PARKING & DIGITAL TRANSFORMATION.

## 1.1 Digital business transformation.

### 1.1.1 Digital economy.

The main prerequisites for technological transformation are new digital technologies: mobile Internet, social networks, artificial intelligence, BigData, cloud technologies, new generation robots, virtual and augmented reality, Internet of things, blockchain. Obviously, they appeared quite a long time ago, but the conditions for their widespread use have developed only in the last decade. First of all, this was influenced by an increase in functionality and a decrease in the cost of technologies. So, according to Accenture, in the period from 2009 to 2019. the cost of data processing decreased by 10%, the cost of data transmission channels – by 40%.

The expansion of the range of uses and the financial availability of technologies have led to the massive creation, presentation and transmission of information in digital form. At the same time, data transfer is carried out continuously, and users increasingly access the Internet not from a stationary computer, but from a mobile device, i.e., almost always connected with each other. That is why the basis of the digital economy is the hyperconnectivity of subjects and objects as a result of the development of digital technologies.

Thus, the digital economy is an economic activity that is the result of a huge amount of Internet communications between people, companies, devices, data and processes; new economy, the next step in the development of the social and business environment. In the digital economy, the business models of companies (Google, Amazon, Alibaba, Airbnb, Uber) are initially built using digital technologies, which are not auxiliary tools, but the basis of their activities. Thus, the key characteristics of digital companies are:

- movement of information in digital form;
- touch interaction with devices;
- customer experience management;
- ensuring cybersecurity;
- automation of processes and decision making;
- use of external and internal social networks.

In order to survive in the digital economy, traditional companies are forced to transform with the help of digital technologies.

### 1.1.2 Digital business transformation.

Often, the main role of digital technologies comes down to the use of advanced analytics and more complex process algorithms. However, technological innovations make it possible to conduct business in a different way: digitalization makes it possible to better understand the internal processes of companies and consumer demands and, based on this, form effective strategic initiatives [33].

Digitization is the conversion of physical/analogue objects (paper documents, images, audio signals, video, etc.) into a digital form that allows storing and transmitting data over the Internet. Digital data can be processed, stored, filtered, identified, reproduced and transmitted in full, at high speed and low cost. As a result, continuous flows of information are formed in electronic (digital) form, which is the basis for the use of algorithms and process automation.

Approaches to the definition of the concept of "digitalization" do not cause discrepancies among specialists and experts in the field of research. Thus, digitalization is considered as "a socio–economic transformation initiated by the massive introduction and assimilation of digital technologies, i.e., technologies for creating, processing, exchanging and transmitting information" [35].

Digitization refers to the improvement of functions and the transformation of processes using digital data and digital technologies. Three areas of application of digital technologies can be distinguished [36]:

- analytics and data visualization;
- automation of processes and equipment management;
- communication between participants in the supply chain.

The basis of process digitalization is the use of advanced analytics for company management. We can talk about the digitalization of marketing or the digitalization of production – this means that many functions and operations will be performed automatically, without human intervention. As a result of digitalization, the conditions for the transition to a digital enterprise are created.

Digital transformation is a transition to digital business, a comprehensive transformation of the company's activities, its business processes, competencies and business models, the fullest use of digital technology opportunities in order to increase competitiveness, create and increase value in the digital economy. As a rule, digital transformation leads to the emergence of new markets, new consumers, and the creation of new businesses.

Research in the field of digital transformation can be divided into several major areas [34]:

- customer experience;
- operational processes;
- business models;

Digital transformation affects three organizational areas [37]:

- external (customer experience and customer lifetime value);
- internal (business processes, decision making and organizational structure)
- the organization as a whole (segments and business functions);

An important consequence of digital transformation is continuous digital communications and transactions of a company with a large number of stakeholders (customers, suppliers, partners, competitors, etc.), as well as the formation of ecosystems. Thus, digital transformation affects not only the company itself, but also its "companions" in the ecosystem, transforming the process of forming ecosystems with consumers, suppliers and partners into one of the significant goals. At the same time, the result of digital transformation will directly depend on the availability of a business development strategy and the quality of its development.

Strategic analysis of companies' activities involves the use of various structural tools. These can be the main and supporting activities in the value chain [Porter, 2005] or blocks of the business model canvas [Osterwalder, Pigneur, 2017]. To analyze the processes of digital transformation, strategic maps (balanced scorecard – BSC) by R. Kaplan and D. Norton are used [Kaplan, Norton, 2003].

**Strategies and models of digital transformation.**

Digitalization and digital transformation strategies are often referred to as digital strategies5 (digital strategy), which refers to the use of digital technologies to change business models and create new competitive business potential.

In recent years, the availability and openness of technologies for business in terms of cost and infrastructure readiness have formed two opposite approaches to the digital transformation process:

- from technology to business need – business is involved in the race for the latest technologies, the evaluation of the results of implementation is usually secondary, the focus is on obtaining competitive advantages through ownership of the technology. Following this approach brings only a short–term effect to "digital fashionists" (fashionistas) due to the lack of connection with the business strategy;

– from business need to technology – the assessment of the desired result and the identification of sources of value creation precede the choice of a specific technology and its subsequent implementation.

This approach is supported by the company's strategic goals and is of a long–term nature.

**Approach 1.** The digital strategy is considered as an independent functional strategy as part of the overall corporate strategy. Being integrated into the overall corporate strategy, the digital strategy of each individual company becomes unique.

**Approach 2.** The digital strategy is not separated into a separate strategic plan. The impact of digitalization processes is reflected in specific functional strategies. The technology implementation roadmap is located at the intersection of the innovation development strategy and the IT strategy.

**Approach 3.** The company's strategy does not imply a strategic development plan with a set of measures, but is formalized exclusively in the form of budgets with key performance indicators. A digital strategy is not being developed.

Approaches 1 and 2 are valid for implementation and can lead to the desired result. When forming a strategy and implementing a digital project, it is important to level the risk of business focusing on the technology itself, creating the appearance of digitalization. The consequence of the isolation of digitalization processes from the goals and business objectives is most likely to be the loss of money and time.

The determining factor in the processes of digital transformation, in particular in the formation of a digital strategy, is the model adopted by the company as part of the implementation of digital projects. Based on the analysis, a number of practically significant models of digital transformation can be identified.

**Model 1.** Assumes the end–to–end penetration of digital ideology into a functioning business. The introduction of digital tools is carried out at the level of the main business processes, which dramatically affects both the corporate strategy and the business model. This model of digital change is the riskiest due to the high requirements for the internal readiness of the company on the part of staff and top management, as well as due to the high cost of exit, up to the complete loss of business.

**Model 2.** It implies the creation of a portfolio of digital projects without affecting the main business processes. At the same time, projects can be either pointwise built into the main business processes of the company, or separated into separate business units.

This model, from the point of view of loss of value, is one of the safest, because:

– involves the phased introduction of technologies;
– due to the focus on a specific business process, it allows more

– accurately, relative to other models, to evaluate the effect. The cost of exiting a project is almost always known in advance and is equal to the amount of investment in the digitalization of a business unit (business process);
– reduces the risk of setting the interests of the core business over a digital project.

**Model 3.** It implies the creation of a business entirely in a digital environment. These companies are most in line with digital transformation trends by creating value based on platform business models.

Shifting focus away from the closed loop of a single company towards platform models with a modular architecture is a key feature of digital transformation.

### 1.1.3 The concept of "Smart City".

A smart city is an urban planning concept for integrating a variety of information and communication technologies (ICT), including Internet of Things (IoT) systems for managing urban infrastructure: transport, education, healthcare, housing and communal services, security, etc. The purpose of creating a "Smart city" is to improve the quality of life of residents using urban informatics technology to improve service efficiency and meet the needs of residents. These processes are associated with the generation and processing of bulk data. Most Belarusian departments have already accumulated enough of this data and can now use their potential to improve the quality of their decisions. In recent years, to improve security in Belarus, a number of infrastructure projects have been implemented, which are primarily related to the installation of video surveillance cameras.

Now, for a number of reasons, intermediaries are needed between our data and data that formally belong to the state, and this function is performed by government agencies. The state provides citizens with services such as parking, but, in fact, but in reality, the service hides the obligation of citizens to perform their data transfer work for government agencies. As a result, analogous relations of intermediaries between citizens and data are being built. Now this mediation is carried out by state bodies, and part of the burden falls on the shoulders of citizens. Digitalization of data processing and analysis completely removes this function, removing it from government agencies and relieving citizens of these problems.

So, when state bodies are eliminated as intermediaries between a person or organization and their data (about statuses, actions, transactions), this, on the one hand, is a technologically solvable task that reduces the number of civil servants, requires high quality data, and as a result, improves the quality solutions. On the other hand, this is a managerial task: how to make changes that would allow creating platform solutions that integrate with each other, how to find people (including civil servants)

with completely different competencies, first in order to carry out the transformation process, and then to be able to adopt a decision culture based on data.

Digital transformation is the third wave: the state has already automated processes (without changing them and creating departmental systems, often with "bad" data), then informatization leaders learned to start with process reengineering. But if you look at digital transformation as a process in which, in the traditional sphere of business, the availability of high–quality data and the speed of exchange lead to new business models that were not previously available or non–existent, and change the patterns of people's behavior, the question arises: what will be the new business model?

The results of automation and digitalization in the form of internal automated and reengineered processes, implemented automated systems and reliable data in many cases form the basis for DT. A typical roadmap for such a transformation would include a variety of projects and activities:

– traditional automation and digitalization projects (aimed, for example, at automating internal processes or implementing data, architecture, IT asset management);
– projects for the creation and development of all components of the architecture on which new digital processes operate (separate digital services or more complex architectures);
– "Drawing in" of external participants in digital interaction (such activities can be organized both on project and other principles);
– continuous development of digital architecture, which can also be organized on design and non–design principles.

When discussing digital strategies, it is important to take into account that, in general, they involve the implementation of not only transformational, but also other projects: in the "digit" (informatization), for the "digit" (infrastructure) and on the periphery of the "digit" (education and training, creation of development institutions).[4]

If we look at global trends in the digital transformation of the state, then these are:

– open development in government departments and IT departments;
– open government data;
– machine–readable laws;
– "Government cloud";
– unified websites of authorities;
– rejection of external IT contractors, in–house development;
– public procurement reform;
– privatization of state organizations – owners of IT systems and databases;
– development of digital administrative codes;
– building a community of government IT developers;

– involvement of CDO (Chief Data Officer) specialists – the main ones in terms of data quality, policy their formation and implementation of data–based solutions;
– personnel training and retraining.

### 1.1.4 Digital transformation technologies.

**Cloud computing.**

Cloud computing is the first of the four digital transformation technologies and is fundamental to it.

Cloud computing is a model of access to a common pool of configurable hardware and software resources: computer networks, servers, storage systems, applications and other services. This technology requires no effort to configure and manage resources, and is accessed via the Internet. Cloud resources can be owned either by the organization itself (private cloud) or by a third party that provides them for a fee (public cloud). Amazon is considered a pioneer in this area. [2]

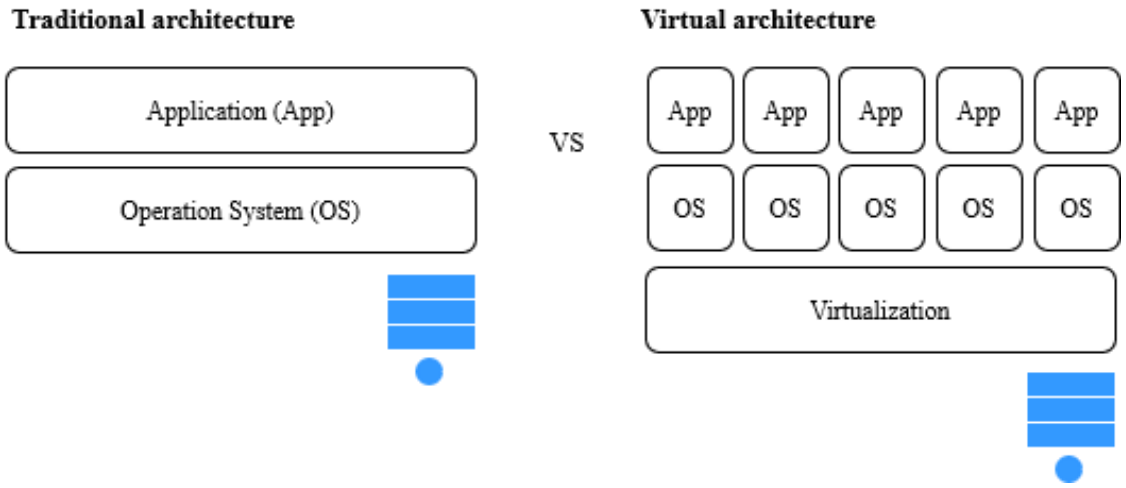
**Virtualization and containers.**

The main mechanism that creates economies of scale in cloud technologies is virtualization.

Containers are another innovation that makes efficient use of physical resources. A container is a lightweight, self–contained package of executable software that includes everything necessary for its operation: program code, runtime environment, system tools and libraries, and settings. The use of virtualization and containers to distribute hardware across applications results in higher and more cost–effective resource utilization rates. As a result, cloud services are becoming much cheaper, and public cloud computing platforms such as AWS, Microsoft Azure, IBM Cloud, and Google Cloud are becoming more widespread.

**Virtualization Dramatically Increases Hardware Efficiency**

Virtualization allows multiple applications to share infrastructure resources. Due to this, the efficiency of using hardware is significantly increased.

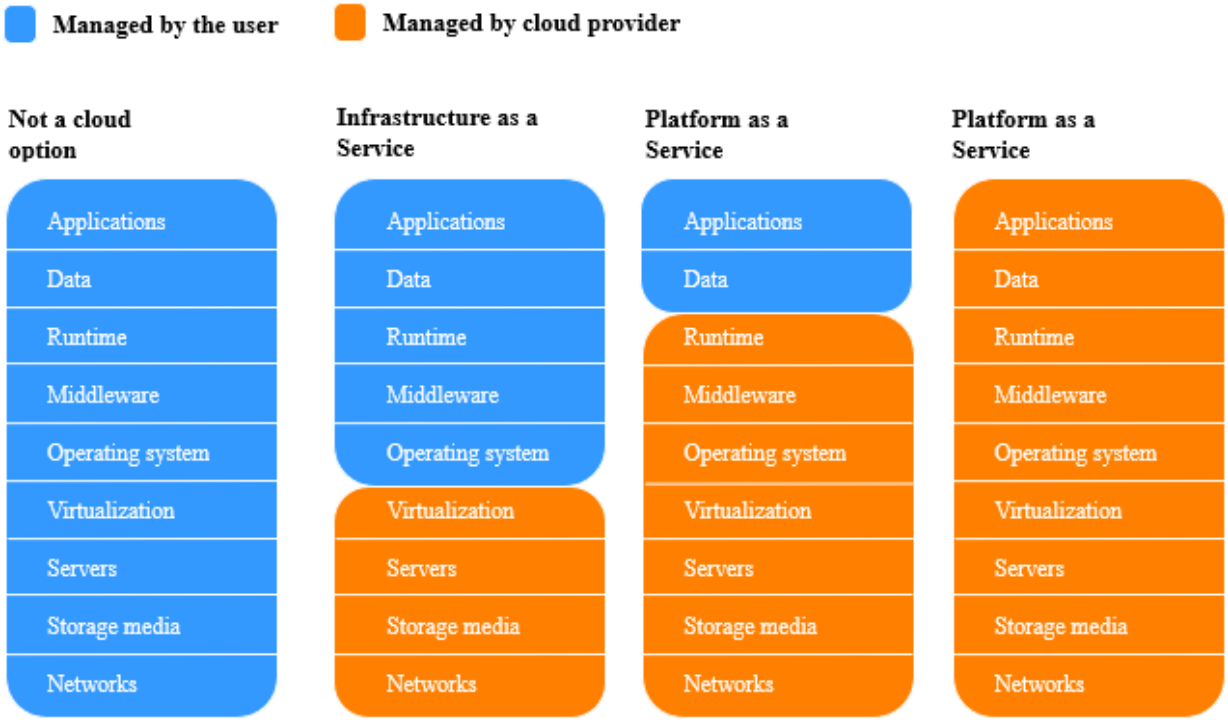



**Picture 1.1 – All as service: IaaS, PaaS and SaaS**

**Note – source: [2]**

Cloud technologies were created by both independent and corporate software developers. They wanted to save time, reduce the cost of purchasing, building and managing a scalable and reliable hardware infrastructure. The cloud model allowed developers to focus on building software. The cloud provider dealt with infrastructure (IaaS – infrastructure as a service), as well as issues of scalability and reliability. Modern cloud platforms are resilient. They dynamically determine the number of resources needed to run the application and allocate them automatically. This freed developers and IT teams from many operational tasks. They no longer need to set up and configure hardware and software, tweak programs, and manage a distributed database cluster. No need to split data across multiple clusters for the sake of scaling. The cloud client pays only for the resources it uses. Today, cloud services have gone beyond IaaS. They now include application development platforms (platform as a service, or PaaS) and application (software as a service, or SaaS). PaaS services offer development tools and services for creating, deploying, using, and managing applications. In addition to managing the related infrastructure (servers, storage, networks, virtualization), PaaS additionally offers services such as the runtime environment, operating system, and integration and other system software.

SaaS services are turnkey applications accessed via the Internet. The SaaS provider manages the entire application, including infrastructure, security, operating environment, and updates. SaaS services free customers from having to purchase hardware or install, manage, and update software.




**Picture 1.2 – Managing of control in IaaS, PaaS and SaaS**

**Note – source: [2]**

## Big data.

The second technology that supports digital transformation is big data. Of course, data is always important, and especially in the era of digital transformation. Many AI applications require huge amounts of data to train and improve their machine learning algorithms as the amount of data grows.

The concept of big data first appeared in astronomy and genomics in the early 2000s. In these areas, large amounts of data arose. It was not possible to process them efficiently and inexpensively using a traditional centralized architecture, or a vertically scalable architecture. Horizontally scalable architecture uses thousands or tens of thousands of processors to process data simultaneously.

Clouds provide unlimited possibilities for computing and storing information. Software is emerging that is designed to process data in parallel on a massive scale. Organizations no longer need to limit and select source data for analysis. Now falling out of the general range or irrelevant data is well–integrated into big data analysis. As a result, more than 20 billion Internet–connected smartphones, sensors and other devices generate an ever–growing stream of data, which is measured in zettabytes annually (1 zettabyte of data will fit on 250 billion DVDs). Today, companies can draw

conclusions from available data in near real time. As we will see shortly, the ability to handle all the data has driven the rapid advances in AI.

Today, the number of devices connected to the Internet is three times the population of the planet. This figure is increasing by 10% annually. [2]

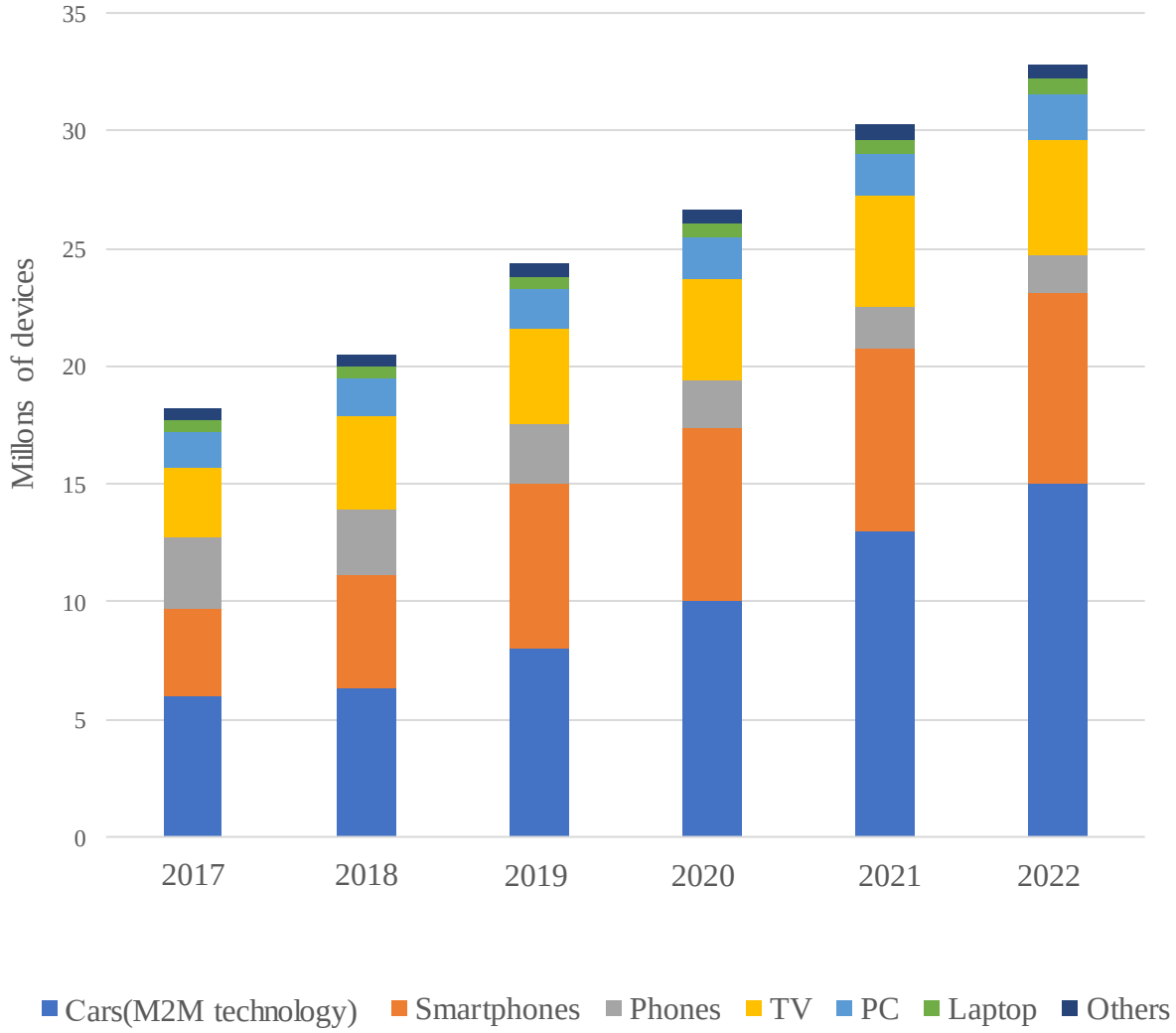



**Figure 1.1 – Growing number of connected devices globally**

**Note – source: [2]**

## Artificial Intelligence.

Artificial intelligence is the third digital transformation technology. This concept includes the scientific and technical data necessary to create intelligent machines and computer programs that can learn and solve problems instead of human intelligence. The scope of AI includes the analysis of language information and translation, image and pattern recognition (for example, when detecting fraud, predicting failures). It provides support in decisions.

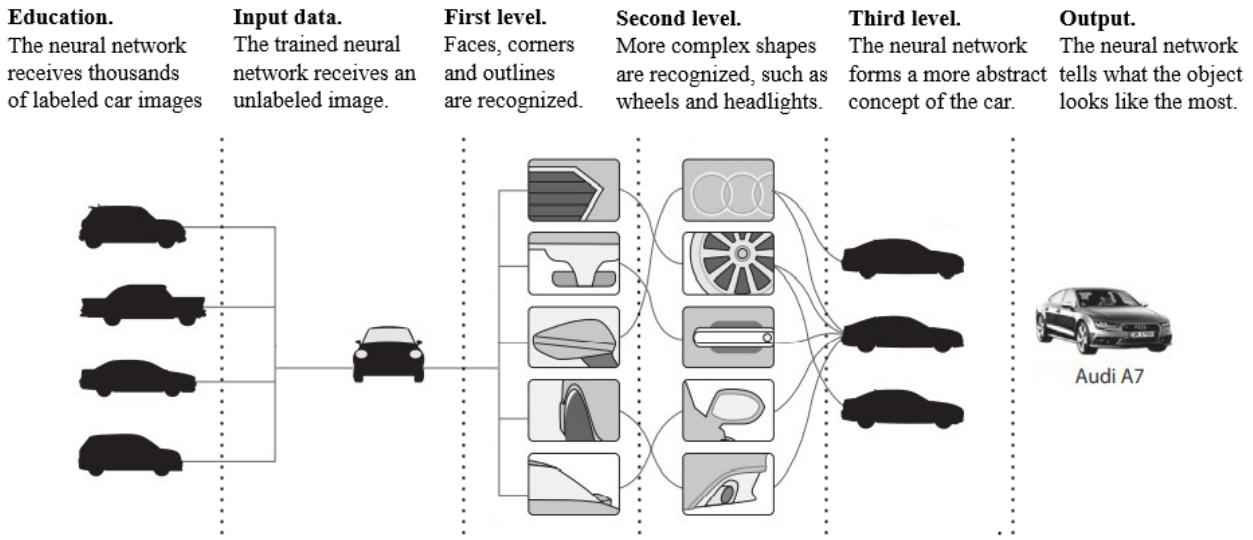
**Machine learning.**

Machine learning, a very broad subgroup of AI, is a class of algorithms that learn on their own by solving similar problems using the entire dataset. They do not follow predefined rules, as is the case with traditional algorithms. An algorithm is a sequence of instructions that a computer executes to transform input into output. Unlike traditional approaches, machine learning algorithms mathematically analyze any kind of data (images, text, sounds, time series) and their relationship and draw conclusions.

**Deep Learning.**

Deep learning is a subset of machine learning. As mentioned earlier, the most traditional types of machine learning require extensive definition of factors and, in turn, serious expertise. The problem is that in this case, data scientists cannot do without data scientists in classifying and defining data, as well as in training the model. However, in deep learning, important factors are not determined by humans. They are identified by the algorithm. This is an important achievement, because the definition of factors solves only some of the problems of AI. When solving many problems, data scientists cannot identify important factors. Consider, for example, the problem of image recognition. For example, you need to create an algorithm that recognizes cars. This is an important requirement for smart parking. There will be a lot of options for images, taking into account all possible shapes, sizes and colors of cars, as well as lighting, distance and perspective. Data scientists would not be able to identify all the important features needed to train an algorithm. For such problems, deep learning uses the neural network technology described below. The network of neurons in the human brain was taken as a model, although in reality the technology has little in common with it. Deep learning allows computers to create complex concepts based on a simple hierarchical structure. This can be represented as a series of interconnected algorithms. At each level of the hierarchy there is an algorithm that generates an intermediate part of the output, and they, in turn, use the next levels of the hierarchy. As a result, the last level of the hierarchy forms a complete set of output data. The neural network is trained to recognize cars by analyzing a huge number of images (with and without cars). Each level of the neural network analyzes different data components, defining more and more abstract concepts such as edges, corners, outlines, circles, and rectangles. The result is a machine concept based on a hierarchical structure. After training, the neural network can determine with a high degree of accuracy from a new photo for itself whether a car is depicted on it or not.

Deep learning with multilayer neural networks allows computers to create complex concepts based on a simple hierarchical structure. [2]




**Picture 1.3 – How a neural network recognizes an image of a car**

**Note – source: [2]**

AI applications of this level can be used in business and government.

**Internet of Things.**

The fourth driver of digital transformation is IoT: connecting any device to the Internet that can receive, process and transmit data. This is a simple concept, but it has the potential to create tremendous economic value. The strength and potential of IoT is that computing is becoming interconnected, microprocessors are steadily becoming cheaper and more energy efficient, and networks are getting faster. Today, many objects — cars, drones, industrial machinery, and even buildings — are embedded with low–cost AI supercomputers the size of a bank card. As a result, cloud computing is successfully spreading to the network edge, that is, to the devices with which data is produced, consumed, and now analyzed.

## 1.2 Video analytics and Computer Vision.

Computer vision is a study of understanding the images and extracting the information out of those images, lets say in a single image we see a cow, and grass. It's possible to obtain a context that it's a dairy farm or something of that sort depending on the objective by classifying each object visible on the image and extract information out of it.

Now video analytics is becoming more and more widespread. The platform of artificial intelligence and deep learning helped her in this. Deep learning and ultra–

precise neural networks (Convolutional Neural Network (CNN)), aimed at efficient image recognition, allow developers to move to the next level, which will replace traditional video analytics.

It's time for high–definition digital video and fast intelligent processing of video content. The error rate dropped from 25% to 16% and then to less than 5%. Computing using graphics processing units (GPUs) has accelerated neural network training from days to minutes.

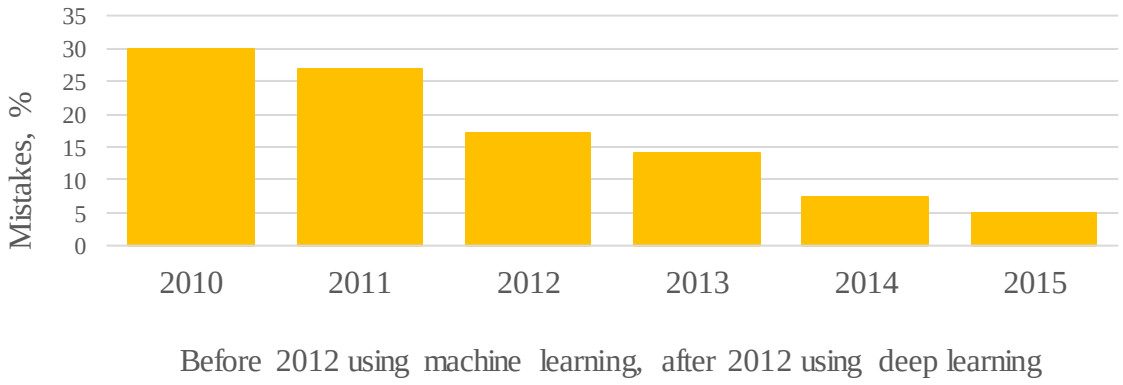



**Figure 1.2 – Percentage of errors in image classification in video analysis systems**

**Note – source: [5]**

This solution allows us to switch to managing the maintenance of the street and road network, including the parking space of the city, based on complete, reliable and up–to–date analytical data and predictive models in real time. The solution makes it possible to ensure more than 99% of cases of violations of parking and stopping rules for 16 types of violations around the clock, reduce the level of such violations, increase the level of road safety, ensure control over compliance with city improvement rules and the receipt of non–tax budget revenues at the expense of their violators.

Video analytics has proven to be a tremendous help in the area of transport, aiding in the development of smart cities.

An increase in traffic, especially in urban areas, can result in an increase in accidents and traffic jams if adequate traffic management measures are not taken. Intelligent video analysis solutions can play a key role in this scenario.

Traffic analysis can be used to dynamically adjust traffic light control systems and to monitor traffic jams. It can also be useful in detecting dangerous situations in real time, such as a vehicle stopped in an unauthorized space on the highway, someone driving in the wrong direction, a vehicle moving erratically, or vehicles that have been in an accident. In the case of an accident, these systems are helpful in collecting evidence in case of litigation.

Vehicle counting, or differentiating between cars, trucks, buses, taxis, and so on, generates high–value statistics used to obtain insights about traffic. Installing speed cameras allows for precise control of drivers and masse. Automatic license plate recognition identifies cars that commit an infraction or, thanks to real–time searching, spots a vehicle that has been stolen or used in a crime.

Instead of using sensors in each parking space, a smart parking system based on video analytics helps drivers find a vacant spot by analyzing images from security cameras.

These are just some examples of the contributions that video analysis technology can make to build safer cities that are more pleasant to live in.

**Defining scenarios and training models.**

Once the physical architecture is planned for and installed, it is necessary to define the scenarios on which you want to focus and then train the models that are going to detect the target events.

Vehicle crashes. Parking spot. – Each scenario leads to a series of basic tasks that the system must know how to perform. An example: detect vehicles, eventually recognize their type (e.g., motorcycle, car, truck), track their positions to check correctness of parking.

The most frequent, basic tasks in video analytics are:

Image classification: select the category of an image from among a set of predetermined categories (e.g., car, person, horse, scissors, statue).

Localization: locate an object in an image (generally involves drawing a bounding box around the object).

Object detection: locate and categorize an object in an image.

Object identification: given a target object, identify all of its instances in an image (e.g., find all soccer players in the image).

Object tracking: track an object that moves over time in a video.

Training models from scratch requires considerable effort. Luckily, there are a fair number of resources available that make this a less burdensome task.

Image datasets such as ImageNet or Microsoft Common Objects in Context (COCO) are key resources that simplify the training of new models.

There are several pre–trained models available for tasks such as image classification, object detection, and facial recognition, which, thanks to transfer learning techniques, allow for the adaptation (fine tuning) of a model for a given use case. This is much less expensive than a complete training.

Finally, open–source projects have been increasingly published in recent years by the community to facilitate the building of custom video analysis systems. Relying on

computer vision libraries, greatly helps build solutions faster and with more accuracy.[5]

## 1.3 What is Business plan.

A business plan is a document that uses new products, services and pretensions, tasks, sources of income, as well as management models and other details that are important for all types of business activities.

The business plan for opening a new enterprise is one of the constituent documents that determine the development strategy of the company. At the same time, it is based on the general concept of the company's development, in more detail develops the economic and financial aspect of the strategy, gives a feasibility study for specific activities. The business plan covers one of the parts of the investment program, the implementation period of which is usually limited to one or several years (often corresponding to the terms of medium– and long–term loans), which allows a fairly clear economic assessment of the planned activities.

The main goal of developing a business plan is to describe the company's proposed activities related to the development of new products and, for the coming year, the definition of the main financial indicators for the next period, taking into account the level target market demand; assessment of available resources and definition need for additional external financing. However, this goal not the only one.

As other equally important development tasks business plan can be as follows:

1. assessment of the degree of viability of a business idea;
2. reducing the risk of opening a new business or business line;
3. attracting the interest of potential investors (sponsors, creditors);
4. gaining planning experience, determining prospects new business development.

Business planning allows us to solve such pressing problems as:

– to determine the degree of viability and stability of the company in the future, to reduce the risks of entrepreneurial activity;
– specify business prospects with the help of qualitative and quantitative indicators;
– attract attention and interest, provide support from company investors;
– to help gain experience in planning, to develop a perspective view of the
– enterprise and its working environment.

The purpose of writing the master's thesis – development of a business plan and its economic evaluation for parking industry.

# CHAPTER 2
# SITUATIONAL ANALYSIS.

## 2.1. Industry analysis.

The Belarus Parking market is relatively not stable and growing, generating roughly US $ 4 million in revenue annually. A wide range of players are involved — most fundamentally, parking operators that plan and manage facilities while providing necessary staff and technology. Those facilities vary by location (on–street, off–street, off–street multilevel, corporate/ university campus), fee type (timed, membership), and real estate type (owned, leased, management contract). Local governments own most public parking lots and facilities, occasionally granting control to parking operators, and often manage streetside parking.

That relative market uncertainty belies a number of persistent, underlying challenges. Lack of legislation control to payment control, often creates considerable economic costs.

The level of parking automation is low and needs to be increased as the number of parking spaces continues to increase and it becomes more and more difficult to control them.

Finally, parking operators see a growing array of technological solutions, but the highest–profile are aimed at helping drivers find and pay for parking, with few holistically addressing operators' business needs.

Urban development takes place in the context of global trends. Four key trends have an impact on urban development.

### 2.1.1 Global trends.

**A focus on sustainability.**

Capgemini research institute done a survey with 7,500 consumers globally to understand their preferences, behaviors, and expectations on sustainability and more than half of consumers say that they share an emotional connection with products or organizations that they perceive as sustainable. Sustainability framework for consumer products include [6]:

**Environmental friendliness.**

Initiatives focused on conservation of natural resources, reducing carbon and greenhouse gas emission. Emission reduction strategies are being successfully

implemented through parking service organizations around the world and nowadays it is very strong trend.

**Social responsibility.**

Initiatives focused on safe working conditions for the workforce, fair labor policies. Every year, each parking space requires a maintenance cost equal to 30% of the cost of its creation. Every day, a huge staff of workers serves the streets of Minsk, these people need decent pay for their work, which guarantees payment for a parking space.

**Economic inclusiveness.**

Initiatives focused on fair trade and commitments to a wider cause – poverty reduction, education, etc.

Parking is not a public and universal good, which is used by everyone without exception. Over the past hundred years, motorists have begun to consider parking as a public human good, which is necessary and necessary for everyone without exception.

Since the times of the USSR, we have become so accustomed to the fact that parking in the yards and on the streets of the city is free that we still cannot agree that it can be paid.

Also, many motorists cannot agree with the correctness of such a measure aimed at introducing paid parking zones, since they believe that they already pay decently enough for owning a car in this modern world (taxes, fuel, car maintenance, washing, repairs, etc.). rubber, etc.). But if we consider the issue of parking fees in the context of sustainability, we can give an example that illustrates the trend.

We all, without exception, use the roads and therefore pay the transport tax, making our personal contribution to the maintenance of the road infrastructure. Everyone uses and everyone pays, but many people believe that the city authorities are simply obliged to maintain parking lots at their own expense, since the multibillion–dollar incomes of local budgets make it possible to do this today. But then what about people who do not have a personal car, why should they pay for free parking services or those car owners who park their vehicles in garages or paid guarded parking lots?

**Urbanization and demographic changes.**

– **Parking app market growth.**
  Among the thousands of wonders the IT industry has gifted this world, one of the most notable solutions is on–demand car parking mobile app development. The world has witnessed how valuable the advantages of smart parking management

apps are. According to IoT Analytics research, over 11% of public car parking spaces across the globe are now smart. As a result, the software development community is now ready for massive growth in the demand for car parking mobile app development.

Fast–growing urbanization has made finding parking spaces a nightmare for most people. On–demand smart parking finder apps are no less than a boon in the current times because they enable users to search and reserve parking spaces easily.

In addition to that, parking app development has made non–cash payments possible for parking fees. The smart features of car parking apps also help drivers avoid getting parking tickets.

– **Surface parking.**
Surface parking will be pushed further and further outside of city centers. As cities continue to redevelop and with a boom in multi–family apartment buildings to accommodate a younger urban demographic, there will be less and less room for vehicle parking lots.[7]

**Globalization, strengthening economic ties and population mobility.**

– **More municipalities will launch networks of e–bikes.**
Based on the success of other startups, cities will begin to develop their own network of e–bikes, giving them more control over fleets.

– **Slower growth for ride sharing.**
Ride sharing services like Uber and Lyft will experience much slower growth throughout 2022 as urban residents opt for new forms of transportation such as scooters, bikes, and local services like Ryd that not only provide mobility solutions but a tangible urban experience.[8]

**Technological progress and structural changes in the economy.**

**The Death of cash payment.**

Cash as a method of payment has been on the decline for a while now, and hygiene concerns raised by the COVID pandemic have further hastened its demise.

In Belgium, France, Great Britain, Canada, Sweden, the Netherlands, the share of non–cash payments is close to 100%. The achievement of such results in these countries became possible, first of all, due to the presence of various government programs, such as the active introduction of modern payment infrastructure, the

introduction of restrictions on cash payments, the spread of mobile payment terminals, and the introduction of additional commissions for cash settlements.

Belarusians make every fourth payment non–cash. Under the pressure of profitable loyalty programs, convenient payment applications and functional card products, even the most persistent skeptics are gradually giving up. At least, this is what the steady growth in the share of non–cash payments indicate. Bank payment cards remain the main payment instrument.

**Population growth in Minsk increases parking demand.**

The parking industry in Belarus is showing stable and sustainable growth. From 2018 to 2021, the industry grew at a compound annual growth rate of 3.3%, which is expected to continue into the future. Meanwhile, city parking assets are likely to fare better as new construction increases the population of city centers and reduces the supply of parking spaces. Over the past few decades, Belarus has experienced strong urbanization trends that are projected to continue.

First the demographic tendency in Belarus and in Minsk city in particular should by analyzed. The World Bata Database provides the following demographic information about population ages 18–59 in thousands. It is approximately 71% of all population in Minsk [Figure 2.1].

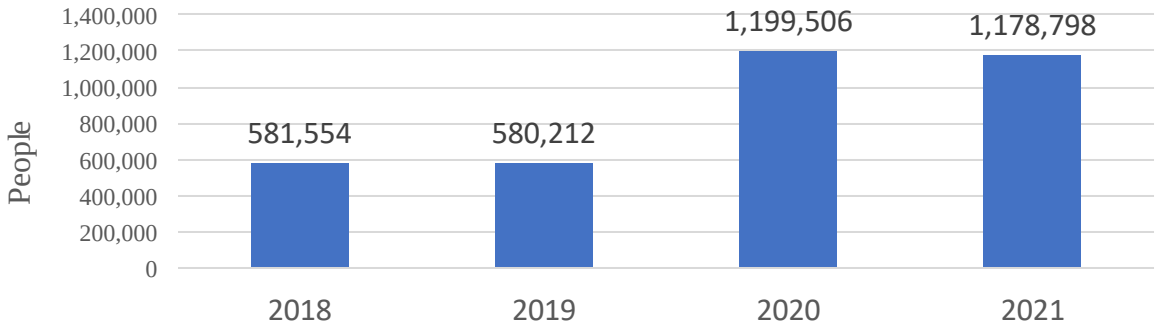



**Figure 2.1 – Population ages 18–59 2018–2021**

**Note – source: own developed from [9]**

We can conclude that the general population growth aged 18–59 has a growing tendency in the Minsk.

Secondly, necessary to say that there is a tendency for population to move to the cities. The Figure 2.2. shows the growth of the urban population in comparison to the rural one.

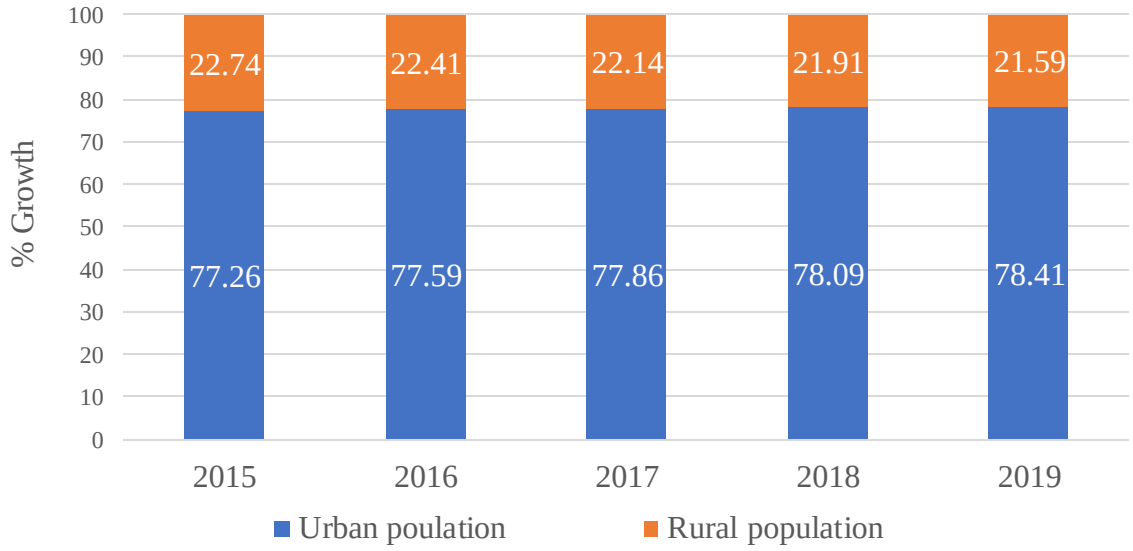
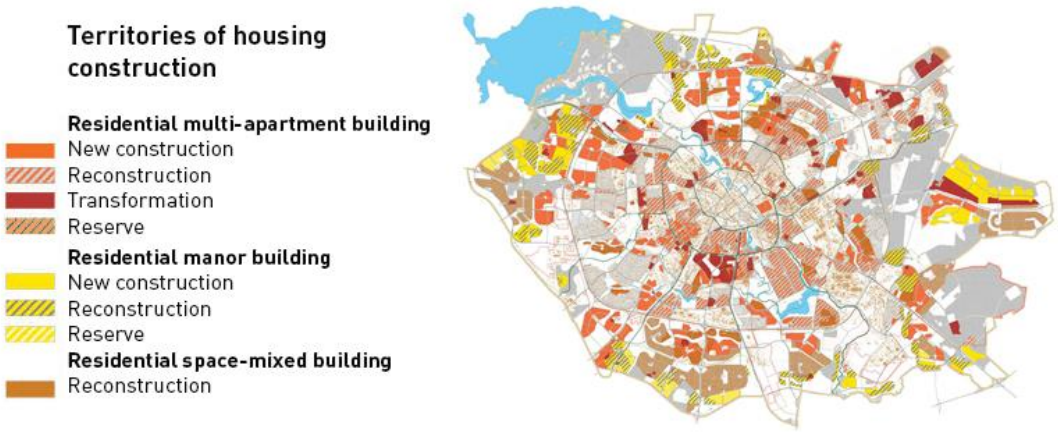



**Figure 2.2 – Urban vs rural population growth in Belarus, 2015–2019**

**Note – source: own developed from [10]**

Thirdly, Minsk is the most densely built–up city among European million–plus cities, it is in 11th place in the world in terms of building density, in comparison with Singapore and Bangkok, which are in 9th and 10th places, respectively. [13]




**Picture 2.1 – Growth of new construction in Minks**

**Note – source: from [11]**

The emergence of new districts and the compaction of the current development leads to a serious reduction in the supply of parking lots. In 2021, it was planned to build 600,000 square meters of new space in Minsk. Despite the general downward trend in construction, Minsk still remains the second after the Minsk region in terms of growth rates.

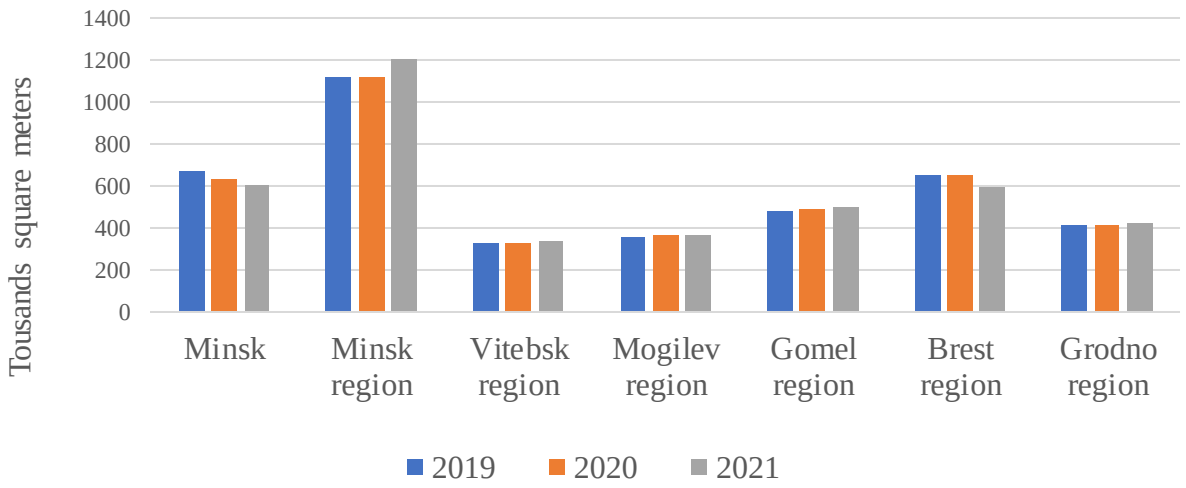



**Figure 2.3 – Growth dynamics of construction in Belarus**

**Note – source: from [12]**

## Dynamic of cars provision for the population.

Belstat published statistics on the provision of cars to the population by regions per 1000 people.

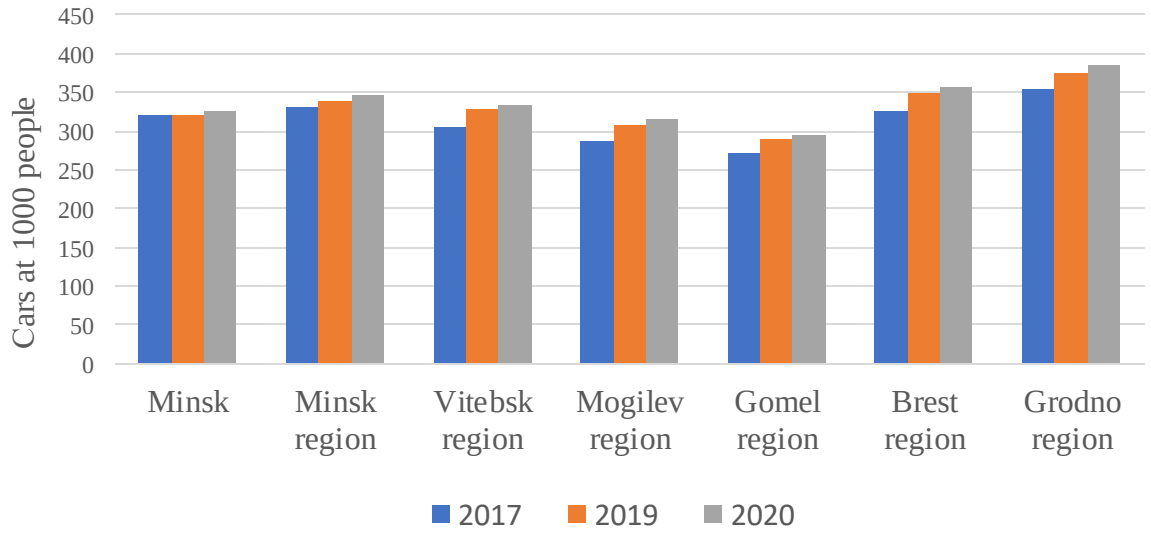



**Figure 2.4 – Provision of cars to the population by regions per 1000 people**

**Note – source: own developed from [10]**

Data on the provision of the population with cars by regions (in thousands of cars). It can be seen that the number of cars in private ownership in Minsk is consistently high, equal to the number of cars in the entire Minsk region.

**Dynamics of the purchasing power.**

The purchasing power of the population correlates with income and can stimulate consumption. So, the next step is to analyze the dynamics of the purchasing power of the population and assessment of its impact on the development of trade and services industry.

The condition of the consumer market in Belarus can be characterized as stable with a high level of saturation. The increase in real incomes of the population is expanding consumer demand. The purchasing power of the population correlates with income and can stimulate consumption. So, the next step is to analyze the dynamics of the purchasing power of the population and assessment of its impact on the development of trade and services industry.

Real disposable income is determined based on cash income of the current period minus mandatory payments and contributions adjusted for the consumer price index. Real disposable income of the city of Minsk as a percentage of the corresponding period of the previous year has declined from 108,2% in the year of 2018 to 107,4% in 2019. The negative dynamics of the standard of living was fixed 2.5 years: from January 2015 to January — July 2017. So, from 2017 general tendency can be considered as positive one. [10]

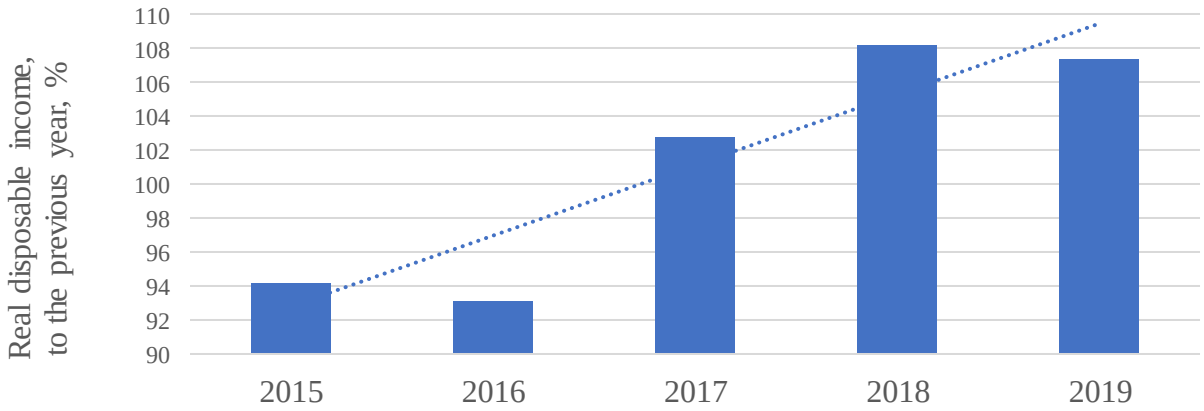



**Figure 2.5 – Real disposable income**

**Note – source: own developed from [10]**

The dynamic of GDP per capita based on purchasing power parity in Belarus is illustrated on Figure 2.6.

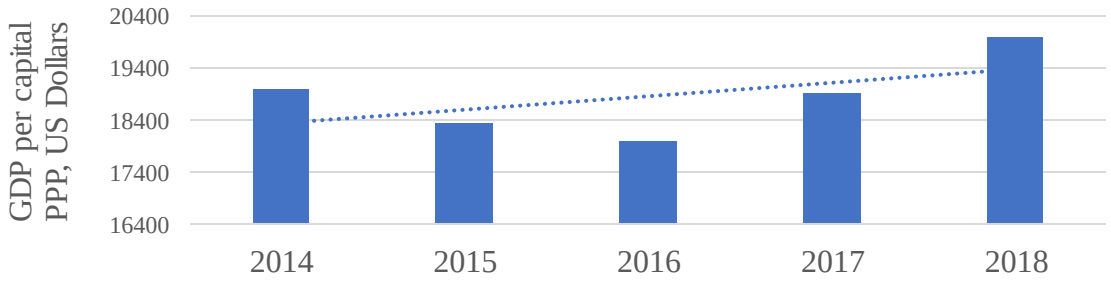



**Figure 2.6 – GDP per capita, PPP (current international $) in Belarus years 2014–2018**

**Note – source: own developed from [10]**

## Dynamics of Growth paid parking spaces in Minsk and the collection rate.

The city budget receives 170,000–180,000 rubles a month from paying for paid parking lots in Minsk. This amount is called the percentage of collection, since not all parking bills are paid due to the fact that at the moment there is no liability for non–payment of parking. Along with the lack of control over the process, within 5 years the number of paid parking spaces in Minsk has grown from 1,336 to 5,000 and it is planned to expand to 7,000 spaces.

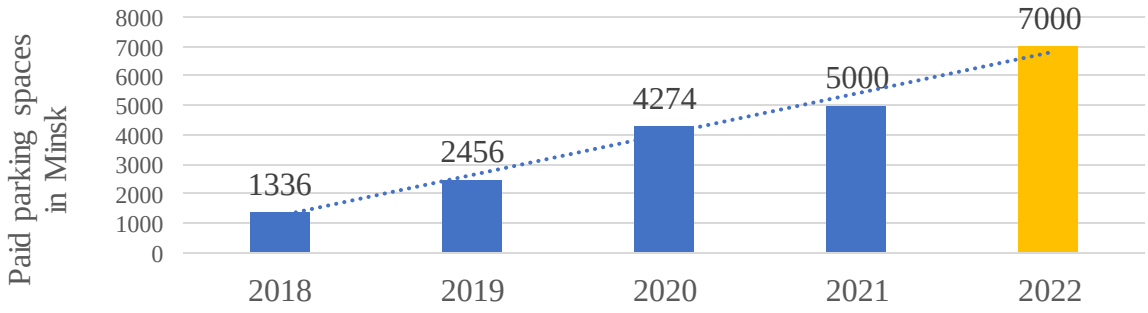



**Figure 2.7 – Growth dynamics of paid parking spaces from 2018 to 2021 with an expansion plan for 2022**

**Note – source: own developed from [10],[14],[15]**

The collection rate from 2017 to 2019 did not exceed 80%, and starting from 2020 it began to decline sharply and currently stands at only 35%. Thus, 180 thousand rubles is 35% of the total amount collected. To solve this problem, Decree No. 589 [16], which regulates liability for non–payment for parking, is currently being negotiated. It will enter into force in 2022. When liability for non–payment of parking spaces is introduced, the collection will increase. At the moment, 20 parking inspectors control this segment of the service sector using an application on a tablet. In the graph below,

the real collection rate of payments is marked in blue, and above it, its possible potential.

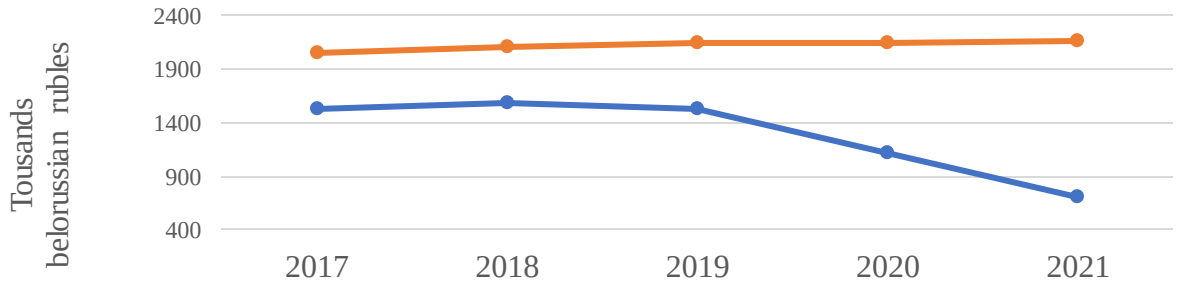



**Figure 2.8 – Actual parking fee collection (blue) in Minsk and possible potential (orange) if the collection control process is adjusted between 2017 and 2021**
**Note – source: own developed from [10], [14], [15]**

### 2.1.2 Smart Parking market.

The global market for smart parking systems will reach $10.3 billion by 2025, according to a report by Grand View Research. The growth of the market will be driven by government initiatives and increased public funding for the deployment of traffic congestion solutions.

In 2018, the hardware segment prevailed in the vertical market due to the decisive role of the supply of components that detect vehicles in parking spaces.

Municipalities face the challenge of securing sufficient parking space as the number of cars continues to grow. As a result, the demand for smart parking systems around the world is increasing. These systems are able to effectively solve the problems associated with urban traffic jams, as well as those arising from a lack of space. They also create opportunities for the reuse of commercial and municipal areas and garages, thereby reducing fuel consumption, reducing harmful emissions and subsequently improving the urban ecosystem.

However, experts expect that factors such as a looming lack of financial initiatives, as well as organizations' awareness of the benefits associated with smart parking, especially in underdeveloped regions, will constrain market growth during the forecast period.

It is expected that in the forecast period there will be an increase in the consumption of consulting services. Consulting services include analysis of the volume of traffic that needs to be managed and recommendations for implementing the necessary solutions according to needs.

The off–street (free–standing multi–story and single–story) parking segment has dominated the smart parking system market, as off–street parking offers the introduction of simple and fast payment and parking solutions that are able to distribute coupons automatically, thereby reducing congestion at the entrances. The growing need for driving and minimizing fuel emissions will lead to the widespread adoption of smart parking systems in the public sector.

In 2018, the European region accounted for over 30% of global revenues. Experts predict that the continued interest of regional car manufacturers in the development of smart parking systems will also contribute to the growth of the regional market.

It is expected that car delivery services to the parking point at the request of the client, combined with the growing need for the installation of control systems in public places, including shopping malls and sports complexes, will drive the demand for smart parking in the global market.

Among other companies, the key players in the market are: Amano McGann, Inc.; Cisco Systems, Inc.; Conduent, Inc.; SKIDATA AG.; Streetline, Inc.; Park mobile LLC; Park Me, Inc.; Robert Bosch GmbH; and Nedap N.V.

Table 2.1 – Main characteristics of the industry.

| **Parameter** | **Characteristics** |
|---|---|
| Market growth rate | According to Belstat and estimates by experts in this field, market operators, the volume of the car park market in 2021 amounted to 4 million rubles, and increase of 1.6% compared to 2020. [10] |
| Life cycle stage | Growth |
| Number of competitors in industry | Around 30 (5000 places) |
| Customers | 1178798 – Population of the city of Minsk aged 18 to 60 years in 2021 |
| Easy to enter/exit | Moderate |
| Product characteristics | Mostly common |
| Economy of scale | Existing on purchase volume level |
| Iindustry profitability | About 25% |

Having some idea about current situation in the market the PESTEL analysis can be added to the complete the picture of the external environment that can affect the strategy of the future company.

PESTEL analysis involves the collection and portrayal of information about internal and external factors which can impact or already have impacted the business.

PESTEL analysis involves consideration of four basic areas: Political, Economical (Economic), Social, Technical, Environmental, Legal.

Thus, this analysis allows us to look at the influence of the external environment on the company's activities from all sides.

Full PESTEL evaluation Matrix is available in APPENDIX A.1. In a table below are the results and forecast for 3 years.

Table 2.2 – Results of PESTEL evaluation Matrix.

| **Factors** | **t** | **t+3** |
|---|---|---|
| Political | 0,86 | 0,96 |
| Economical | 0,55 | 0,64 |
| Social | 0,64 | 0,64 |
| Technological | 0,36 | 0,56 |
| Environmental | 0,16 | 0,16 |
| Legal | 0,8 | 0,8 |
| **Total** | **3,37** | **3,76** |

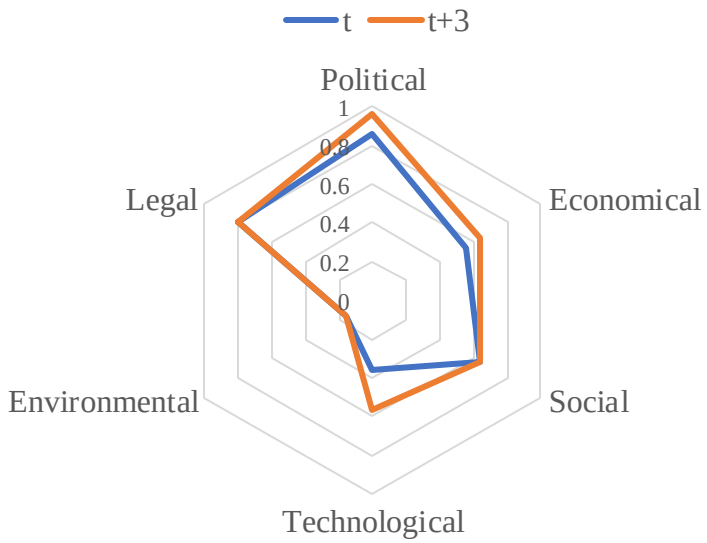



**Figure 2.9 – PESTEL factors dynamics**

## Conclusion.

The overall result we have to compare with the value 3.0. If the value is less than 3.0, then the company cannot cope with threats and use opportunities at an acceptable level, if 3.0 and above, then the company's current strategy allows us to cope with threats and use opportunities. Current result is 3.37.

Based on the analysis of external factors affecting the company, it can be also concluded that in the current situation, social factors such as lifestyle trends are favorable, there is potential for growth and gaining market share with further development.

**Technological factors.**

- Technological factors, overwhelming digitalization is forcing business implement modern technologies.

**Social factors.**

- We must pay some attention to the growing power of the sustainability trend and educate citizens.

**Economical.**

- Since the beginning of 2020 do not give a bright picture of any opportunities in terms of customer purchasing power, especially given the epidemiological situation in the world at the beginning of 2020.

According forecast, in 3 years company will:

**Technological.**

- Have an experience about internet channel that required for stability of working service supporting infrastructure and will improve weakness points.
- Understand how to handle better with obsolescence of software and equipment.

**Political.**

- Company will follow the price dynamics of necessary equipment and the ways to buy them. This will help company to handle with the foreign trade regulation threat better.

**Economical.**

- The introduction of a flexible pricing system for paid parking may partially compensate for losses due to rising inflation.

The expected result in three years for the external factors analysis matrix is: 3.76.

## 2.2. Market research.

In order to carry out a digital transformation of the service, it is necessary to assess the quality of the existing service, determine what drivers are not happy with at the moment and to what extent they are ready to increase prices for the paid parking service in Minsk.

The world statistics of paid parking research has a wide range of data on the topic of parking in big cities [19], but not in any of them Minsk no secondary information is mentioned and there is no secondary information, therefore, in addition to the direct purpose of this study – obtaining data for the digital transformation of the paid parking

service in Minsk, the secondary goal is also to supplement the statistical studies of parking lots in big cities of the world.

There are the following uncertainties regarding paid parking in Minsk:

1. It is not known how many drivers using paid parking in Minsk, pay the invoice for the service.
2. It is not known how drivers evaluate the quality of the paid parking service in Minsk.
3. It is not known how many drivers are aware of the absence of administrative responsibility for non–payment of paid parking in Minsk.

I assume that:

1. About 70% of drivers do not pay for paid parking services in Minsk.
2. More than 50% of drivers consider paid parking affordable and the quality of service is average and above.
3. More than 70% of drivers are aware of the absence of administrative responsibility for non–payment of paid parking in Minsk.

I plan to explore the uncertainty and confirm or refute the hypotheses put forward and, based on the findings, draw up a plan for the digital transformation of the service and a marketing strategy.

Study units: People; Access: Community based; Nature of factors: Individual and nature; Allocation: Drivers; Timeline: Retrospective; Research base: Drivers; Data type: Primary.

Quantitative Research. Type: quantitative; Descriptive study: Prevalence surveys, Analytic study: Observation studies;

Qualitative Research. Type: qualitative; Descriptive study: Interview, Analytic study: Observation studies;

The most multiuse, effective and widespread research method are interview and a survey. Three experts from the Minsk City Executive Committee will be invited for the interview. For survey, the most convenient and effective way to conduct it will be the type of questionnaire through electronic forms of google.

The selection of participants took place at the address: Moskovskiy Trakt 2, Minsk 223049 in the lobby of the Minsk Registration Department of the traffic police. This place always has an organized electronic queue of 80 – 120 people who register or re–register their car. The waiting time in such a queue can be from 2 to 7 hours.

Participants for the survey were selected through a personal invitation to take part if the person had a driver's license, an electronic queue coupon and a residence permit in Minsk.


**Picture 2.2 – Minsk Registration Department of the traffic police. Moskovskiy Trakt 2, Minsk 223049**

It is also necessary to resolve the issue of sample size, which determines the number of units studied, since the target audience is large and cannot be fully covered during the study.

The sample was calculated using an online calculator with the following parameters:

- 95% confidence level
- error 3%
- The population aged 18 to 59 is 1,178,798.

The required sample size was 1066 people.

### 2.2.1 Qualitative research.

In a qualitative study, I want to make a portrait of the driver and his behavior, as well as find out why drivers do not pay for paid parking and what factors they consider decisive if they decide to pay.

I conducted in–depth interviews with five parking experts. I tried to select experts from different areas of the parking business in order to get the most complete picture in this area. Thus, I interviewed experts with main aim to get answers to the following questions:

1. Which factors influence driver to pay for a paid parking?
2. Why drivers don't pay paid parking?
3. What characteristics of paid parking are of paramount importance for drivers?
4. What problems with the service exist at the moment?
5. What is the biggest disadvantage of Smart Parking?

Based on the results of the interview, the answers where found. Questions are in APPENDIX A.2

The most significant information:

1. Fear of punishment; social responsibility;
2. Drivers save; Drivers understand that they may not pay and use this in the absence of a supervisory employee in a paid parking lot;
3. Availability; Quality of service;
4. There is no automation of the process of monitoring the parking time, which entails an increase in the percentage of unpaid hours;
5. The service life of equipment for video analytics is on average no more than 6 years, which means that every 6 years it is necessary to re–finance the infrastructure almost in full;

### 2.2.2 Quantitative research.

The purpose of quantitative research:

– make a portrait of the driver who uses paid parking,

and also find out answers on the questions:

1. How many drivers don't pay for paid parking service in a regular base;
2. How many drivers consider the parking service acceptable;
3. How many drivers know about the possibility not to pay for parking;
4. How many drivers believe that the main factor influencing their choice not to pay paid parking is the lack of control;

Checking the correspondence of the questionnaire questions with the search questions. – APPENDIX A.3.

### 2.2.3 Customer analysis.

A customer analysis is an essential section of a company's business plan and marketing plan. It identifies target customers' needs and specifies how the product will satisfy these needs.

**Customer analysis should go through three stages:**

– customer profile (portrait identification);
– customer needs identification;

– to bridge target customer group and their needs in order to find the way to meet these needs.

Drawing the customer portrait let's look to the research results. The distribution of respondents by gender is shown in diagram below:

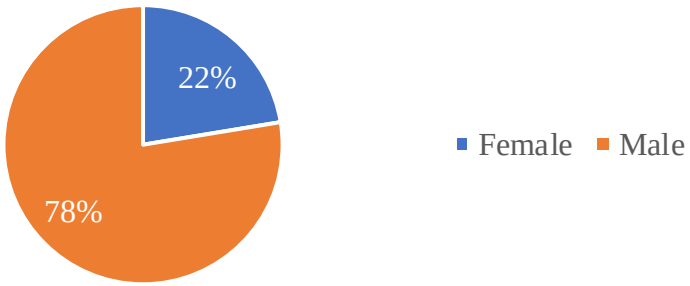



**Figure 2.10 – Distribution of respondents by gender**

According to the research female respondents are 22% and male respondents are 78%. Age distribution among respondents is shown in pie chart below:

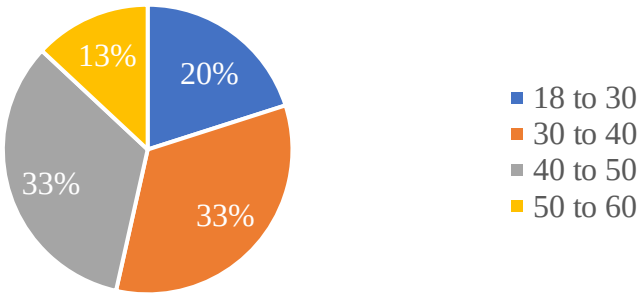



**Figure 2.11 – Age distribution of respondents**

The research shows that 33% of the respondents are in from 30 to 40 age category and from 40 to 50 age category, 20% – from 18 to 30 age category, 13% – from 50 to 60 age category.

To draw the customer portrait, we have also look on to the level of income of future consumers. The visualization of the distribution of respondents by level of income per person in the family per month below.

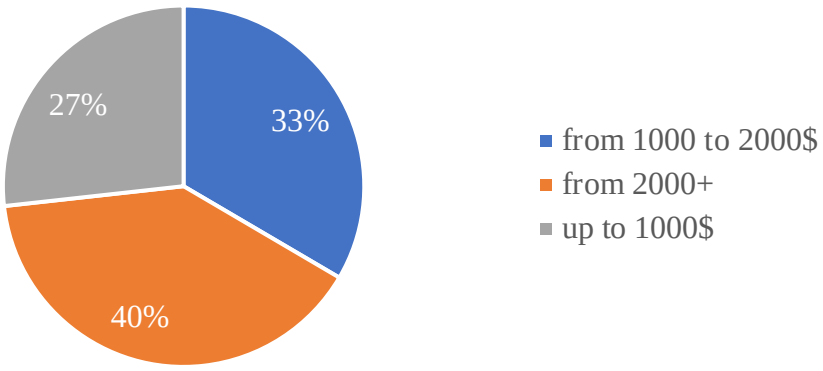



**Figure 2.12 – Distribution by level of income per person on the family per month**

Key customer groups can be divided as follows:

– Men
– Age from 30 to 50
– Income from 1000$ to 2000$ and more
– living in the densely populated residential area of the city.

Now we have to bridge target customer group and their needs in order to find the way to meet these needs and show benefits.

Table 2.3 – Behavioral segmentation and target audience. Benefits.

| Service | Target audience | Benefit | Needs satisfied |
|---|---|---|---|
| 1. Parking.<br>2. Searching an available space. | 1. Geographic: Minsk.<br>2. Demographics: men aged 18-49;<br>3. Socio-economic: working, with an average and above average income.<br>4. Psychographic: success-oriented thinkers are open to new ideas, are active consumers, value useful experience. They lead a technological lifestyle.<br>5. Behavioral: motivation based on the pursuit of the ideal. When considering the purchase of a service, first of all, they prefer a stable and reliable service. | Saving time;<br>Safety of property; | 1. The need to come as much closer to destination point as possible with minimum time spending on parking;<br>2. The need to keep property safe. |

Lets analyze the demand of core services according to research results. What concerned parking service it is expected to be demanded as we can see it from the research results. According to research results 43% of respondents need parking from 17:00 to 22:00, 28% – from 8:00 to 10:00 and 29% – from 8:00 to 10:00:

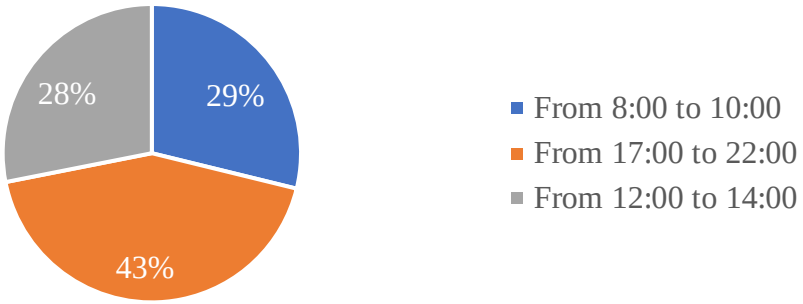



**Figure 2.13 – Distribution by time drivers need parking**

As a result of the customer analysis the target audience was determined, customer portrait was drawn and customer needs were connected to the core services demand which are meet these needs.

**Simple and Cross tabulation analysis.**

**How many drivers park in an open paid parking without a barrier, but do not pay for the service?**

Table 2.4 – Hypothesis.

| | |
|---|---|
| **Hypothesis** | About 70% of drivers do not pay for paid parking services in Minsk |
| **Result variable** | Number of positive responses |
| **Primary exposure factor** | Lack of external control over payment |

**Simple tabulation analysis of how often drivers pay for parking.**

"How often drivers pay for paid parking?" research result table in APPENDIX – A.5

According to the survey results, only 40% of drivers do not pay for paid parking without a barrier.

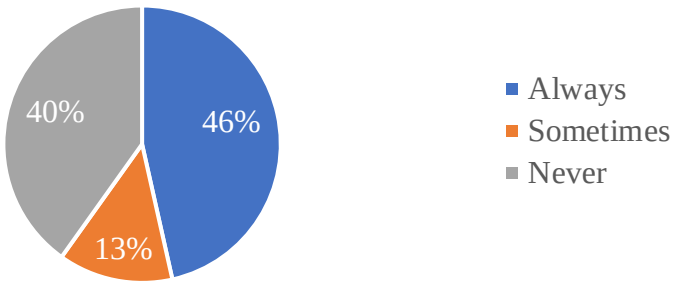



**Figure 2.14 – Actions of drivers in relation to paying for paid parking as a percentage**

**Checking data.**
Calculations for checking data – APPENDIX A.6

**Cross tabulation analysis of Variables: "Do drivers know about lack of liability" and "How often drivers pay for a parking".**

Cross Table of Data: Variables: "Do drivers know about lack of liability?" and "How often drivers pay for a parking?" research result table in APPENDIX – A.11

64% of Drivers who are aware of the lack of administrative responsibility do not pay for open paid parking without a barrier. 14% of drivers who do not know about the absence of administrative responsibility do not pay for open paid parking without a barrier.

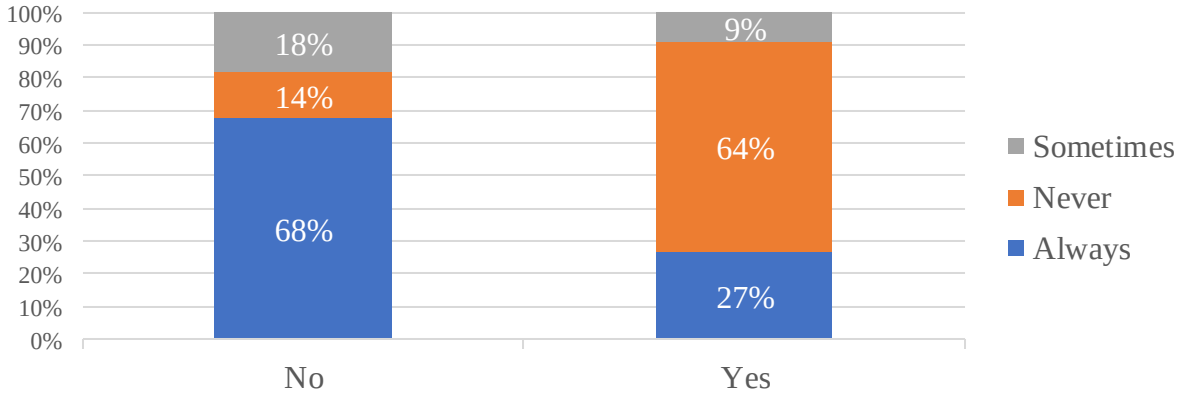



**Figure 2.15 – Cross Table of Data: Variables: "Do drivers know about lack of liability" and "How often drivers pay for a parking"**

**Checking data.**
Calculations for checking data. – APPENDIX A.12

**Cross tabulation analysis of Variables: "Payment frequency" and "The factors that decisive for the drivers when they pay for paid parking".**

Cross Table of Data: Variables: "The frequency of drivers' payments for paid parking" and "The factors that decisive for the drivers when they pay for paid parking". research result table in APPENDIX A.17

Among the drivers who always pay for paid parking without a barrier, 42% chose "External control" as the decisive factor influencing the payment. Among the drivers who sometimes pay for paid parking without a barrier, 100% chose "Social Responsibility" as a decisive factor influencing the payment. Among drivers who do not pay paid parking without a barrier, 33% chose "Social responsibility" as a decisive factor influencing the payment and 67% chose "Fear of punishment" as a decisive factor influencing payment.

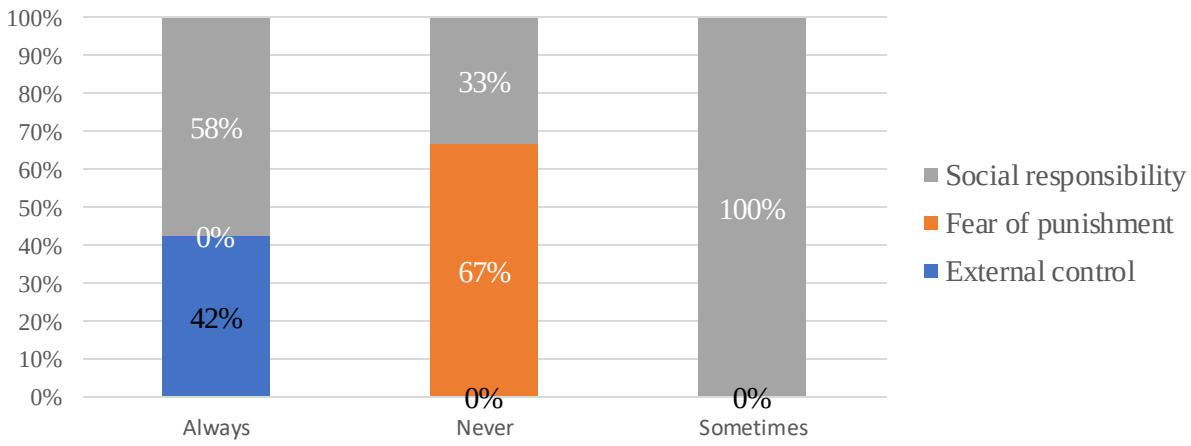



**Figure 2.16 – Cross Table of Data: Variables: "How often driver pay for parking" and "What factor is decisive for the drivers when they pay for paid parking?".**

**Checking data.**

Calculations for checking data – APPENDIX A.18

**Conclusion.**

According to the results of the survey analysis, the hypothesis that "About 70% of drivers do not pay for paid parking services in Minsk" was not confirmed. Less than half of all drivers surveyed do not pay for paid parking without a barrier.

64% Of drivers who do not pay are aware of the lack of administrative responsibility and do not pay consciously.

The most significant factor that influences drivers' decision to pay for parking, or not to pay, was called "Social Responsibility". For drivers who never pay, the main factor of influence is the fear of punishment. This choice means that the penalty in the form of a fine that cannot be paid is not significant for drivers.

**How many drivers rate the quality of paid parking service as average or higher?**

Table 2.5 – Hypothesis.

| | |
|---|---|
| **Hypothesis** | More than 50% of drivers consider paid parking affordable and the quality of service is average and above. |
| **Result variable** | Number of positive responses |
| **Primary exposure factor** | – |

**Simple tabulation analysis of drivers' opinion according current service quality level.**

Drivers' opinion according current service quality level result table in APPENDIX A.23

36% Of Drivers rated the quality and availability of parking at 2 points. And 18% rated the quality and availability at 1 point.

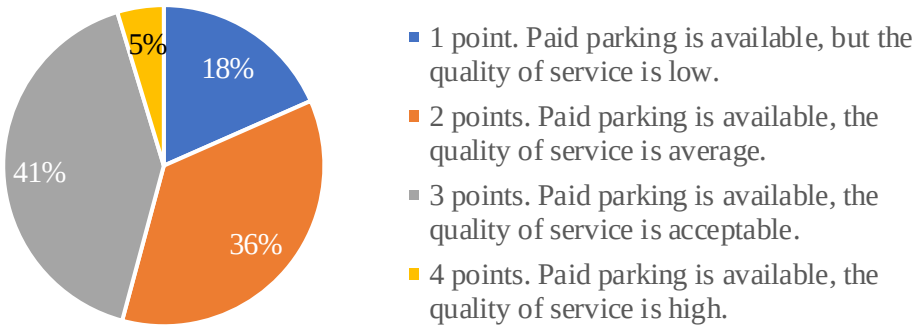



**Figure 2.17 – Drivers' opinion according current service quality level**

**Checking data.**

Calculations for checking data – APPENDIX A.24

**Conclusion.**

The hypothesis "More than 50% of drivers consider paid parking available and the quality of service is average and above" is correct, as 82% of all drivers perceive it this way.

When selecting candidates for the survey, 100% of respondents indicated that they use paid parking on a regular basis, so I don't consider such a factor as "frequency of using the service", which can affect the resulting variable, because. I am only interested in the opinion of drivers who regularly use the service.

**Do you know that at the moment there is no administrative liability for non–payment of a parking fine in Minsk?**

Table 2.6 – Hypothesis.

| | |
|---|---|
| **Hypothesis** | More than 70% of drivers are aware of the absence of administrative responsibility for non–payment of paid parking in Minsk. |
| **Result variable** | Number of positive responses |
| **Primary exposure factor** | Reluctance to tell the truth. |

**Simple tabulation analysis of awareness of drivers that there is no administrative responsibility for non–payment of parking fines in Minsk.**

"Awareness of drivers that there is no administrative responsibility for non–payment of parking fines in Minsk" result table in – APPENDIX A.29

52% Of drivers do not know that there is no administrative responsibility for non–payment of fines for paid parking.

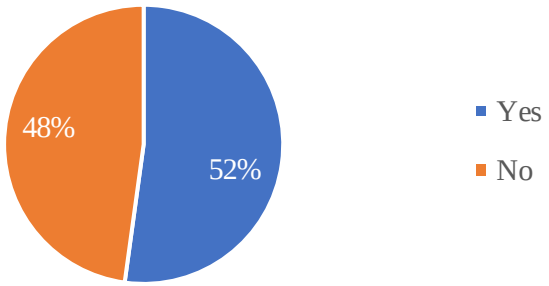



**Figure 2.18 – Awareness of drivers that there is no administrative responsibility for non–payment of parking fines in Minsk**

**Checking data.**

Calculations for checking – APPENDIX A.30

**Conclusion**.

The hypothesis that "More than 70% of drivers are aware of the absence of administrative responsibility for non–payment of paid parking in Minsk." Not true. 52% of drivers do not know that there is no administrative liability for non–payment of fines for paid parking.

### 2.2.5 Competitors analysis.

At the moment, there are about 150 private parking lots and car parks in Minsk. I evaluated the advantages and disadvantages of the competitors and displayed them through a table of weighted ratings.

**Competitor Weighted Scoreboard.**

Table 2.7 – Competitor Weighted Scoreboard.

| | Importance | Weight | Parking Gravitas | Parking Avtovek | Parking Dialogue |
|---|---|---|---|---|---|
| Location | 1 | 20% | 8 | 7 | 7 |
| Parking price | 2 | 19% | 9 | 6 | 7 |
| Working hours | 3 | 18% | 8 | 9 | 9 |
| Security | 4 | 17% | 9 | 8 | 8 |
| Staff | 5 | 16% | 7 | 7 | 8 |
| Fences | 6 | 10% | 9 | 9 | 9 |
| **Total** | | **100%** | **8,3** | **7,54** | **7,89** |

A comparative analysis of competitors' pricing policy was also carried out. Results are provided in the table below.

Table 2.8 – Competitors' pricing.

| Name of product | Parking Gravitas | Parking Avtovek | Parking Dialogue | Average retail price of competitors | Minimum retail prices of competitors |
|---|---|---|---|---|---|
| Subscription for 1 month | 45 | 50 | 40 | 45 | 40 |
| Subscription for 7 days | – | – | – | – | – |
| Subscription for 1 day | – | – | – | – | – |
| 1 hour | 1 | 1 | 1 | 1 | 1 |

### 2.2.4 Swot analysis.

Considering a SWOT analysis, it is to understand where we stand compared to our direct competition. This includes reviewing:

– the strengths of the other businesses;
– the weaknesses of the other businesses, over which we has an advantage;
– the opportunities that exist in the external market that we can partake in;
– the threats that exist in the market.

SWOT analysis is given in the Table below.

Table 2.9 – SWOT analysis.

| N | Strengths | Weaknesses |
|---|---|---|
| **1** | Best locations in Minsk. | High service support costs. |
| **2** | State control over the price. | Strong dependency from equipment; |
| | **Opportunities** | **Threats** |
| **1** | Decree, which regulates liability for non–payment for parking, is currently being negotiated. It will enter into force in 2022. When liability for non–payment of parking spaces is introduced, the collection will increase. [16] | Increasing taxes on car imports. |
| **2** | It is declared that the budget–tax is aimed at improving the efficiency of using budget funds and their concentration in priority areas of socio–economic development while maintaining the social orientation of budget expenditures and increasing their share for innovative development. [18] | The amount of data transmitted in real time and the number of calculations required is really large and requires high powers and speeds. In the event of a drop in speed, the smart paid parking service may lose its relevance. |

Tows table is a table that represents crossing of points from SWOT matrix, where each cell includes actions that would be done in each particular point. TOWS analysis table – APPENDIX A.35

### 2.2.5 Suppliers analysis.

Analysis of suppliers is aimed at identifying those aspects in the activities of entities supplying the organization with various types of equipment, information resources.

Analysis of potential suppliers is carried out on the basis of the study of the most important supply quality criteria:

– quality of the delivered goods/ services;

– the number of nomenclature units in the purchased assortment matrix of the supplier.

– quality of supply;

– financial benefits;

– quality of communication with the supplier.

All suppliers can be divided in to 2 groups according to the service or product supplied.

In the table below there are suppliers' groups and core requirements.

Table 2.10 – Suppliers.

| Type of service | Provided Supplier type | Requirements | Criteria For analysis |
|---|---|---|---|
| Equipment and software | Private owners,<br>Security companies,<br>Software companies. | – Reliable | – Price<br>– Payment terms<br>– Rental period |
| Support | Security companies | – Stable quality | – Price |

The choice of supplier is an important thing because the business strongly depends from reliable equipment and trouble proof technologies. High quality, safety of data – the most important criteria.

**Porter's Five analysis.**

To overcome the challenge of finding a way to build a sustainable competitive advantage over the competitors in the market Porter Five Forces model will help.

Table 2.11 – Porter's Five model analysis.

| | Availability assessment | Assessment of the negative impact | Parry options | t | t+3 |
|---|---|---|---|---|---|
| Existing competitors | 10 | 2 | 9 | 3 | 3 |
| Threats of new players | 8 | 2 | 9 | 1 | 1 |
| The threat of substitutes | 8 | 7 | 7 | 8 | 6 |
| Supplier Power | 8 | 7 | 3 | 12 | 12 |
| Buyer Power | 9 | 7 | 6 | 10 | 8 |

The most significant threats to the company are:

– The strength of suppliers, as 100% of the entire business process depends on the reliability of equipment, software, technical support and response to problems.
– The power of buyers, as drivers are extremely sensitive to the price of parking and when the price increases, buyers will go to competitors.
– Within three years, we expect that the experience gained will allow us to find the most reliable suppliers, but the power of their influence on the business will remain critical.
– Over the next two years, Minsk is planning to build an additional 2,000 paid public parking spaces, and this will reduce the power of substitutes.
– The economic crisis associated with the coronavirus and the geo–political situation will not allow the strength of new players to increase.
– Since the state can set limits, including on private paid parking lots, this can reduce the power of buyers by adjusting prices for private parking lots.

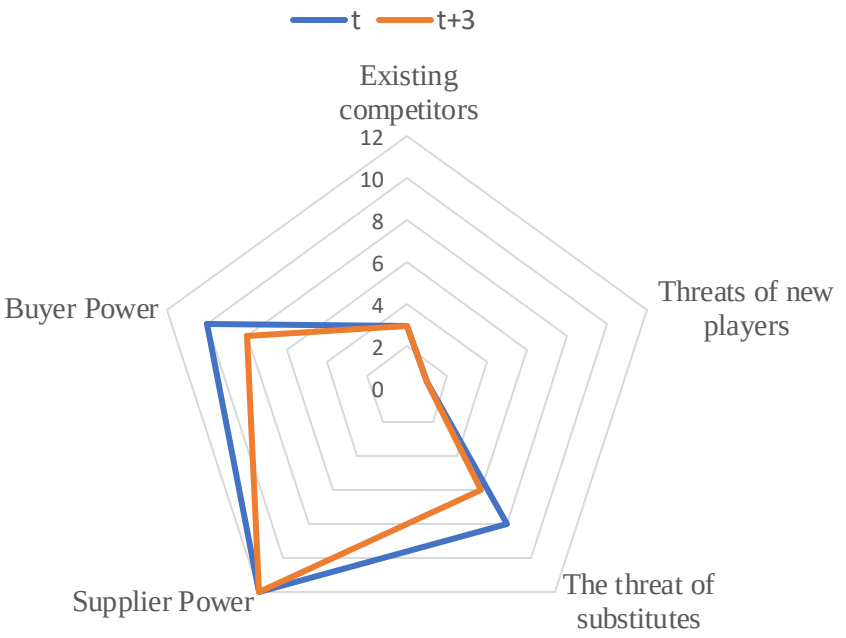



**Figure 2.19 – The change of different power growth in perspective of three years**

# CHAPTER 3
# PLANS AND CALCULATIONS.

## 3.1 Digital transformation of a service.

### Strategic analysis of companies' activities.

Strategic analysis of companies' activities involves the use of various structural tools. To analyze the company's activities, blocks of the business model canvas were used Osterwalder. Company's Activity by Osterwalder Business Model. – APPENDIX B.12.

### Analysis of digital transformation processes.

To analyze the processes of digital transformation in this project, it is proposed to apply the perspectives of the strategic map of the Balanced Scorecard (BSC) by R. Kaplan and D. Norton, with the division of its section «Development», in connection with digital transformation, into two groups – «Personnel» and «Technology». Thus, within the framework of the model, sections are considered: Finance, Clients, Processes, Personnel and Technologies.

In the context of strategic management, KPIs (Key performance indicators) – key performance indicators – are identified in the following blocks: customer satisfaction and experience, service quality, net profit and profitability, return on investment, cost control, productivity and flexibility, business process efficiency, innovation.

By combining the modified strategy map with KPI, a digital transformation model was obtained. Model of digital transformation within the framework of the modified strategic map of R. Kaplan and D. Norton. – APPENDIX B.2.

### Digital strategy.

In this project, the Digital Strategy is considered as an independent functional strategy as part of the overall corporate strategy.

The chosen model implies the creation of a portfolio of digital projects without affecting the main business processes. At the same time, projects are separated into separate business units.

This model, from the point of view of loss of value, is one of the safest, because:

- involves the phased introduction of technologies;
- due to the focus on a specific business unit, it allows more accurately, relative to other models, to evaluate the effect. The cost of exiting a project is almost always known in advance and is equal to the amount of investment in the digitalization of a business unit;
- reduces the risk of setting the interests of the core business over a digital project.

With the successful implementation of pilot projects in the main business areas, the logical transition from the digitalization of individual business units is the creation of a fully digital company.

According to the connection between the target settings of the company's market behavior and the digital transformation strategy chosen by it, the category «Innovators» corresponds – companies focused on building new competencies for business modernization.

Table 3.1 – Key Features of Digital Transformation Models.

| Model of digital transformation | Type of company by transformation goal | Connecting digital and corporate strategy | Critical factor in order of importance |
|---|---|---|---|
| Phased implementation of technologies through the allocation of digital projects into separate business processes | «Innovators» | The digital strategy is seen as a functional strategy as part of the overall corporate strategy. | 1. Personnel<br>2. Technology<br>3. Processes<br>4. Clients<br>5. Finance |

**Analysis of factors of the internal and external digital environment.**

Digital transformation processes – from developing a strategic plan to the actual implementation of digital projects and evaluating their effectiveness are closely correlated with the internal business environment and depend on the environment of the company, its digital environment. To assess the company's internal environment in terms of readiness for digital transformation, the Digital Maturity and Digital Readiness models developed by Gartner, McKinsey, Deloitte, Ernst & Young and others are used.

Digital maturity shows the ability of a business to respond to the challenges of the digital environment and is assessed according to the following parameters: the presence of a strategy, the technologies used, customer focus, and the use of analytics.

The analysis of data from open sources makes it possible to classify the existing models of digital maturity according to the prevailing factors, with the change of which the process of digital transformation begins. In the case of this project, the Digital transformation maturity assessment will be assessed through the "Clients" and "HR" approaches. Models of digital maturity (by groups of factors) – APPENDIX B.3.

As factors of the external environment, will be consider the development of digital technologies: in a country, city or region, industry, business ecosystem.

## 3.2 Marketing plan.

Make a marketing strategy, plan and develop a business strategy plan of action and goals must be understood.

The business objectives for the first 3 years are as follows:

1. Profit targets
   – Return on investment after 12 months.
   – Income from sales of at least 30% per month.
2. Image goals.
   – Creation of the company's image associated with manufacturability, high quality service and safety.

Company mission: We provide affordable parking, high quality service and safety on the road.

Vision: Better service quality through transformation and innovation.

The marketing goals of the company to achieve business goals are:

– Increasing customer loyalty.

– Increasing the frequency of service consumption.

A marketing plan is a direct and specific guide to action. The plan explains how we are going to achieve our goals. This is a kind of road map that will lead to the final destination. The STP model is useful for creating a marketing communications plan as it helps us prioritize and then develop and deliver personalized and relevant messages to reach different audiences.

The company offers two main services:

– Search for a parking space through a mobile application;

– Automatic parking registration;

Table 3.2 – STP.

| Score service | Segmentation | Targeting | Positioning |
|---|---|---|---|
| Searching available parking place through the app | 1. Geographic: Minsk.<br>2. Demographics: men aged 18-49;<br>3. Socio-economic: working, with an average and above average income.<br>4. Psychographic: success-oriented thinkers are open to new ideas, are active consumers, value useful experience. They lead a technological lifestyle.<br>5. Behavioral: motivation based on the pursuit of the ideal. When considering the | People who are going to work close to center of Minsk from residential areas;<br>People, who take their cars during lunch for leisure or short trips. | Hi–technology; available, reliable and secure parking |
| Parking service visit | | | |

| | | | |
|---|---|---|---|
| | purchase of a service, first of all, they prefer a stable and reliable service. | | |

What will be the result of the customer after contact with advertising? The choice of the type of advertising, the promotion channel and the frequency of contacts depends on them.

The goal of communication is to increasing the level of knowledge and recognition of the service provided.

The marketing plan includes internet marketing, events, advertising campaigns and other areas.

To achieve marketing goals, the following promotion channels will be used:

– Publications in local media, city portals.
– Website promotion.
– Advertising in public transport.
– SMS and Mailings.

## 3.3 Organizational plan.

### Composition of participants and areas of responsibility.

Specialists of the CIT of the Minsk City Executive Committee and the NGO "Garages, parking lots and parking lots" take part in the implementation of the Pilot Project. Interaction between enterprises is carried out on the basis of an agreement, in which, in accordance with the instruction, the Customer's side is represented by the GO "Garages, parking lots and parking lots", the contractor's side is the CIT of the Minsk City Executive Committee.

Other suppliers, developers and/or technology holders are also invited to participate in the Pilot Project in the manner prescribed by this Terms of Reference, by sending out invitations to potential (well–known) suppliers of technical solutions for the traffic video analytics system with an offer to participate in the implementation of the Pilot Zone. The choice of a specific supplier is carried out by the CIT of the Minsk City Executive Committee and the GO "Garages, parking lots and parking lots" at their discretion, as a rule, according to the principle of the most complete compliance (at the time of presentation and evaluation) of its technical solution with the functional requirements for the system, according to APPENDIX B.4 to these technical requirements.

Between each of the above participants, areas of responsibility on the project should be delimited in accordance with the requirements of this Terms of Reference.

Each of the participants must identify and inform other participants about the list of specialists who install, configure, operate software or hardware, as well as provide technical support, advice to other participants.

**Action Plan to organize and conduct a pilot project.**

Action Plan to organize and conduct a pilot project "Creation of a pilot zone for test operation of a segment of an automated system for informing citizens about the availability of free spaces in paid parking lots in Minsk" provided in APPENDIX B.5.

## 3.4 Implementation plan.

**General information.**

This term of reference describes the main approaches, goals, objectives for organizing and conducting a pilot project "Creating a pilot zone for test operation of a segment of an automated system for informing citizens about the availability of free spaces in paid parking lots in Minsk" (hereinafter referred to as the Pilot Project), and also describes basic criteria for evaluating the expected results from its implementation.

The pilot project is the initial practical use of existing technical solutions, including those developed in the process of preparing for the pilot project, at the facilities.

The organization and implementation of the pilot project sets the following goals and objectives: selection and testing in practice of existing technologies and technical solutions for monitoring paid parking spaces (zones) in Minsk, fixing, processing (analytics) of the received data and generating information on their basis for drivers of vehicles and other stakeholders about the presence (absence) of free parking spaces at a particular point in time;

experimentally determine whether the existing video monitoring (video surveillance) technologies for open spaces (parking) are suitable for obtaining objective information about the presence (absence) of free parking spaces at a particular point in time;

acquisition of own practical experience in organizing and operating systems built on the basis of video analytics, identifying their strengths and weaknesses and the applicability of these systems as a whole in the context of implementing the task of organizing an automated system for informing citizens about the availability of free places in paid parking lots in Minsk.

It is expected that the implementation of the Pilot Project will provide important practical information necessary to assess the quality of the functioning of video monitoring (video surveillance) technology for open spaces (parking) to obtain objective information about the presence (absence) of free parking spaces at a particular point in time. An important function of the Pilot Project is to make a decision regarding the advisability of further scaling the system or abandoning this technology, the need to refine it or search for or develop another, alternative technology.

The negative result of the Pilot Project will make it possible to prevent and avoid more significant material costs associated with the use of the selected technology in the event of its large–scale implementation without field tests.

**General goals and objectives of the project.**

It is necessary to put into operation a technical solution for citizens and guests of the city of Minsk, who come to the city and need free parking spaces for temporary (during the day) storage of vehicles. The information system should automatically analyze, identify and provide drivers of vehicles with up–to–date and reliable information about paid parking lots in real time, where there are currently free parking spaces. In addition to the specified information, it is important to provide users with the functionality to plot the route of the vehicle to the free parking space chosen by the driver, and upon the fact of parking, to provide him with the opportunity to pay for the paid parking services provided.

Access to this information can be provided through a test (as part of a pilot project) mobile application or through a Web interface.

An additional functionality of the information system should be the ability to connect paid closed–type parking lots (parking lots) to provide information on the availability of free spaces, incl. and on such sites, their selection and payment.

The pilot project should include a parking space (zone) that includes several busy streets in Minsk and adjacent areas, preferably in the city center, as well as at least one paid closed parking. The choice of a parking space (zone) for the Pilot Project, and not a local parking on one of the streets, is necessary, among other things, for experimental verification of the possibility of a prospective introduction in Minsk of a zonal approach to parking regulation, following the example of the cities of the European Union.

Also, if there is a technical possibility, it is advisable to test and verify the capabilities of the selected technology (information system) to implement the functions of identifying and fixing violations of the rules for stopping and parking vehicles (traffic violations).

The following organizations are defined as organizations carrying out the practical organization and implementation (implementation) of the pilot project:

PUE "Center for Information Technologies of the Minsk City Executive Committee" – in terms of determining technologies and technical implementation, including installation and operation of video surveillance tools and systems, selection, if necessary, refinement, and implementation of video analytics systems, creation of a test version of a mobile application;

State Institution "Parking of the Capital" – as a methodological assistance, solving emerging organizational issues, including interaction with the owners of closed–type parking lots (parking lots), as well as financing, in accordance with the procedure established by law, the costs associated with the organization and implementation (implementation) of the Pilot Project.

If necessary, these state–owned enterprises, at their discretion, involve other interested organizations, including service providers and technical solutions, to participate. Financing of expenses of other participants is carried out at the expense of own funds of such participants.

**Specific tasks that realize the set goals.**

From the overall global task to be implemented during the Pilot Project, several of the following key (component) tasks that implement the goals set can be distinguished:

- choice of technology for the organization of the Pilot Zone;
- selection of a parking space (zone) in Minsk, for which a Pilot project will be organized and carried out, in order to be able to test the application of uniform requirements during the transition in Minsk from local parking to zonal parking;
- equipping the selected parking space (zone) of the streets with the necessary technical means;
- the choice of at least one paid parking of a closed type;
- selection of a technical solution for connection to the Pilot Project of an internal information system for paid parking of a closed type;
- installation and configuration of the video analytics information system of the Pilot Project, including, if necessary, the development (updating) of individual modules;
- development of a test version of a mobile application (or use of an existing one), which will be used to search and select free parking spaces;
- implementation of the function of laying the route, the ability to make payment and other functionalities of the project;
- carrying out of the Pilot project and evaluation of its results, development of proposals (recommendations).

**Criteria for evaluating results.**

To evaluate the results of the implementation of the Pilot Project, evaluation criteria based on the above tasks will be used. Such an assessment should identify possible problems and key characteristics of the Pilot Project that may affect the suitability of the applied technology for scaling up and practical implementation of the Pilot Project adopted throughout the city of Minsk.

The key indicator for evaluating the results of the Pilot Project is the successful implementation of measures to organize it in accordance with this Terms of Reference and conduct it within the time frame established by the Terms of Reference.

Any result achieved as a result of the organization and implementation (implementation) of the Pilot Project, regardless of whether it is successful (the results achieved are in line with the expectations) or unsuccessful (the results achieved are not in line with the expectations), is nevertheless considered and evaluated as the result of the implementation of the event.

The final evaluation of the project is carried out on the basis of the following categories and corresponding actions:

- The pilot project showed that the achieved practical results do not correspond to the expected goals and objectives of the project;
- The pilot project showed that the selected technical solutions do not solve the tasks set or have significant shortcomings, without the elimination (improvement) of which their large–scale application can cause a number of problematic issues;
- The pilot project failed, which, however, is not related to the choice of technology, but depends on untimely and / or not fully resolved (carried out) organizational and technical measures (refusal to place or connect equipment, lack of resources, failure to meet deadlines individual events, the presence of force majeure situations, etc.);
- The pilot project was completed successfully, i.e. Based on the results of the implementation of the Pilot Project, the expected goals and objectives of the project have been achieved and fulfilled.

**Preparatory activities for the organization of the Pilot Project.**

Currently, there are a number of technologies used to solve similar problems. Among the most popular are the installation of specialized sensors with a built–in magnetic and / or infrared sensor in the road surface in parking lots and the use of video surveillance system (VSS) functions.

According to the first option, the parking system constantly monitors the parking lot in real time, using radio frequency sensors that signal the presence of a car within the parking space. These sensors operate from built–in batteries and, as a rule, are connected to each other in a MESH network, which does not require additional engineering networks (constant power supply systems, telecommunication channels) to be connected to them. At the same time, such systems have a number of disadvantages, including a limited number of tasks to be solved, the need for replacement and maintenance when working with a road surface, the ambiguous behavior (reaction) of the system in controversial situations: the presence of snow, dirt, fallen leaves on the sensor, the presence of a large mass metal near a free parking space and others. One of the main disadvantages of the system is the difficulty of objectively recognizing the state of a parking space (occupied or free) in cases of improper parking of vehicles (parking for 2–3 spaces at once).

An alternative solution in the form of using the functionality of VSSs is devoid of most of these disadvantages.

Despite the expectedly higher costs of equipping parking lots with VSSs compared to the cost of sensors, nevertheless:

their competent location (for the widest possible coverage area) allows minimizing the capital costs for deploying the system;

the use of software algorithms makes it possible to eliminate analysis errors associated with incorrect parking of vehicles (parking for 2–3 places);

The use of VSSs makes it possible to obtain a number of additional functionalities, in addition to those established by the basic tasks of the Pilot Project, but no less important for the operation of the system in an urban environment. In particular the possibility:

- recognition of license plates and fixation of violations of the rules for stopping and parking vehicles (violation of traffic rules);
- implement individual functions of public safety monitoring systems, incl. causing damage to vehicles parked.

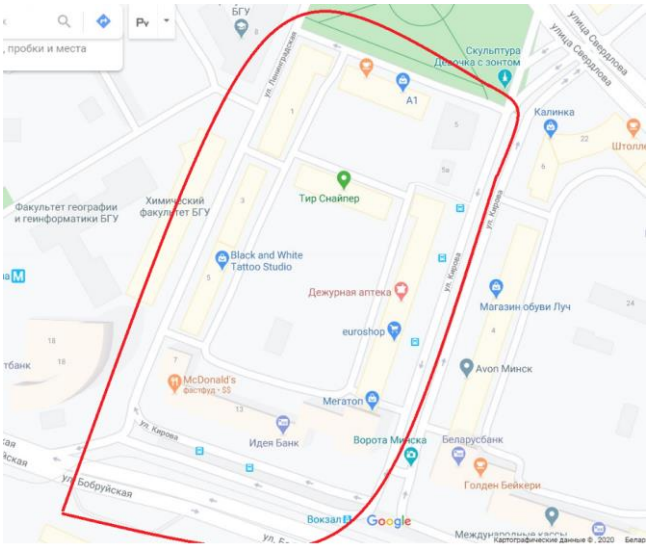
Thus, the implementation of the Pilot Project is expedient with the use of existing or newly installed video cameras in the pilot area of the required technical characteristics, followed by the use of the functions of the video analytics system for detecting, processing and presenting the necessary information about the state of parking spaces (occupied, free).

**Site selection for the organization of the Pilot Project.**

Based on the results of the preliminary study, and also taking into account the feasibility of additional involvement and testing of the system's capabilities to identify

and record violations of the rules for stopping and parking vehicles (traffic violations), it is advisable to choose a parking space (zone) located in the center or close to the center as a pilot zone city.

Taking into account a number of accompanying factors, as well as the goals and objectives of the project, it is proposed to use the parking space (zone) in the area of the station square and St. Leningrad – Kirov (Minsk).




**Picture 3.1 – Parking space proposed as a pilot area**

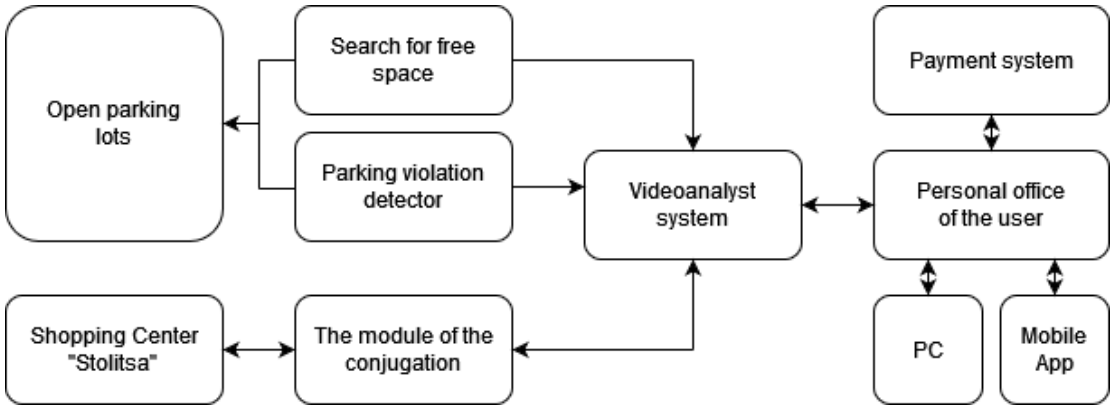
The choice of location was justified by a number of reasons, including:

- location in the city center;
- the presence in the immediate vicinity (at 8, Nezalezhnosti Ave.) of engineering networks serviced by the CIT of the Minsk City Executive Committee, which minimizes the cost of installing and connecting video cameras, organizing communication channels;
- the presence of pronounced problems with parking vehicles on a given street, including with multiple violations of the rules of stopping and parking (traffic violations);
- high demand for parking spaces in this part of the city, especially given the proximity of the railway station, and, as a result, the opportunity to involve the maximum number of potential users in testing.
- As a paid closed–type parking (parking), it is advisable to use a parking lot (parking) located in the Stolitsa shopping center. The choice of location was justified by a number of reasons, including:
- location in the city center in an area with a potentially high demand for free parking spaces;

– low occupancy of the parking lot;
– subordination (belonging) of this parking to the GO “Garages, parking lots and parking lots”;
– equipping the parking lot with a functioning system for counting free spaces;
– the possibility of organizing joint testing of a system for searching for free parking spaces in open paid parking lots, with proposals, as an alternative, for free spaces located in the parking lot of the Stolitsa shopping center located nearby (within a 1 km zone or about 3–4 minutes by car).

**System architecture.**

Architecturally, the automated system for informing citizens about the availability of paid parking spaces, organized as part of the Pilot Project, consists of the components shown in the figure:




**Picture 3.2 – The main components of the system**

The main components of the system:
– video cameras placed on the territory of the parking space (zone) for monitoring the folding situation, fixing and transmitting video images to the appropriate software modules;
– an interface module used to connect the existing information system for managing the parking space of the Stolitsa shopping center to the system used to operate the Pilot Project;
– a video analytics system, a central component, a software package that processes the video traffic coming from the VSS, its analytics, and the identification of free and occupied seats;
– a client program (Web interface) and mobile applications for Android (iOS) used by end users to obtain information.

**Specifications for a typical parking space.**

The technical solutions used within the pilot zone are focused on motor vehicles classified according to GOST 31286 – 2005 "Road transport. Basic terms and definitions. Classification" to category M (power–driven vehicles with at least four wheels and used for the carriage of passengers), in particular, category M1.

For reference: category M1 – vehicles used for the carriage of passengers, having, in addition to the driver's seat, no more than eight seats (according to clause 5.1.2.1 in accordance with GOST 31286–2005).

Typical dimensions of a vehicle of category M1:

– an ordinary passenger car – length from 3,115 to 4,800 mm, width from 1,500 to 1,850 mm;
– medium passenger car – length 5,540 mm, width 1,940 mm;
– a large passenger car – length 5,800 mm, width 2,500 mm.

In different countries of the world, various passenger car classification systems have historically developed and are currently used, using various parameters as the basis for classification – overall dimensions, usable volume of the passenger compartment, weight, engine displacement or power, place in the consumer market, and so on.

Based on the analysis of regulatory documents of various countries for the purposes of the Pilot Project, it is possible to derive the following classification of vehicles according to their dimensions (length), which is not official in APPENDIX B.7.

Conditional gradation of car classes by popularity:

Table 3.3 – Car Classes by popularity.

| **Class** | **Three leaders** | **Top color** | **Rarity** |
|---|---|---|---|
| A (4%) | Chevrolet Spark, Citroen C2, Peugeot 107 | Black, white | No |
| B (46%) | Hyundai Accent, VW Polo, Kia Rio | Black, white, grey | Black and red Citroen Ds3, Alfa Romeo Mito |
| C (15%) | Skoda Octavia, VW Jetta, BMW 1–series | Black, white, grey | Honda Civic 9th, Suzuki Kizashi |
| D (11%) | Audi A6, Mazda 6, Toyota Camry | Black, white, grey | No |
| Crossovers (21%) | Hyundai Creta, Renault Duster, Toyota Rav4 | Brown, Silver, Black | Peugeot 3008 |
| Others(3%) | Old cars and coupes | | |

In accordance with paragraph 11.6.13 of the TCP 45–3.01–116–2008 (02250) "Urban planning. Settlements. Planning and building standards", the dimensions of one parking space in car parks should be taken:

for passenger cars – from 2.5x5.0 to 2.5x5.5 m, depending on the availability of free territory and the purpose of the facility where parking is being installed;

for special vehicles driven by a disabled person with a violation of the functions of the musculoskeletal system, or for vehicles carrying such a disabled person – 3.5x8.0 m;

trucks – 3.0x8.0 m.;

road trains – 3.5x20.0 m.;

tourist buses – 3.5x15.0.

In accordance with TKP 45–3.01–116–2008, the minimum area of a land plot (site) for a ground parking lot with a capacity of 100 parking spaces (including driveways) is 0.25 hectares (APPENDIX B.6 "Sizes of land plots for storage and maintenance of vehicles").

Thus, within the framework of the Pilot Project, it is proposed to use the following standard sizes:

– vehicle dimensions – 1.8x4.8 m;

– dimensions of the parking space – 2.5x5.5 m.

This will allow to calculate and provide information on the presence (absence) of a parking space suitable for the vast majority of vehicles used by the population (from class A to class F, including crossovers and SUVs).

If there is a technical capability of the video analytics system within the framework of the Pilot Project, it is possible to test various sizes of a typical parking space, i.e. the actual choice is in the range from 2.5x5.0 to 2.5x5.5 m. to choose the most optimal one as the ratio of the area of the parking lot to the maximum number of cars that can be placed on it, subject to comfortable conditions for parking and leaving it.

**Algorithm and logic of the system.**

The general logic of the system operation under the Pilot Project is planned as follows:

in normal operation, the video analytics system receives data (video traffic) from the video surveillance system and analyzes it. Using built–in algorithms, the system must calculate the entire parking space and divide it into conditional (logical) places based on the size of a typical parking space.

As free parking spaces are occupied, the video analytics system should detect a change in state and automatically recalculate the number of free and occupied parking

spaces. At the same time, regardless of the actual position of the parked car, the system must nevertheless calculate based on the total parking space and the total ability to place vehicles (cars) on it.

The system should transmit information about the availability of free and occupied parking spaces, interacting with users' mobile applications, as well as to the Web application.

System users (vehicle drivers) using information about free parking spaces should have a function that allows using built–in maps or by transferring information to third–party mapping applications (Yandex, Google and others) to build a route to a free parking space. The advantage is the use of built–in maps, and the use of functionality that allows us to rebuild the route (offer another free place nearby) if at the moment (during) the car is moving, the selected parking space is occupied by another driver. If possible (optional), the system should test the functionality that does not allow choosing a free parking space if the system knows that it has already been selected by another driver (a route has been built to it), or to inform the driver that this place has been selected by another user.

The system user (vehicle driver) must be able to pay for the use of paid parking (occupied parking space) using a mobile application. As payment methods, the functionality (interaction protocol) of ERIP, the functionality of mobile payment systems, incl. using a linked bank card, or an existing payment system from the subscriber's mobile phone account by sending an SMS message in a format agreed with the cellular mobile telecommunication operator. Given that the integration of a mobile application with ERIP or other payment systems requires, in accordance with the current connection regulations, significant time and financial costs, the test version of the mobile application should be able to pay, however, commercial connection to payment systems may not be implemented, or it may be implemented optional.

In the process of preparing the Pilot Project, it is necessary to conduct a survey and analysis of the existing information system for managing the parking space of the Stolitsa shopping center to determine the technical feasibility of automated (remote) obtaining information about free and occupied parking spaces. Also, during the survey, it is necessary to determine the possible protocols and format (API) for organizing the interaction of information systems.

Also, optionally, as part of the Pilot Project, the system should provide for the functionality of conducting video analytics of traffic coming from video surveillance systems to identify vehicles that violate the requirements of traffic rules in terms of stopping and parking vehicles in places where it is prohibited by traffic rules (closer than 15 meters from the intersection, pedestrian crossing), road signs or markings. To do this, it is required to analyze the selected parking space (zone), identify such places and adjust the system accordingly. In the intended functionality, the system, using

traffic from video surveillance systems, must record the registration plate of the vehicle that has stopped and parked, and provide the system operator (operating personnel) with information about this fact indicating: the time when the event was recorded, the registration number and at least two photos of such a car with an interval of at least 5 minutes between them. The specified data is not transmitted to system users (vehicle drivers). It is necessary to provide for the possibility of generating, at the end of the Pilot Project, a report on the number of detected violations of stopping and parking vehicles in the pilot zone for its analysis and development of proposals on the advisability (not expediency) of using this functionality in case of system scaling.

In the process of organizing a Pilot Project, setting up and / or finalizing the system, other algorithms of work or functionality of the system can be configured and used.

**Technical requirements for system elements.**

**Video camera resolution and locations, coverage area, placement, connection.**

Specifications for the location of video cameras to solve the problems of parking control will be developed during the Pilot Project. The following requirements are proposed as preconditions for the Pilot Project:

Video cameras of the video surveillance system should be located, if possible, on the opposite side of the street along which paid parking is organized. In the absence of technical feasibility, cameras may be located on the same side of the street where parking spaces are organized. Such an arrangement is also allowed in cases where, based on the technical features of the surveyed site, it is established that this will allow the video surveillance system to "see" the registration plates of vehicles as well;

Video cameras should be placed at a height of at least 3 m from the level that coincides with the level of the parking lot. A good location of a video camera is one that provides the most complete overview of the parking area, as well as vehicle coverage, which allows the video analytics system to make the necessary calculations of the dimensions of the vehicle and its location on the site with a sufficient degree of probability.

If there are two or more video cameras on the parking lot, their viewing areas must overlap by at least 5%.

The technical characteristics of video surveillance systems used under the Pilot Project must comply with the requirements of the Regulations on the use of security systems and video surveillance systems, approved by Resolution of the Council of Ministers of the Republic of Belarus No. 1135 dated December 11, 2012, including:

- video encoding in H.264 and (or) H.265 standards;
- use of the main transport protocol for information transfer TCP/IP;

– synchronization of events with the single exact time system;

– operation in a wide temperature range (from –30 to +40 °C) when located outside heated or air–conditioned rooms;

– work 24 hours a day, seven days a week;

– individual adjustment of image parameters (brightness, color, contrast);

– support for video stream transmission in CBR and VBR modes with the ability to adjust the video stream speed;

– support for the transmission of a secondary video stream with a resolution of at least 640 x 480 pixels;

– the ability to select different frame rates;

– resolution of at least 1280 x 720 pixels.

In order to ensure video recording of events by a video surveillance system, sources of infrared lighting are installed on unlit areas of the terrain and objects.

To ensure the functioning of the means of forming and processing video images, power is used in accordance with the PoE standard (power over Ethernet).

**Requirements for server hardware and information system.**

The server (cloud) software of the video analytics information system is located on the technical means of the CIT of the Minsk City Executive Committee.

Connection and administration of the system must be carried out remotely, with access control by login and password.

The server part is configured by specialists of the CIT of the Minsk City Executive Committee, the installation (installation) and configuration of the software is carried out by the supplier (developer).

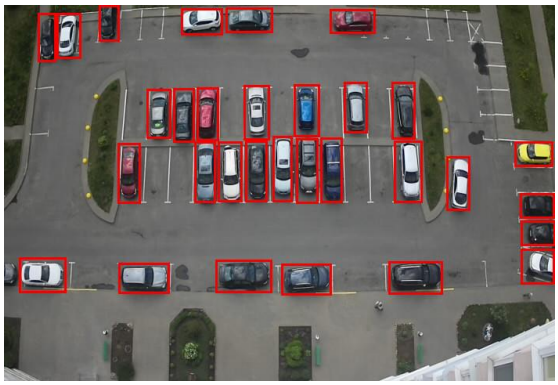
The video analytics system should:

– analyze incoming video traffic from video surveillance systems and recognize free and occupied parking spaces (parking lots);
– fold (glue) video from several cameras into a single image, providing a single rendering of vehicles, parking spaces;
– automatically and in real time recalculate the status (presence or absence of parking spaces) in case of a change in the situation;
– detect and exclude the influence of static objects, including small ones (cones, fences, garbage cans, etc.), as well as passing vehicles, pedestrians, etc.;
– be able to select video information according to specified time parameters and events for its viewing, copying and playback;
– provide registration of images from CCTV cameras with a quality no worse than the transmitted video stream.

– The system must have a Web interface for administration and operation of the system from a desktop computer.

The web interface should have user functionality similar to a mobile application, and additionally:

– the ability to view the video stream from the selected video camera at the facility (parking lot) (in parking lots – if technically possible);
– visual display of parking markings on polygons with separate color gradation: car, parking space, cars parked in violation of traffic rules;
– visual display of parking markings on polygons with separate color gradation: car, parking space, cars parked in violation of traffic rules;
– visual display of parking markings on polygons with separate color gradation: car, parking space, cars parked in violation of traffic rules;



**Picture 3.3 – An example of displaying a parking zone marked into polygons**

– displaying information about the registration plate of the vehicle (if the registration plate is in the field of view of the video camera);
– the possibility of graphical display (marking) of places (zones) where parking is prohibited according to traffic rules and/or road signs;
– the possibility of manual training (adjustment) of the video analytics (AI) system if the administrator visually sees that parking spaces, areas or objects are recognized (marked) clearly incorrectly (optional).

The system should have a module for connecting external systems, in particular, within the framework of the Pilot Project, the existing information system of the Stolitsa shopping center.

The software interface (Administrator's panel) must be branded under the CIT of the Minsk City Executive Committee.

Optionally, the system should be able to connect to closed–type parking lots (using a barrier that opens on an event for entry).

**Mobile Application Requirements.**

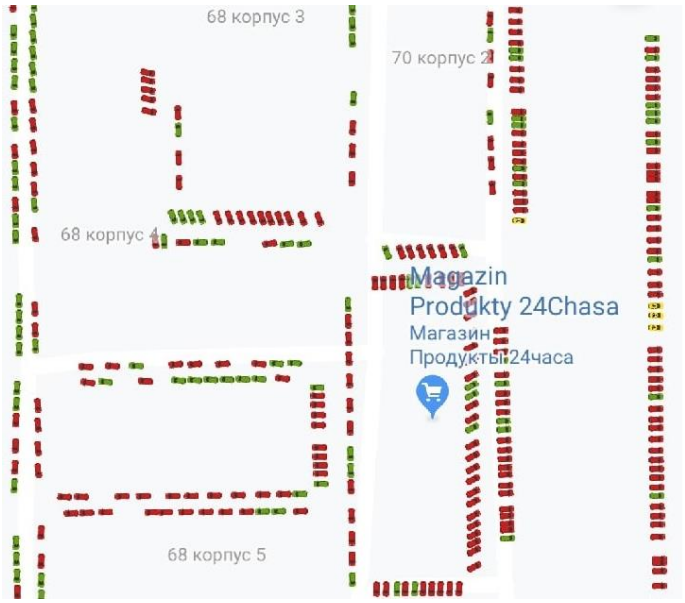
As part of the Pilot Project, it is advisable to test mobile applications for Android systems (iOS is optional).

At the same time, if it is impossible to develop a mobile application during the Pilot Project, if there is limited functionality, and in general it is impossible to officially publish them in the application stores (Apple and Google Store), it is allowed to develop test versions of mobile applications (without official publication) to check the availability and ways to implement the functionality of the video analytics information system.

Test mobile applications, regardless of the platform, should provide:

1. Mandatory requirements:

– display of free and occupied places with icons of different colors (green and red);
– the possibility of graphic designation of parking spaces intended for parking vehicles belonging to the disabled (yellow);




**Picture 3.4 – An example of a graphical display of the designation of parking spaces**

– displaying addresses (locations on the map) of paid parking lots known to the application in the city of Minsk;
– display on the map of the current position of the user's car (while driving);
– separate (different) display of open–type paid parking lots and parking lots;
– provide information about the opening hours of paid parking, service organizations, the cost of the service;
– the ability to select a free parking space and build a route to it on the roads in compliance with traffic rules. Route building can be carried out both by built–in tools and by transferring relevant data to third–party mapping services (Yandex,

Google, etc.). If built–in tools are used, the system must take into account that other users have already built a route to the selected parking space and not offer it for selection (optional);

2. Additional (optional) requirements:

- the ability to view from a mobile application a picture from a video camera in a parking lot – a statistical image (by default) and a stream in real time (optionally);
- the possibility of paying for paid parking services (not used for parking lots).
- When scaling, the mobile application should provide grouping of parking lots by the total number of spaces and the number of free ones, and when approaching, it should detail or (if the scale is minimal) display a parking plan showing the actual location of free (green space) and occupied (red car icon) spaces;
- registration in the application by username and email address (default), as well as username and mobile phone number, with confirmation via SMS (optional).
- The interface of the mobile application should be branded under the corporate colors of the CIT of the Minsk City Executive Committee. The interface should not contain any indications and references to external (third–party) developers.
- Distribution of official versions of mobile applications is carried out through the official stores of Google (Apple) using the CIT account of the Minsk City Executive Committee, distribution of test versions – from the servers of the CIT of the Minsk City Executive Committee.

**Timing of the Pilot Project.**

The pilot project is organized and carried out within the time frame specified in APPENDIX D.3 to this Terms of Reference. The estimated duration of the pilot project is 130 calendar days (about 4.5 months).

If necessary, including based on the operational results achieved during the implementation, the timing of the pilot project can be changed in the direction of reduction or increase, of which all its authorized (with whom contracts have been concluded) participants are notified.

Testing of the elements of the system is carried out by employees of the CIT of the Minsk City Executive Committee, GO "Garages, parking lots and parking lots", other participants (within the limits of the provided capabilities of their software). Representatives of the Minsk City Executive Committee and other interested persons may be involved in testing by decision of the CIT of the Minsk City Executive

Committee. Configuration and testing is carried out using a Web application, as well as test mobile applications downloaded from third–party sources.

Subsequently, as the system is ready and its functional requirements meet the requirements of the pilot project, mobile applications can be placed in public access in the Google Store (Apple) application store from the CIT accounts of the Minsk City Executive Committee. During the official publication of mobile applications, testing involves a wide range of interested users who have downloaded the application and registered (authorized) in it.

**Report on the results, evaluation criteria, conclusions and applications.**

Upon completion of the Pilot Project, within the time frame specified in APPENDIX D.3, a report on the completion of the Pilot Project is prepared, which indicates the results achieved by the project, the compliance of the results obtained with the goals and objectives of the project, and other information.

The report is prepared jointly by specialists from the CIT of the Minsk City Executive Committee and the NGO "Garages, parking lots and parking lots" and is approved by the heads of these enterprises.

The report may include information, information and suggestions received from other project participants.

Based on the results of the implementation of the Pilot Project, the report agreed upon and approved by the parties, together with a cover letter, is sent by the CIT of the Minsk City Executive Committee to the Minsk City Executive Committee for consideration of the results and proposals.

**Other requirements and provisions.**

Participation of other participants in the Pilot Project is carried out at their request in the manner specified in Section 11 of this Terms of Reference. A cooperation agreement is signed with the selected participant, which, among other things, must contain confidentiality provisions (NDA), after signing which the participant becomes available the documentation on the pilot project, up–to–date information on the progress of the pilot project, including changes and additions. The Participant, at his request, may also be provided with one copy of the official (approved) report on the results of the implementation of the Pilot Project.

The cooperation agreement with such participants on the part of the responsible executors for the project is signed by the CIT of the Minsk City Executive Committee.

The cooperation agreement between the participants should regulate the use of intellectual property, objects of copyright and related rights, as well as rights to the results obtained upon completion of the Pilot Project.

Unless otherwise specified in the cooperation agreement, exclusive rights to the results (information, knowledge, technologies, reporting materials, etc.) obtained as a result of the implementation of the Pilot Project belong to the CIT of the Minsk City Executive Committee.

A pilot project, based on these goals, is being implemented to test the applicability of the selected technology to solve the problems of monitoring and controlling free parking space in Minsk. The organizers, including the CIT of the Minsk City Executive Committee and the NGO "Garages, parking lots and parking lots", do not declare and do not accept any obligations for the further commercial use of the technical solutions of the participants developed (used) during the implementation of the Pilot Project.

Applications to technical requirements: APPENDIX B.4 – functional requirements for a video analytics system.

## 3.5 Production plan.

To implement the production plan for the smart parking pilot project, it is necessary to calculate the costs of installing and renting the necessary equipment, as well as take into account the costs of service maintenance. These costs are necessary investments:

### One–time costs.

Table 3.4 – Equipment required for the implementation of the pilot project.

| N | Name of equipment | Quantity, pcs. | Price | Total Price |
|---|---|---|---|---|
| 1 | RYi–IPC38YM4 (2.7–12) CCTV network camera | 6 | 742.92 | 4457.51 |
| 2 | RYi–IPC48YM4 (2.7–12) CCTV network camera | 10 | 1173.03 | 11730.27 |
| 3 | RVi–NS 1604M Network switch | 4 | 752.60 | 3010.40 |
| 4 | RYi–PS Ethernet and PoE lightning protection | 24 | 78.20 | 1876.85 |
| 5 | Eaton 9 PX 3000 i RT3U uninterruptible power supply | 4 | 3500.00 | 14000.00 |
| 6 | Electrical cabinet TsMO ShTV–1–24,7,9–43AA | 4 | 1791.58 | 7166.32 |
| 7 | Temperature regulator (thermostat) for heater TsMO KTO 011–2 | 4 | 25.98 | 103.91 |
| 8 | Component for wiring cabinet CMO HG14 0–l 50W | 4 | 104.76 | 419.04 |
| 9 | RYi–380BP–K pole mount bracket | 6 | 65.17 | 391.01 |
| 10 | RYi–M82 Junction box | 6 | 52.14 | 312.81 |

Continuation of the Table 3.16

| N | Name of equipment | Quantity, pcs. | Price | Total Price |
|---|---|---|---|---|
| 11 | Cross optical rack KOC–24–SC/l U–24SMSX–24UPC9(657 A–1)–1 | 4 | 63.32 | 253.28 |
| 12 | Cross optical rack KOC–48–SC /2U–l 6SMSX–l 6UPC9(657 A–1)–2 | 1 | 57.81 | 57.81 |
| 13 | (MLMCV–SG–RJ, formerly ML–GU–SFP) MlaxLink UTP/SFP Media Converter l Gb / s RJ45/SFP | 1 | 46.50 | 46.50 |
| 14 | OPLIN K–1 SFP Module , 25G–D40–DDM | 1 | 70.00 | 70.00 |
| 15 | module OPLlNK–1, 25G–U40–DDM | 1 | 46.50 | 46.50 |
| 16 | Optical transceiver OPL–SFP–W35–03–SC | 4 | 19.00 | 76.00 |
| 17 | Optical transceiver OPL–SFP–W53–03–SC | 4 | 19.00 | 76.00 |
| 18 | Socket block for REM R–10–9S–1–440–Z | 4 | 62.63 | 250.51 |
| 19 | Fan module CMO R–FAN–3T | 4 | 151.73 | 606.92 |
| 20 | RVi–MB5 Mounting box | 6 | 41.71 | 250.26 |
| 21 | Fiber optic cable (meters) | 4000 | 1.17 | 4680.00 |
| | | | **Total** | **49 881.89** |

Table 3.5 – Construction and installation works for the implementation of the pilot project.

| N | Name of equipment | Quantity, pcs. | Price | Total Price |
|---|---|---|---|---|
| 1 | Construction and installation works | 1 | 48661.91 | **48 661.91** |

Table 3.6 – Selecting, installing and configuring the server and network architecture.

| N | Name of equipment | Quantity, pcs. | Price | Total Price |
|---|---|---|---|---|
| 1 | Selection, installation and configuration of the server and network architecture | 1 | 720.5 | **720.5** |

Table 3.7 – Computer for administrator in office.

| N | Name of equipment | Quantity, pcs. | Price | Total Price |
|---|---|---|---|---|
| 1 | Computer for administrator in office | 1 | 2313 | **2313** |

## Monthly expenses.

Table 3.8 – Server rental, network infrastructure and maintenance per month.

| N | Name of equipment | Quantity, pcs. | Price | Price |
|---|---|---|---|---|
| 1 | **Server and network infrastructure rental** | | | |
| | **Hardware:**<br>CPU: AVX–512 silver/gold intel 8+8 pin 2.6–3 GHz<br>RAM: 128 Gb<br>SSD: 512 SSD<br>Storage per day: 600 GB / 1 full HD – 1.2 TB.<br>Camera: 4 Mb and 100 Mb on stream | 1 | 1492.4 | 1693.3 |
| | **Operation System and Software:**<br>OS: RedHat/Centos8<br>Virtual Management System: Genetec Omnicast with 30 days storage; | 1 | 200.9 | |
| 2 | Service support from a partner company providing video analytics services | 1 | 574 | 574 |
| | | | **Total** | **2267.3** |

Table 3.9 – The calculated structure of investment.

| **One–time costs** | **amount, Br.** |
|---|---|
| Equipment required for the implementation of the pilot project. | 49 881.89 |
| Construction and installation works for the implementation of the pilot project. | 48 661.91 |
| Selection, installation and configuration of the server and network architecture | 720.5 |
| Computer for administrator in office | 2313 |
| **Total initial investment** | **101 577.3** |
| **On–time costs** | |
| Salary for two employees of administrators per month | 4592 |
| Server, network, infrastructure rent & partner company support service | 2267.3 |
| Administrative expenses | 385.5 |
| Depreciation (1,32% per month) | 724.9 |
| **Total investment per month** | 7969.70 |
| **Total capital required for the project** | **109 547** |

## 3.6 Financial plan.

The purpose of the evaluation of investment projects is an exhaustive answer to three main questions:

– what is the return on investment;
– what is the payback period of the project;
– what are the risks of the project;

The methods used in the analysis of investment activity can be divided into two groups:

– based on discounting (Net present value (NPV), Profitability index (PI), Internal rate of return (IRR), Modified internal rate of return (MIRR), Discounted payback period (DPP).
– without discounting (Payback period, accounting rate of return).

Using methods without discounting, cost–effectiveness can be quickly assessed based on simple calculations.

The cash flow of the project is calculated by the direct method and based on the following assumptions:

1. Planning period – 6 years.
2. Occupancy: Search for an available duty station through a mobile application and visit a parking lot: 92%;
3. Refinancing rate: 12%;[20]
4. Inflation: 14.11%;[21]
5. Cumulative refinancing rate: 26.11%
6. The price list is fixed.

Table 3.10 – Calculation of monthly revenue for paid parking for 86 places with a load of 92% on the street. Kirov (site near the house number 8) Leninsky district.

| Payment options | Price | Revenue at 100% fill per day | Revenue at 100% completion per month | Distribution of sales per month | Real download per month in cost |
|---|---|---|---|---|---|
| Monthly subscription | 35 Br | 3 010 Br | 90 300 Br | 5% | 4515 |
| Subscription for the day | 5 Br | 430 Br | 12 900 Br | 2% | 258 |
| Subscription for a week | 7 Br | 602 Br | 18 060 Br | 3% | 541,8 |
| Hour | 1 Br | 774 Br | 23 220 Br | 90% | 20898 |
| **Total** | | | | | **24115,78 Br** |

To implement the project, it is planned to attract 101 577.3 Br.

When evaluating the effectiveness of the project using the discounting method, the NPV, IRR, MIRR and PI indicators were calculated.

Table 3.11 – NPV, IRR, MIRR and PI indicators calculations.

| | **0 Year** | **1 Year** | **2 Year** | **3 Year** | **4 Year** | **5 Year** | **6 Year** |
|---|---|---|---|---|---|---|---|
| **Net cash flow from operations** | –101577 | 123084 | 121889 | 121555 | 121012 | 120914 | 120399 |
| Cumulative refinancing rate | 26,11% | | | | | | |
| Discounted net cash flow | –101577 | 97600 | 76642 | 60607 | 44405 | 37908 | 29931 |
| Cummulative Cash Flow | –101577 | 21507 | 143396 | 264951 | 385963 | 506877 | 627276 |
| Payback period | 0,83 | | | | | | |
| Discounted Payback period | 1,04 | | | | | | |
| Net Present Value (NPV) | 245516 | | | | | | |
| Internal Rate of Return (IRR) | 119% | | | | | | |
| Modified Internal Rate of Return (MIRR) | 155% | | | | | | |
| Profitability Index (PI) | 2,4 | | | | | | |

The income statement of the project for six years is given.

Table 3.12 – Income statement.

| | **1st year** | **2nd year** | **3rd year** | **4th year** | **5th year** | **6th year** |
|---|---|---|---|---|---|---|
| Service revenue | 278444 | 278444 | 278444 | 278444 | 278444 | 278444 |
| Expences | 95636,4 | 95636,4 | 95636,4 | 95636,4 | 95636,4 | 95636,4 |
| General operating and administrative expenses | 4620 | 4712 | 4807 | 4903 | 5001 | 5101 |
| Wages | 55104 | 56206 | 56446 | 56893 | 56893 | 57308 |
| Depretiation | 8699 | 8699 | 8699 | 8699 | 8699 | 8699 |
| Net income | 114384 | 113190 | 112856 | 112313 | 112215 | 111699 |
| Return on sales, % | 41% | 41% | 41% | 40% | 40% | 40% |

Payback period represents a period of time after which the income from the project becomes equal to the amount of money invested. The payback period is clearly shown in Figure below and estimated to be 0,83 year.

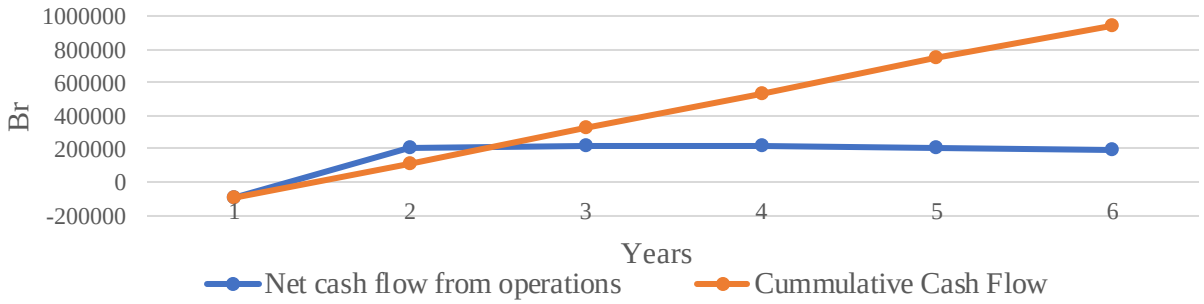



**Figure 3.1 – Project Payback**

Using the figures from Income statement in can be calculated that break–even point is achieved at 4 months of operations with the month revenue 22792 Br.

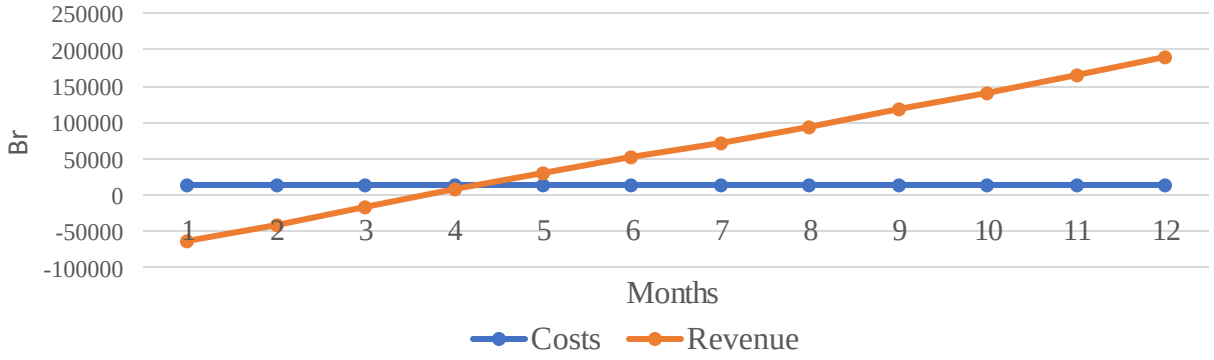



**Figure 3.2 – Break–even point**

Project risk is a concept associated with the uncertainty of the result (effect) of an investment project or in other words the possibility of unforeseen adverse events that could have a negative impact on the effect of the project. Possible risks of the project can be divided as follows:

Table 3.13 – Project risks classification.

| Risk | The corresponding parameter of the financial model |
|---|---|
| Market | Sales Volume |
| Capital | Capital expenditures or invested capital |
| Operating | Operating expenses |
| Currency | Exchange rate |

## 3.7 Risk analysis.

The main potential risk of the project is a low flow of customers and, as a result, failure to achieve the goal of 30% profitability. To reduce this threat, such an indicator as pricing policy was taken into account, as well as the level of services offered. Description and assessment of high risks, as well as recommendations for minimizing these risks are given in the table.

Table 3.14 – Project risk assessment and measures to prevent the occurrence and/or consequences.

| Risk | Probability | Severity of consequences | Prevention measures |
|---|---|---|---|
| Low flow of customers | high | high | Is not controlled. But there some prevention measures as: active work on attracting customers with the help of marketing tools, increasing their loyalty. |
| Increase in costs. | high | high | Find another video analytics service company. |
| Customers will not pay the bills | high | high | Create additional legal requirements for drivers compulsory technical inspection, that all parking bills should be paid to have technical inspection approved. |

Sensitivity analysis (sensitivity analysis) – a method for assessing the impact of the main parameters of the financial model on the resulting indicator (NPV). Suppose a pessimistic scenario with changes according two high risks mentioned in the Table above:

- 20% drop in sales;

  or
- 25% increase in costs.

Evaluating the impact on economic model it can be predicted changes could be as follows:

Table 3.15 – Pessimistic scenario calculations.

| | Optimistic scenario | Drop of sales 20% | Increase in costs 25% |
|---|---|---|---|
| Payback period, years | 0,83 | 1,51 | 1,24 |
| Discounted Payback period | 1,04 | 1,90 | 1,56 |
| Net Present Value (NPV) | 245516 | 85254 | 126563 |
| Internal Rate of Return (IRR) | 119% | 62% | 77% |
| Modified Internal Rate of Return (MIRR) | 155% | 140% | 144% |
| Profitability Index (PI) | 2,4 | 0,8 | 1,2 |

The decrease in sales on 20% reduce NPV by 65,28%, and increase of expenditures give the reduction of NPV by 48,45%. Changes in Net Cash Flow are given in the Figure below.

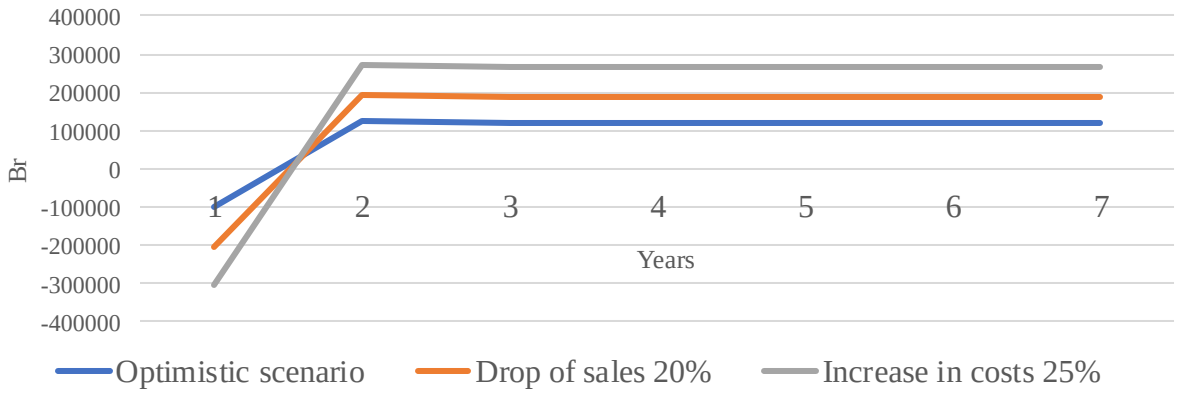



**Figure 3.3 – Changes in Net Cash Flow**

Competitor growth is evaluated also as uncontrolled risk. To minimize the risk the company has to use competitive advantages, considering the possibility of using loyalty programs.

## CONCLUSION.

Thus, in this work, we studied the main theoretical and practical aspects of creating a business plan.

The main issues arising in the preparation of a business plan are investigated.

The structure of the business plan, the procedure for accounting for the costs of its development. The business plan of the kids indoor play cafe was drawn up and the main financial indicators of its activities for the first year of work were analyzed.

When developing this business plan the main goal was pursued: to calculate the number of necessary investments in a new project and the economic effect from the implementation of this project.

The calculations made showed that the business can achieve its goal.

Project implementation requires 101 577.3 Br.

With the skillful management of costs in the 0,5 year of work, it is possible to make a profit of 4727 Br.

Analyzing financial indicators, it can be argued that the main expense item is service maintenance.

The payback period of the project is 0,83 years which is very fast.

Break–even point at 4th month of operation with the revenue 24116 Br.

Based on the available financial indicators of the business plan, in conclusion it should be noted that the proposed business plan was successful.

Table 3.16 – Integral assessment of the project, affecting the main indicators of profitability and financial stability.

| N | Indicators | Value | Comment |
|---|---|---|---|
| | **Iindustry** | | |
| 1 | The global market for smart parking systems | $ 10.3 billion | By 2025 |
| 2 | The Belarus Parking Market Revenue annually | $ 4 million | |
| 3 | Densely built–up city among European million–plus cities | 3–rd place | |
| 4 | Customers | 1178798 | Population of the city of Minsk aged 18 to 60 years in 2021 |
| 5 | Population ages 18–59 in thousands in Minsk | 71% | |
| 6 | Urban vs rural population growth | 0.5% | Plus, to urban population every year |
| 7 | Real disposable income | + | Positive growth tendency |
| 8 | GDP per capita | + | Positive growth tendency |

Continuation of the Table 3.16

| N | Indicators | Value | Comment |
|---|---|---|---|
| 9 | Growth dynamics of paid parking spaces from 2018 to 2020 | 1 336 to 5 000 | spaces and it is planned to expand to 7,000 spaces. |
| 10 | Current public paid parking collection rate | 35% | |
| 11 | Iindustry profitability | 25% | |
| 12 | Number of competitors in industry | 30 | 5000 places |
| 13 | Current strategy | + | Strategy allows to cope with threats and use opportunities at an acceptable level. |
| | **Market research** | | |
| 14 | % Of drivers who don't pay for parking | 50% | |
| 15 | % Of those who do not pay know that there is no responsibility for non–payment of the fine. | 64% | The penalty for non–payment of the fine is minor. |
| 16 | Drivers consider parking available and service at an acceptable level driver are unaware of the lack of punishment. | 82% | |
| 17 | The main factor influencing the payment of the paid parking service | 52% | |
| | **Marketing** | | |
| 18 | Profit target – Return on investment after | after 12 months | |
| 19 | Profit target – Income from sales | 60% | Per month. |
| | **Impementation** | | |
| 20 | Duration of the pilot project | about 4.5 months | |
| | **Production** | | |
| 21 | Total capital for the project | 109 547 Br | |
| | **Finance** | | |

Continuation of the Table 3.16

| N | Indicators | Value | Comment |
|---|---|---|---|
| 22 | Planning period | 6 years | |
| 23 | Occupancy rate | 92% | |
| 24 | Refinancing rate | 12% | |
| 25 | Inflation | 14.11% | |
| 26 | Cumulative refinancing rate | 26.11% | |
| 27 | Price list | Fixed | |
| 29 | Payback period | 0,83 | |
| 30 | Discounted Payback period | 1,04 | |
| 31 | Net Present Value (NPV) | 245516 | |
| 32 | Internal Rate of Return (IRR) | 119% | |
| 33 | Modified Internal Rate of Return (MIRR) | 155% | |
| 34 | Profitability Index (PI) | 2,4 | |
| 35 | Return on sales, % | 42% | |
| 37 | Break–even point | 4 month | Of operations with the month revenue 22792 Br. |

The smart paid parking project is profitable and viable.

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# APPENDIX A

Table A.1 PESTEL evaluation Matrix.

| | | | | t | | t+3 | |
|---|---|---|---|---|---|---|---|
| **N** | **Factors/events/tendencies** | **O/T** | **Weight** | **Raiting** | **Weight score** | **Raiting** | **Weight score** |
| **Political** | | | | | | | |
| 1 | **Tax policies.** Increasing taxes on car imports. | Threat | 0,1 | 4 | 0,4 | 4 | 0,4 |
| 2 | **Foreign trade regulations.** Smart parking equipment is imported into Belarus and changes in trade regulations may create a risk of increasing the cost of equipment or problems with its delivery to Belarus. | Threat | 0,1 | 3 | 0,3 | 4 | 0,4 |
| 3 | **Government expenditure.** Capital expenditures could be decrease in a case of some emergencies and it can reflect negatively on new technological infrastructure that requires continuously maintained service. | Threat | 0,04 | 4 | 0,16 | 4 | 0,16 |
| **Economical** | | | | | | | |
| 4 | **Monetary policies.** Contractionary monetary policy of Belarus that tries to achieve decrease of inflation can lead to higher exchange rate and reduce export of necessary equipment. | Threat | 0,09 | 3 | 0,27 | 4 | 0,36 |
| 5 | **Level of disposable income.** Changing the basket of products consumed in the industry. Refuse/ reduction in expenditures to consume offered services. | Threat | 0,07 | 4 | 0,28 | 4 | 0,28 |
| **Social** | | | | | | | |

Continuation of the Table A.1.

| N | Factors/events/tendencies | O/T | Weight | Raiting | Weight score | Raiting | Weight score |
|---|---|---|---|---|---|---|---|
| 6 | **Population size and growth.** In general population growth in the country has a negative trend, but Minsk population of the age 18–59 years old is constantly growing. | Opport-unity | 0,08 | 4 | 0,32 | 4 | 0,32 |
| 7 | **Population mobility.** People have wide variety of options how to move in a city and new options appear every year. Public transport availability and evolution of taxi and shearing services can lead to declining of car usage. | Opport-unity | 0,08 | 4 | 0,32 | 4 | 0,32 |
| **Technological** | | | | | | | |
| 8 | **Rates of obsolescence.** Technologies are developing quickly and the software becomes outdated, but the modularity of the smart parking system with video analytics allows it to be maintained and expanded. | Threat | 0,08 | 3 | 0,24 | 4 | 0,32 |
| 9 | **The speed of technology transfer.** The amount of data transmitted in real time and the number of calculations required is really large and requires high powers and speeds. In the event of a drop in speed, the smart paid parking service may lose its relevance. | Threat | 0,12 | 1 | 0,12 | 2 | 0,24 |
| **Environmental** | | | | | | | |

Continuation of the Table A.1.

| N | Factors/events/tendencies | O/T | Weight | Raiting | Weight score | Raiting | Weight score |
|---|---|---|---|---|---|---|---|
| 10 | **Protection legislation. Decree of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus dated February 19, 2021 N 6 "On approval of environmental standards and regulations".** In this Decree are we can see a list of Initiatives focused on conservation of natural resources, reducing carbon and greenhouse gas emission. It is part of sustainability trend and all decree provides all important KPI's of pollution in cities. Each KPI has average maximum level and in 2022 this maximum can decline.[17] | Opport-unity | 0,04 | 4 | 0,16 | 4 | 0,16 |
| **Legal** | | | | | | | |
| 11 | **Decree No. 589 (Decree of the President of the Republic of Belarus dated October 3, 2006 No. 589 "On streamlining the work of car parks and car parks.").** Decree, which regulates liability for non–payment for parking, is currently being negotiated. It will enter into force in 2022. When liability for non–payment of parking spaces is introduced, the collection will increase.[16] | Opport-unity | 0,12 | 4 | 0,48 | 4 | 0,48 |

Continuation of the Table A.1.

| N | Factors/events/tendencies | O/T | Weight | Raiting | Weight score | Raiting | Weight score |
|---|---|---|---|---|---|---|---|
| 12 | **Decree No. 466 (Decree of the President of the Republic of Belarus dated 15.12.2016 No. 466 "On Approval of the Program of Socio–Economic Development of the Republic of Belarus for 2016–2020").** It is declared that the budget–tax is aimed at improving the efficiency of using budget funds and their concentration in priority areas of socio–economic development while maintaining the social orientation of budget expenditures and increasing their share for innovative development.[18] | Opport-unity | 0,08 | 4 | 0,32 | 4 | 0,32 |
| | **Total** | | **1** | | **3,37** | | **3,76** |

Table A.2. The codebook.

| N | The name of the variable | Assigned response code |
|---|---|---|
| 1 | What is your gender? (V1) | 1 – Male<br>2 – Female |
| 2 | What category does your monthly income fall into? (V2) | 1 – up to 1000 $<br>2 – from 1000 to 2 000$<br>3 – from 2 000 + |
| 3 | What category does your age belong to? (V3) | 1 – From 18 to 30<br>2 – From 30 to 40<br>3 – From 40 to 50<br>4 – From 50 to 60<br>5 – From 60+ |

Continuation of the Table A.2.

| N | The name of the variable | Assigned response code |
|---|---|---|
| 4 | How often do you pay for open paid parking without a barrier, if there is an opportunity not to do this? (V4) | 1 – Always<br>2 – Sometimes<br>3 – Never |
| 5 | How do you rate the paid parking service in Minsk from 0 to 5 points at the moment? (V5) | 1 – 0 points. Paid parking is not available and the quality of service is low<br>2 – 1 point Paid parking is available, but the quality of service is low<br>3 – 2 points. Paid parking is available, the quality of service is average, needs to be improved<br>4 – 3 points. Paid parking is available, the quality of service is acceptable<br>5 – 4 points. Paid parking is available, the quality of service is high |
| 6 | What are the reasons why you do not pay paid parking? (V6) | 1 – I save<br>2 – I think parking should be free.<br>3 – in a hurry<br>3 – Another variant |
| 7 | What factor is decisive for you when paying for paid parking? (V7) | 1 – Fear of punishment<br>2 – Social responsibility<br>3 – External control<br>4 – Another variant |
| 8 | Do you know that at the moment there is no administrative liability for non–payment of a parking fine in Minsk? (V8) | 1 – Yes<br>2 – No |

Table A.13 – Interview questions for experts.

| N | Questions |
|---|---|
| 1 | Which factors influence driver to pay for a paid parking? |
| 2 | Why drivers don't pay paid parking? |
| 3 | What characteristics of paid parking are of paramount importance for drivers? |
| 4 | What are the problems with the service at the moment? |
| 5 | What is the main drawback of Smart Parking? |

Table A.14 – Checking the correspondence of the questionnaire questions with the search questions.

| N | Main Questions | Questions for drivers |
|---|---|---|
| 1 | Driver portrait | – What is your gender?<br>– What category does your monthly income fall into?<br>– What category does your age belong to? |
| 2 | How many drivers park in an open paid parking without a barrier, but do not pay for the service? | – How often do you pay for open paid parking without a barrier, if there is an opportunity not to do this? |
| 3 | How many drivers rate the quality of paid parking service as "average" or "below"? | – How do you rate the paid parking service in Minsk from 0 to 5 points at the moment? |
| 4 | How many drivers believe that the main factor influencing their choice not to pay paid parking is the lack of control? | – What factor is decisive for you when paying for paid parking? |
| 5 | How many drivers know that at the moment in Minsk there is no administrative liability for non–payment of a parking fine? | – Do you know that at the moment there is no administrative liability for non–payment of a parking fine in Minsk? |

Table A.5 – How often drivers pay for paid parking.

| Answers | How often do you pay for paid parking? |
|---|---|
| Always | 139 |
| Sometimes | 40 |
| Never | 121 |
| **Grand Total** | **300** |

**Checking data.**

**Table A.6 – Hypothesis.**

In order to check the reliability of the obtained data, we put forward a null hypothesis.

H0: Variable "Actions of drivers in relation to paying for paid parking" is evenly distributed.

Table A.7 – Observed data.

| **Observed** | |
|---|---|
| Always | 139 |
| Sometimes | 40 |
| Never | 121 |
| **Total** | **300** |

Table A.8 – Expected data.

| **Expected** | |
|---|---|
| Always | 100,0 |
| Sometimes | 100,0 |
| Never | 100,0 |
| **Total** | **300** |

Table A.9 – Deviations for data.

| **Deviations** | |
|---|---|
| Always | 15,2 |
| Sometimes | 36,0 |
| Never | 4,4 |
| **Total** | **55,62** |

Table A.10 – Chi Square value, Degree of freedom and P–value.

| | |
|---|---|
| Chi Square value | 40,4 |
| DF | 1 |
| p–value | 0% |

Chi Square value is bigger then 3.841 and p–value is 0 so we can reject Ho hypothesis;

Table A.11 – Cross Table of Data: Variables: "Do drivers know about lack of liability" and "How often drivers pay for a parking".

| **Do you know that at the moment there is no administrative liability for non–payment of a parking fine in Minsk?** | **How often drivers pay for a parking** | | | |
|---|---|---|---|---|
| **Answers** | Always | Never | Sometimes | **Grand Total** |
| No | 97 | 20 | 26 | **143** |
| Yes | 42 | 100 | 15 | **157** |
| **Grand Total** | **139** | **120** | **41** | **300** |

## Checking data.
## Table A.12 – Hypothesis.

In order to check the reliability of the obtained data, we put forward a null hypothesis.
H0: Variable "Knowledge about liability" does not affect the "Payment frequency" variable.

Table A.13 – Observed data.

| **Observed** | Always | Never | Sometimes | **Total** |
|---|---|---|---|---|
| No | 97 | 20 | 26 | 143 |
| Yes | 42 | 100 | 15 | 157 |
| **Total** | 139 | 120 | 41 | **300** |

Table A.14 – Expected data.

| **Expected** | Always | Never | Sometimes | **Total** |
|---|---|---|---|---|
| No | 66 | 57 | 20 | 143 |
| Yes | 73 | 63 | 21 | 157 |
| **Total** | 139 | 120 | 41 | **300** |

Table A.15 – Deviations for data.

| **Deviations** | Always | Never | Sometimes | **Total** |
|---|---|---|---|---|
| No | 14 | 24 | 2,13 | 40,6 |
| Yes | 13 | 22 | 2 | 37,0 |
| **Total** | 27,26 | 46,23 | 4,08 | **77,6** |

Table A.16 – Chi Square value, Degree of freedom and P–value.

| | |
|---|---|
| Chi Square value | 87,7 |
| DF | 6 |
| P–value | 0% |

Chi Square value is bigger then 5.991 and p–value is 0 so we can reject Ho hypothesis;

Table A.17 – Cross Table of Data: Variables: "The frequency of drivers' payments for paid parking" and "The factors that decisive for the drivers when they pay for paid parking".

| **How often do you pay for paid parking?** | **The factors that decisive for the drivers when they pay for paid parking** | | | |
|---|---|---|---|---|
| **Answers** | External control | Fear of punishment | Social responsibility | **Grand Total** |
| Always | 59 | | 80 | **139** |
| Never | | 80 | 40 | **120** |
| Sometimes | | | 41 | **40** |
| **Grand Total** | **59** | **80** | **161** | **300** |

## Checking data. Table A.18 – Hypothesis.

In order to check the reliability of the obtained data, we put forward a null hypothesis. H0: Variable "Payment frequency" does not affect "Factors that decisive for the drivers when they pay for paid parking" variable.

Table A.19 – Observed data.

| **Observed** | External control | Fear of punishment | Social responsibility | **Total** |
|---|---|---|---|---|
| Always | 59 | 0 | 80 | 139 |
| Never | 0 | 80 | 40 | 120 |
| Sometimes | 0 | 0 | 41 | 41 |
| **Total** | 59 | 80 | 161 | **300** |

Table A.20 – Expected data.

| **Expected** | External control | Fear of punishment | Social responsibility | **Total** |
|---|---|---|---|---|
| Always | 27 | 37 | 75 | 139 |
| Never | 24 | 32 | 64 | 120 |
| Sometimes | 8 | 11 | 22 | 41 |
| **Total** | 59 | 80 | 161 | **300** |

Table A.21 – Deviations for data.

| **Deviations** | External control | Fear of punishment | Social responsibility | **Total** |
|---|---|---|---|---|
| Always | 37 | 37 | 0 | 74 |
| Never | 24 | 72 | 9 | 105 |
| Sometimes | 8 | 11 | 16 | 35 |
| **Total** | 68 | 120 | 26 | 214 |

Table A.22 – Chi Square value, Degree of freedom and P–value.

| | |
|---|---|
| Chi Square value | 214,4 |
| DF | 4 |
| p–value | 0% |

Chi Square value is bigger then 9.488 and p–value is 0 so we can reject Ho hypothesis;

Table A.23 – Drivers' opinion according current service quality level.

| **Answers** | **How do you rate the paid parking service in Minsk from 0 to 5 points at the moment?** |
|---|---|
| 0 point. Paid parking is not available, the quality of service is low. | 0 |
| 1 point. Paid parking is available, but the quality of service is low. | 55 |
| 2 points. Paid parking is available, the quality of service is average. | 107 |

Continuation of the Table A.2.

| **Answers** | **How do you rate the paid parking service in Minsk from 0 to 5 points at the moment?** |
|---|---|
| 3 points. Paid parking is available, the quality of service is acceptable. | 123 |
| 4 points. Paid parking is available, the quality of service is high. | 15 |
| **Grand total** | **300** |

**Checking data.**
**Table A.24 – Hypothesis.**

In order to check the reliability of the obtained data, we put forward a null hypothesis.
H0: Variable "Drivers' opinion according current service quality level" is evenly distributed.

Table A.25 – Observed data.

| Observed | |
|---|---|
| 0 | 0 |
| 1 | 55 |
| 2 | 107 |
| 3 | 123 |
| 4 | 15 |
| Total | 300 |

Table A.26 – Expected data.

| Expected | |
|---|---|
| 0 | 60 |
| 1 | 60 |
| 2 | 60 |
| 3 | 60 |
| 4 | 60 |
| Total | 300 |

Table A.27 – Deviations for data.

| Deviation | |
|---|---|
| 0 | 60 |
| 1 | 0 |
| 2 | 37 |
| 3 | 66 |
| 4 | 34 |
| Total | 197 |

Table A.28 – Chi Square value, Degree of freedom and P–value.

| | |
|---|---|
| Chi Square value | 197,1 |
| DF | 4 |
| p–value | 0% |

Chi Square value is bigger then 3.841 and p–value is 0% so we can reject Ho hypothesis;

Table A.29 – Awareness of drivers that there is no administrative responsibility for non–payment of parking fines in Minsk.

| Answers | Do you know that at the moment there is no administrative liability for non–payment of fines for parking in Minsk? |
|---|---|
| Yes | 156 |
| No | 144 |
| **Grand total** | **300** |

## Checking data. For Table A.30 – Hypothesis.

In order to check the reliability of the obtained data, we put forward a null hypothesis.

H0: Variable "Awareness of drivers that there is no administrative responsibility for non–payment of parking fines in Minsk" is evenly distributed.

Table A.31 – Observed data.

| **Observed** | |
|---|---|
| Yes | 156 |
| No | 144 |
| **Total** | **300** |

Table A.32 – Expected data.

| **Expected** | |
|---|---|
| Yes | 150 |
| No | 150 |
| **Total** | **300** |

Table A.33 – Deviations for data.

| **Deviation** | |
|---|---|
| Yes | 0,24 |
| No | 0,24 |
| **Total** | **0,48** |

Table A.34 – Chi Square value, Degree of freedom and P–value.

| | |
|---|---|
| Chi Square value | 0,5 |
| DF | 1 |
| p–value | 49% |

Chi Square value is less then 3.841 and p–value is 49% so we can't reject Ho hypothesis.

Table A.35 – TOWS analysis.

| | | **Opportunities** | | **Threats** | |
|---|---|---|---|---|---|
| | **N** | **1** | **2** | **1** | **2** |
| **Strengths** | **1** | We will increase the collection of parking fees from 70% to 100%. | We are guaranteed to be able to count on the financing of our project from the state budget. We will receive funds for the implementation in full. | We will leave prices fixed in case of a crisis, instead of switching to a flexible pricing system, this will allow drivers to continue using the service as usual | We will set increased requirements for the stability of the Internet and equipment in the best locations. |
| | **2** | We will be able to change the tariff from fixed payment prices to a flexible parking payment system. | If we set a flexible pricing tariff, we will be able to return the money received from the budget for the project implementation faster. | We will leave a fixed payment for the service in case of a crisis. | We can raise prices in a fixed amount in case of additional costs to ensure the smooth operation of the service. |
| **Weaknesses** | **1** | We will teach the model to collect additional statistics and sell it to private companies in order to compensate for the high cost of maintenance. | We will be given enough time to phase the project and reduce the cost of the final service. | We will leave a fixed payment for the service in case of a crisis. We will fix all cases of failures and improve the system. | We will increase the quality of the Internet to the maximum in problem areas. We will reduce the cost–of–service maintenance by selling statistics. |
| | **2** | We can create standards for acceptable equipment ourselves and thus increase the reliability of the system. | We will install a parking machine at each paid parking lot in case of a failure in the service. We will reduce the cost of service maintenance by selling statistics. | We will install a parking machine at each paid parking lot in case of a failure in the service. We will leave the prices for the service fixed in case of a crisis | Set up a backup system in case the main system fails. |

# APPENDIX B

Table B.15 – Company's Activity by Osterwalder Business Model.

<table>
<tr><th>Key Partners</th><th>Key activities</th><th>Value proposition</th><th>Relationships with clients</th><th>Consumer segments</th></tr>
<tr><td rowspan="3">1. Municipal unitary enterprise "Center for Information Technologies of the Minsk City Executive Committee". 2. Republican fund of universal communication and informatization service. 3. Ministry of Internal Affairs. 4. Bank "Belarus bank". 5. Equipment suppliers. 6. Companies providing equipment installation services and video analytics maintenance services. 7. Companies providing cloud infrastructure and computer software. 8. Companies developing software and mobile applications. 9. Insurance companies. 10. Belstat.</td><td>1. Automated parking service of open and closed types in the form of providing parking spaces with payment by the hour or by subscription with automatic accounting of parking time and online billing.<br>2. Accident warning.<br>3. Providing a Mobile application for searching and booking parking spaces.<br>4. Providing an online platform for working with the service.</td><td rowspan="3">1. The company strives to satisfy the need of Minsk drivers for an affordable, tech-advanced and high-quality parking service.<br>2. The company ensures the safety of cars in the parking lot.<br>3. The company provides the clients with the fastest parking with a clear automated account of the time of using the service. 4. The company provides the client with a service for searching and booking a parking space in a specified location through a MA, and also provides information about the nearest available parking spaces if an unbooked space is occupied upon the client's arrival at the location.</td><td>1. Mobile application interface.<br>2. SMS<br>3. Email address<br>4. Personal account on the state online platform.<br>5. Surveys on the quality of service based on the state platform in order to obtain feedback from users.<br>6. Advertising in the subway.</td><td rowspan="3">1. Geographic: Minsk.<br>2. Demographics: men aged 18-49;<br>3. Socio-economic: working, with an average and above average income.<br>4. Psychographic: success-oriented thinkers are open to new ideas, are active consumers, value useful experience. They lead a technological lifestyle.<br>5. Behavioral: motivation based on the pursuit of the ideal. When considering the purchase of a service, first of all, they prefer a stable and reliable service.</td></tr>
<tr><td>Key resources</td><td>Sales channels</td></tr>
<tr><td>1. Leased capacities of infrastructure and software.<br>2. Equipped workstations for system administrators.<br>3. Collected video analytics statistics.</td><td>1.People living in a densely populated residential area of the city.<br>2.People who work in institutions in the city center.</td></tr>
</table>

Continuation of the Table B.1

| Cost Structure | | | Income streams | | |
|---|---|---|---|---|---|
| | to revenue 2023 | to revenue 2022 | | 2023 | 2022 |
| cost of sales | **59.3%** | **58.9%** | **revenue** | **278 444** | **278 444** |
| sales and marketing expenses | **1.7%** | **1.7%** | | | |
| | | | | | |
| Administrative expenses | **20.2%** | **19.79%** | | | |
| financial expenses | **40.65%** | **0.04%** | | | |
| profit | **40.7%** | **41.1%** | | | |

Table B.2 Model of digital transformation within the framework of the modified strategic map of R. Kaplan and D. Norton.

| Chapter | Model | KPI |
|---|---|---|
| **Finance** | Project's budget | – Payback period;<br>– Discounted Payback period;<br>– Net Present Value (NPV);<br>– Internal Rate of Return (IRR);<br>– Modified Internal Rate of Return (MIRR);<br>– Profitability Index (PI); |
| **Clients** | Segment of current customers | – increasing the effectiveness of promotion;<br>– increase in conversion;<br>– increase in the number of customers<br>– involved in digital marketing and communication channels; |
| **Processes** | Digitalization processes are separated into a separate project | – reduction of process execution time;<br>improving the accuracy of operations;<br>decrease in the level of errors due to the minimization of the human factor; |

Continuation of the Table B.2

| Chapter | Model | KPI |
|---|---|---|
| **Staff** | Digital competencies are formed for a specific project. Full–time staff has been allocated for the digital project. | – reduction of time of routine work due to process automation;<br>– availability of employee analytics; |
| **Technology** | Embedded in the digital project without affecting the main processes | – the degree of development of key digital;<br>– technologies for the company;<br>– the level of use of information systems;<br>– level of data integration;<br>– share of automated processes; |

Table B.3 Models of digital maturity (by groups of factors).

| Model and developer | Level of digital maturity | Evaluation parameter |
|---|---|---|
| **Client approach (clients)** | | |
| Digital Transformation Maturity Model [Sirius, 2017] | 0. Preparatory<br>1. Online sales marketing<br>2. Omnichannel<br>3. Progressive digital business | – high customer confidence;<br>– high customer loyalty;<br>– collected customer reviews;<br>– collected behavioral characteristics of customers; |
| **HR approach (competencies)** | | |
| Digital Competency Maturity Model [ICAI, 2017] | 1. Automation of internal processes2. Availability of digital competencies 3. Automation of reporting processes | – the system of the pilot project provides for the introduction and management of digital identifiers.<br>– the pilot project system provides for the introduction of digital internal communications;<br>– there is centralization of information management;<br>– there is IT infrastructure management competencies;<br>– there is digital professional ethics;<br>– there is digital content; |

| | | |
|---|---|---|
| | | – there is protection of digital assets; |

Table B.4 Functional requirements for video analytics system components.

| N | Functional Requirement |
|---|---|
| **Video analytics system** | |
| 1 | Analysis of video traffic with VHN, detection of free and occupied parking spaces (parking lots) |
| 2 | The possibility of gluing into a single image video from several cameras, providing a single rendering of vehicles, parking spaces |
| 3 | Automatic real–time recalculation of the state (presence or absence of parking marks) in case of a change in the situation |
| 4 | Automatic real–time recalculation of the number of free parking spaces in case of incorrect parking of vehicles (for 2–3 spaces), or parking of oversized vehicles |
| 5 | Detection and exclusion of the influence of static objects, including small ones (cones, fences, garbage cans, etc.) |
| 6 | Detection and exclusion of the influence of passing vehicles, passing pedestrians, etc. |
| 7 | Detection of the moment of entry and exit of the vehicle into the parking space (zone) |
| 8 | Ability to select video information according to specified time parameters and events for viewing, copying and playback |
| 9 | Possibility of graphical display (marking) of places (zones) where parking according to traffic rules and/or road signs is prohibited<br>– automatic detection<br>– input and teaching in manual mode |
| 10 | Ability to detect violations of the rules for stopping and parking vehicles:<br>– by time (more than 5 minutes)<br>– by registration number<br>– on the fact of parking in a prohibited zone |
| **Web interface** | |
| 1 | Administration (management) of all system functions from a personal computer |
| 2 | Display of free and occupied seats with icons of different colors (green and red) |

| | |
|---|---|
| 3 | The possibility of graphic designation of parking spaces intended for parking vehicles belonging to the disabled (yellow) |
| 4 | Visual display of parking markings on polygons with separate color gradation: car, parking space, cars parked in violation of traffic rules |
| 5 | Displaying addresses (locations on the map) known to the application of paid parking in the city of Minsk |

Continuation of the Table B.4

| N | Functional Requirement |
|---|---|
| 6 | Separate (different) display of open–type paid parking lots and car parks |
| 7 | Separate (different) display of closed–type paid parking lots and car parks |
| 8 | Providing information on the opening hours of paid parking, service organizations, cost of services |
| 9 | Ability to view images from a video camera in the parking lot:<br>– statistical image<br>– video stream (stream) in real time |
| 10 | When scaling, grouping parking lots by the total number of spaces and the number of vacant ones, and when zooming in, detail or (if the scale is minimal) display a parking plan showing the actual location of free (green space) and occupied (red car icon) spaces |
| 11 | Displaying information about the registration plate of the vehicle (if the registration plate is in the field of view of the video camera) |
| 12 | Possibility of graphical display (marking) of places (zones) where parking according to traffic rules and/or road signs is prohibited |
| 13 | Possibility of manual training (adjustment) of the video analytics (AI) system if parking spaces, platforms or objects are recognized (marked) incorrectly |
| 14 | The software interface (Admin panel) is branded under the CIT of the Minsk City Executive Committee |
| 15 | Availability of an API for connecting a mobile application |

Table B.5 Action Plan to organize and conduct a pilot project "Creation of a pilot zone for test operation of a segment of an automated system for informing citizens about the availability of free spaces in paid parking lots in Minsk".

| N | Event | Deadline | Responsible |
|---|---|---|---|
| Preparatory activities | | | |

| | | | |
|---|---|---|---|
| 1. | Development and distribution for approval of the draft terms of reference for the implementation of the Pilot Project | April | CIT, GO |
| 2. | Finalization of the terms of reference, taking into account the received comments and suggestions, re–sending (if necessary) | May | CIT, GO |
| 3. | Approval of the revised version of the terms of reference | June 1st | CIT, GO |

Continuation of the Table B.5

| N | Event | Deadline | Responsible |
|---|---|---|---|
| Organizational and technical measures | | | |
| 4. | Signing of an agreement on the implementation of a pilot project (agreement on interaction) between the NGO "Garages, parking lots and parking lots" and the PUE "Center for Information Technologies of the Minsk City Executive Committee" | within 10 calendar days from the date of approval of the TOR | GO, CIT |
| 5. | Elaboration of organizational and technical issues with potential participants, including suppliers of video analytics software, signing an agreement, cooperation agreements | within 20 calendar days from the date of signing the cooperation agreement (hereinafter – calendar days) | CIT, PS |
| 6. | Inspection of the parking space (zone) for the need for video surveillance equipment, possible places for their installation, availability of engineering infrastructure, coordination with the owners of buildings and structures , etc. | within 25 calendar days | CIT, GO |
| 7. | Survey and analysis of the existing information system for managing the parking space of the Stolitsa shopping center to determine the technical feasibility of automated (remote) obtaining | within 28 calendar days | GO, CIT |

| | | | |
|---|---|---|---|
| | information about free and occupied parking spaces, harmonization of technical conditions for connection | | |
| 8. | Preparation, including the acquisition, if necessary, of technical means of a video surveillance system, means of communication | within 30 calendar days | CIT, GO |

Continuation of the Table B.5

| N | Event | Deadline | Responsible |
|---|---|---|---|
| 9. | Preparation (selection) and configuration of server equipment for receiving and storing video streams coming from the video surveillance system | within 10 from the moment of implementation of point 8 | CIT |
| 10. | Installation and configuration of video surveillance system elements | within 5 calendar days from the date of implementation of clause 8 | CIT, GO |
| 11. | Carrying out preparatory activities to refine and configure existing software solutions (server part) | within 45 calendar days | CIT, PS |
| 12. | Integration of prepared software solutions with a video surveillance system | within 50 calendar days | PS, CIT |
| 13. | Integration and connection of the existing information system for managing the parking space of the Stolitsa shopping center | within 50 calendar days | GO, PS |
| 14. | Preparing and configuring a Web application (administrator console), mobile applications (app) for Android ( iOS ) | within 50 calendar days | CIT, PS |
| Test operation | | | |

| | | | |
|---|---|---|---|
| 15. | Trial run of the integrated system, tuning and refinement to ensure stable performance | within 52 calendar days | CIT, GO, PS |
| 16. | Start of test operation of the elements of the pilot project, provision of interested copies of the software, credentials for test access | within 55 calendar days | CIT, GO, PS |

Continuation of the Table B.5

| N | Event | Deadline | Responsible |
|---|---|---|---|
| 17. | Completion of measures to set up the main functionality of the system, including the authorization system and the payment system | within 50 calendar days | PS, CIT |
| 18. | Demonstration of the existing functionality of the system to interested representatives of the Minsk City Executive Committee | within 58 calendar days | CIT, GO |
| 19. | Fixing the received functionality of the system and making a decision to start public testing | within 60 calendar days | CIT, PS |
| Conducting a pilot zone and analyzing the results | | | |
| 20. | Start of public testing with the participation of a wide range of potential consumers (drivers) | within 60 calendar days | CIT, GO, PS |
| 21. | Collection, processing and analysis of incoming feedback from users, elimination of identified comments and suggestions, submission, if necessary, of new versions of mobile applications | within 90 calendar days | CIT, GO, PS |
| 22. | Analysis of the results obtained during the implementation of the pilot project | within 100 calendar days | CIT, GO, PS |
| 23. | Preparation and coordination with stakeholders of the report on the implementation of the pilot project, proposals for its further scaling | within 115 calendar days | CIT, GO |

| | | | |
|---|---|---|---|
| 24. | Sending the final version of the report on the implementation of the pilot project to the Minsk City Executive Committee | within 130 calendar days | CIT |
| 25. | Coverage of the preparation and implementation of the pilot project, the results achieved in the media, preparation of relevant comments for the media | during the project | CIT<br>GO |
| 26. | Making a decision on the further operation of the organized pilot zone or its disbandment (dismantling and shutdown) | within 130 calendar days | CIT, GO, PS |

Abbreviations in the text of the Action Plan:

CIT – PUE "Center for Information Technologies of the Minsk City Executive Committee"; GO – GO "Garages, parking lots and parking lots"

Table B.6 Dimensions of land for storage and maintenance of vehicles.

| **Object name** | **Plot area per facility, ha** |
|---|---|
| Cargo automobile enterprise with a capacity, cars: | |
| 100 | 2.0–2.5 |
| 200 | 3.0–3.5 |
| 300 | 4.0–4.5 |
| 500 | 6.0–6.5 |
| Tram depot with capacity, wagons: | |
| without repair shops: | |
| 100 | 6.0–6.5 |
| 150 | 7.5–8.0 |
| 200 | 8.0–8.5 |
| with repair shops | |
| 100 | 6.5–7.0 |
| Trolleybus depot with capacity, trolleybuses: | |
| without repair shops: | |

| | |
|---|---|
| 100 | 3.5–4.0 |
| 150 | 5.5–6.0 |
| 200 | 6.0–6.5 |
| with repair shops | |
| 100 | 5.0–5.5 |
| Bus fleet with capacity, buses: | |
| 100 | 2.5–3.0 |
| 200 | 3.5–4.0 |
| 300 | 4.5–5.0 |
| 500 | 6.5–7.0 |

Continuation of the Table B.6

| **Object name** | **Plot area per facility, ha** |
|---|---|
| Taxi fleet, rental base (multi–storey) with a capacity of cars: | |
| 100 | 0.5 |
| 300 | 1.2 |
| 500 | 1.6 |
| 800 | 2.1 |
| 1000 | 2.3 |
| Garage for storage of cars with a capacity of 100 cars: | |
| one–story | 0.30 |
| double decker | 0.20 |
| three–storey | 0.14 |
| four–storey | 0.12 |
| five–storey | 0.10 |
| Surface car park with a capacity of 100 cars (including driveways) | 0.25 |
| Car service stations with capacity, posts: | |
| 10 | 1.0 |
| 15 | 1.5 |
| 25 | 2.0 |
| 40 | 3.5 |
| Filling station with capacity, dispensers: | |
| 2 | 0.10 |

| | |
|---|---|
| 5 | 0.20 |
| 7 | 0.30 |
| 9 | 0.35 |
| 11 | 0.40 |

Table B.7 – Classification of vehicles according to their dimensions.

| N | Class | Sizes | Description |
|---|---|---|---|
| | | *Cars* | |
| 1. | A | length<br>no more than 3.8 m. | Particularly small class.<br>Includes small cars, designed mainly for operation in the city ("compact cars").<br>Representatives: Citroen C1, Hyundai i10, Peugeot 106, 107, Renault Twingo |
| 2. | B | length<br>from 4.2 to 4.5m, width<br>1.5–1.7 m. | Small class. A popular class of cars, usually with a hatchback body.<br>Typical representatives: Audi A1, Citroen C2, C3, DS3, Fiat Punto, Ford Fiesta, Kia Rio, Opel Corsa, Peugeot 205, 206, 207, Volkswagen Polo, Golf |
| 3. | C | length<br>4.2 – 4.5 m, width from 1.6 – 1.75m. | Middle or "golf" class.<br>Type representatives: Audi A3, BMW 3 Compact, 1–Series, Citroen Xsara, C4, Fiat Bravo/Brava, Ford Escort, Focus, Honda Civic, Hyundai Accent, Mazda 323, 3, Peugeot 309, 306, 307, 308, Renault Megane, Skoda Octavia, Subaru Impreza, Toyota Corolla, Volkswagen Golf, Jetta, Volvo C30, S40, V40 |
| 4. | D | length<br>from 4.6 to 4.9m | Middle class.<br>Type representatives: Audi 80, A4, BMW 3–Series, Citroen Xantia, C5, Ford Mondeo, Honda Accord, Hyundai Sonata, |

| | | | |
|---|---|---|---|
| | | | Mazda 626, 6, Mercedes C, Opel Ascona, Vectra, Insignia, Peugeot 405, 406, 407, 508 , Renault Laguna, Skoda Superb, Subaru Legacy, Toyota Avensis, Volkswagen Passat, Volvo S60, V60, V70 |
| 5. | E | length<br>from 4.9 to 5.1m | Business Class<br>Type representatives: Audi 100, A6, BMW 5–Series, Citroen C6, Chrysler 300C, Hyundai Grandeur, Lexus ES, GS, Mercedes E, Opel Omega, Peugeot 605, 607, Renault Safrane, Saab 9000, Toyota Camry, Volvo S80 |

Continuation of the Table B.7

| N | Class | Sizes | Description |
|---|---|---|---|
| 6. | F | length<br>over 5.1 m. | The highest (representative) class.<br>Typical representatives: Audi A8, BMW 7–Series, Hyundai Equus, Infiniti Q, Jaguar XJ, Lexus LS, Mercedes S, Volkswagen Phaeton |
| 7. | S | — | As a rule, sports cars (Porsche 911) and convertibles, as well as minivans or off–road station wagons (Lada Largus) |
| *Crossovers and SUVs* | | | |
| 8. | M | Length<br>from 4.3 to 4.8 m. | microvans, compact vans, minivans and MPVs |
| 9. | J | Length<br>from 4.3 to 4.8 m. | SUVs of different classes, crossovers |
| 10. | P | — | Pickups |