

## DEVELOPMENT STRATEGY OF SUSTAINABLE URBAN ENVIRONMENT IN JELGAVA

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**Abstract.** Taking into account that Jelgava is one of the largest cities in Latvia, the city's urban environment must show an example that it is possible to develop sustainably. As the city adopts the concept of smart city development, its urban systems should operate in a rapid and efficient manner, and the city itself should comply with the principles of smart city mobility. As smart cities nowadays are developing rapidly and an important factor is their management systems and the opportunities offered by the urban environment, it is also necessary to base development on the above-mentioned elements when planning the development strategy of Jelgava. Thus, over the next few years, Jelgava needs to be developed as a smart city with modern transport infrastructure and technology-based everyday life in other sectors as well. One of the most important elements of Jelgava's development is smart entrepreneurship, which, taking into account the current situation in Jelgava and trends in the development of the industry, can become one of the main cornerstones in the creation of a smart city. In addition, any smart city nowadays needs to involve its citizens as much as possible in the planning process. Active participation of citizens is one of the most important principles of successful urban development. In addition, it builds a cohesive and inclusive society, which also helps to build new generations of healthy, smart and sustainable-thinking members of society. The authors of the paper have developed conclusions and provided proposals for the further development of the urban environment of Jelgava, based on the principles of sustainable development and examples of smart cities in the world.

**Keywords:** development strategy, sustainability, sustainable development, urban environment.

### Introduction

With regard to the future direction of urban development, there is a consensus on the key principles for future urban and territorial development in Europe. One of the most important principles on which future development should be based is the growth of a balanced economy and the organization of territorial activities with a polycentric urban structure. In addition, this development should be based on well-organized and high-quality urban regions that are competitive both in their own country and in the region as a whole, and should be able to ensure good and orderly access to services in the economic sector. The development of the cities of the future is also related to the fact that as the urban population grows, the places increasingly shrink in the urban environment, and cities will therefore continue to expand and increase their areas. However, in order to ensure the smooth and sustainable development of cities, it is necessary to gradually reduce the size of these areas, thus increasing the density of the urban population and concentrating on the development of existing areas. In line with the principles of sustainable development, European cities need to ensure a higher level of environmental protection and the quality of the environment in the coming years, which has deteriorated rapidly in the 21<sup>st</sup> century. The future development of European cities should be based on thriving and dynamic small and medium-sized cities, which can act as European metropolises and become the research, service and business centres of a given regions. This would also ensure the merging of smaller and separate administrative territories into a single and strong mechanism [1].

The degradation and depletion of natural resources, pressure of climate change on green areas have become one of the major concerns for cities. In response to these problems, urban planning policies have shifted to a sustainable focus and cities have begun to develop new strategies for improving the quality of urban ecosystems. An extremely important function of an urban ecosystem is to provide healthy and sustainable environment for both natural systems and communities [2]. Nowadays urban design plays a key role in the creation of sustainable communities in terms of the three main dimensions of development – economy, environment and social dimension. Therefore, urban design seeks to enhance the life of the city and its inhabitants in accordance with socio-economic and environmental terms. However, the current approach to urban design is mainly top-down – generally, the architects or the planners design the urban environment and at the implementation stage the community may have some involvement [3].

Therefore, cities start implementing the concept of sustainable development and other resource-efficient concepts. Jelgava is one of the most dynamic small and medium-sized cities in Latvia. It is also the research, cultural-historical and tourism centre of Zemgale region. The city of Jelgava is located in an advantageous geographical position, as it is crossed by international and national transport routes, and the city is relatively easy and convenient to reach from the point of view of the capital city and other development centres of national importance [4]. The aim of the research is to develop a concept of a sustainable urban development strategy for the city of Jelgava.

## Materials and Methods

The present research is based on the following research methods: literature analysis, monographic or descriptive, observation, mathematical and statistical methods, such as descriptive statistics which is the form of a quantitative data collection and aggregation process used to transform data from a large number form to a form that is convenient for human perception and further analysis, as well as survey.

Within the framework of the research, a survey “Sustainable Urban Development Strategy in Jelgava” was conducted to find out the opinion of residents of Jelgava and surrounding cities and municipalities about the current situation of urban environment in Jelgava and its future development opportunities. The survey consisted of 12 questions covering the gender, age group, place of residence and questions regarding the development of urban environment of Jelgava. 210 respondents took part in this survey, from which 67.6% were residents of Jelgava. Other respondents were residents of Jelgava and Ozolnieki municipalities, whose daily life is closely related to the city of Jelgava. In total, 42.9% of respondents were in the age group of up to 20 years. 18.6% of respondents were in the age group of 21 to 30 years, while 15.7% of respondents were aged 31 to 40. As a result, more than 75% of respondents were under 40, which represents the population, which at least the next 15 to 20 years will be significantly interested in the processes in the city. Among respondents, there were scholars from schools of Jelgava. It is crucial to take into account the opinion of young generations about the urban environment in Jelgava, as this population group is already actively using the urban environment and in the future will be those who will be able to develop the city.

In order to establish the concept of the development strategy, the residents of Jelgava were introduced to five potential directions of sustainable development, from which one specific direction had to be chosen for promoting the sustainable development of Jelgava’s urban environment:

1. Industrial city with developed industry and production;
2. Intelligent or smart city with a modern transport infrastructure and technology-based everyday life;
3. Environmentally-friendly city with a wide range of recreational opportunities;
4. Tourist city;
5. Student city with developed educational infrastructure.

Taking into account the population of the city and limited financial resources, the city of Jelgava is likely to focus on one of the proposed directions of sustainable development, on which to base the sustainable development of the urban environment, supplementing it with the most appropriate opportunities from other directions of sustainable development. For example, the development of the city could be based on the concept of a smart city, supplemented with environmental improvement measures, thus trying to maximize the opportunities to spend free time in well-maintained and tidy recreation areas. This way, the development of the city would also include the features of the concept of environmentally-friendly urban development, which would complement the main directions of sustainable urban development.

## Results and Discussion

The importance of sustainability, sustainable development and related issues is addressed in various researches [5-9]. To ensure the sustainable development of urban environment in European cities also in the future, it is necessary to find solutions to the various problems that affect the cities themselves and their residents. One of the main challenges is a demographic change in the urban environment, as more and more European cities are facing an aging population problem. As the influence of several large cities in the region reduces, it also has some effect on the urban population – as the city’s greatness and competitiveness reduce, the competitiveness of the city residents in the global market decreases as well.

More and more people are being excluded from the labour market or forced into low-skilled and low-paid jobs as progress in the overall interaction among economic growth, employment and social affairs is declining [1].

Apart from the problems of social development, one of the main threats to sustainable territorial development is the gradual expansion of cities and the expansion of low-density settlements. Due to the fact that public services and resources are becoming more expensive and it is more difficult to provide all members of society with resources, as well as natural resources are used inefficiently, municipalities are not able to provide the same services to residents from distant regions compared to residents of more densely populated areas. As cities and their surroundings expand, it is more difficult to provide public transport networks throughout the territory, as it is not cost-effective. In this case, the municipality uses the available resources in an inefficient and unsustainable way. If public transport services are not fully provided in cities, the population's dependence on individual vehicles and their daily use increases immediately [1].

The potential of socio-economic, cultural and intergenerational diversity, including the ethnic diversity created by the process of globalization, has been mentioned as one of the main positive aspects of European cities in a pathway towards sustainable development. In order for cities to be able to ensure sustainable development in the future, it is necessary to unite the society in a group, where different members of society can be co-responsible and united, as well as society should be tolerant and respect all its members. Within this united society, it is necessary to be able to find ways to reduce spatial exclusion and energy poverty in order to make cities and their neighbourhoods not only attractive and adaptable to modern living conditions, but also to improve the state of environment. Apart from improving their own housing and competitiveness, cities as a whole should strive to become greener and healthier [1].

The sustainable urban development model of the future also requires the adoption of new management methods that address urban challenges in an integrated and coherent way, based on the day-to-day use of different innovations and technologies. The model should also have coherent and site-specific and people-based approaches and principles that help address existing management challenges. For example, existing governance structures that aim at achieving sustainable urban development need to be combined with a variety of informal and freely existing governance structures that can address the internal challenges of a neighbourhood. Existing governance systems should also create common frameworks within which it is possible to develop shared visions, given that involving different informal bodies with as different views as possible should enable matching of competing goals and objectives in a single development model [1].

In the context of sustainable urban development, urban governance systems are complex mechanisms that are able to adapt to different changing circumstances and take into account a cross-sectoral vision rather than relying on the need for a single sector. Community involvement in planning process is one of the cornerstones of successful territorial development [10]. Within the governance system, it is necessary to integrate governance arrangements based on citizen participation and the involvement of all actors in society in order to create innovative uses of social capital. In this way, public space is also expanding and citizens are becoming more active, sustainable and open to creativity and innovation [1].

Good examples of sustainable urban development in global scale are the cities of Barcelona and Copenhagen, which are known for their smart and sustainable transport infrastructure solutions. Barcelona is known for its high level of development, which is strongly influenced by its smart traffic and parking management system, as well as its new lighting system. The city stands out with its smart energy efficiency management system, which, according to the latest research, will save the city 9.5 billion euros per year. In addition, Barcelona is applying a series of traffic restriction measures that aim at renewing and reducing the amount of circulating vehicles to improve the air quality. The measures include changes in the built environment to reduce private vehicle space in specific areas through the so-called "superblocks" and tactical urban planning actions [11]. In turn, Copenhagen can be considered one of the possible examples in the field of cycling infrastructure. In the 20th century, the city launched initiatives such as "Car-free Sundays" and "Copenhagen without Cars", which promoted the development of cycling culture and marked a new trend or the Danish model. The Danish model determines the development of street space for all road users equally for pedestrians, cyclists and

motorized transport. Within the framework of the Danish model, the construction of bicycle lanes together with roads is provided. The streets in the city are being rebuilt and the beneficiaries are all the city residents, not just a certain group of society [12]. Copenhagen is also an example on how to coordinate the different modes of public transport in terms of journey duration and waiting time, the adequacy of transfer points to ensure a smooth transfer from one mode of transport to another, and the importance of the availability of convenient access and disembarkation modes [13].

Norway is also a great example of smaller and larger cities aiming to improve the competitiveness of public transport compared to private vehicles. In Norwegian cities, the public transport system is organized in such a way that greater frequencies and direct connections are more important than shorter walks to stops, encouraging people to travel by public transport. Walking distances to local public transport stops should increase in proportion to the size of the city [14]. The trend towards smart cities can also have a positive impact on various areas of the city, including transport. Public transport can be made more attractive by choosing the right mode of public transport to accommodate other elements of a smart city. In this way, the city can achieve greater use of public transport in the city, and reducing the share of individual transport will improve the overall quality of life of the population [15].

The survey “Sustainable Urban Development Strategy in Jelgava” conducted within the framework of the research clarified the opinion of the residents about the future development of Jelgava. An important indicator for analyzing the satisfaction of the city’s population and the potential development of the urban environment itself is the assessment of the quality of life, which includes physical well-being, material well-being, interpersonal relationships, personal development, emotional well-being, social inclusion and other emotional characteristics. It is an important aspect, because a sustainable city is based on a modern-minded, healthy and satisfied citizen who is able to make a logical and reasoned assessment of their daily life and make the necessary improvements in the city as well. It is often possible to observe that people will not be satisfied with their workplace, the processes taking place in the city and the country, if there are problems and difficulties in everyday life. Respondents rated their quality of life in Jelgava with an average of 3.59 points out of 5, which indicated that the population was generally satisfied with their life.

In order to analyze the shortcomings and problems in the urban environment, it is necessary to find out exactly what objects of the urban environment should be created in Jelgava, aiming to make it more diverse and lively. According to the respondents, the most necessary object in the urban environment is cinema (148 respondents). A cinema is one of the elements of the urban environment that encourages the city’s residents, especially young people, to gather in a certain place where they can spend their leisure time. Creating a square or park nearby will also create opportunities for outdoor cafes, shops and lounges. Respondents stress also the need for recreational areas (94), improved sports infrastructure (73) and pedestrian and bicycle paths (68) (see Fig 1).

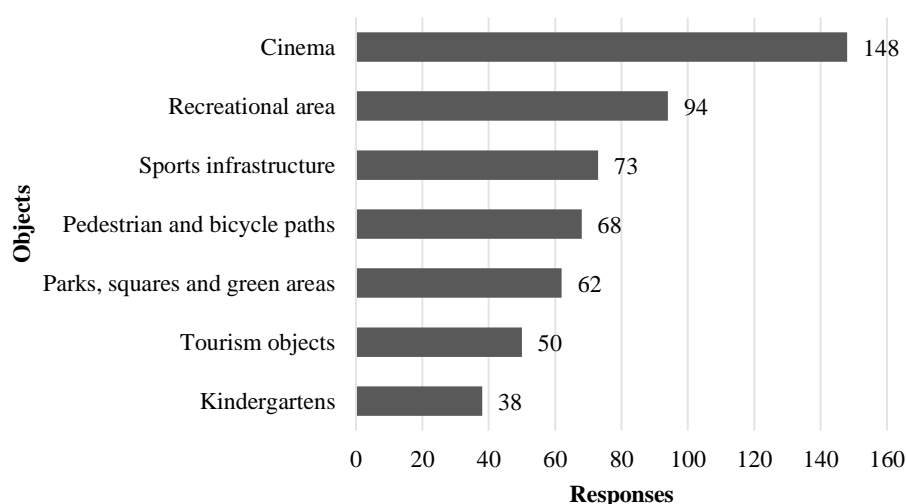


Fig. 1. Most necessary urban objects in Jelgava according to the results of the survey (developed by the authors)

However, there is still a significant development opportunity by involving the population more in the planning process. 33% of respondents believe that Jelgava should continue to develop as a smart city, the development of which is based on the creation of modern transport infrastructure and everyday technologies (see Fig. 2). In turn, 32% of the respondents expressed a desire to see Jelgava as an environmentally-friendly city with a wide range of recreational opportunities.

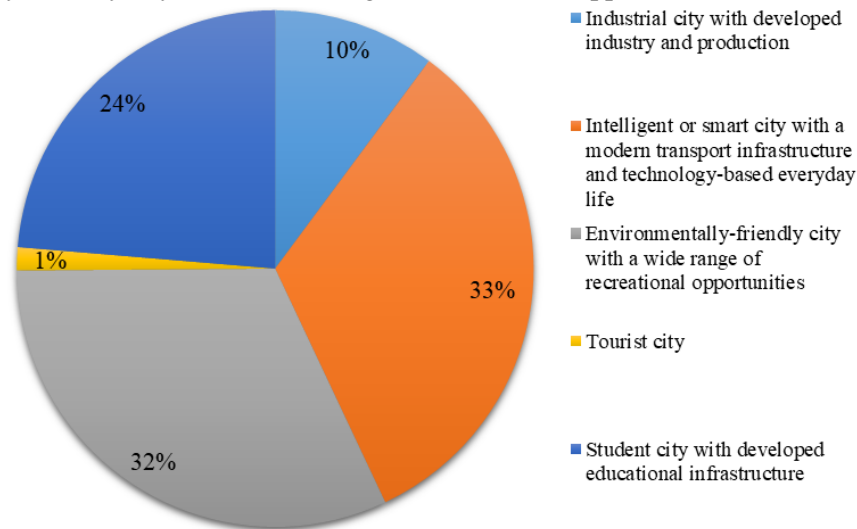


Fig. 2. Concept of sustainable urban development in Jelgava (developed by the authors)

When developing the concept of sustainable urban development of Jelgava with the aim to create it as a smart city with modern transport infrastructure and technology-based everyday life in the next 10 years, it is necessary to evaluate in which sectors, apart from transport infrastructure, the city can develop in a smart direction. While the transport infrastructure already has certain elements based on modern technologies, such as a traffic light system, data acquisition sensors and video cameras, other sectors do not have such elements and thus the process of developing a sustainable strategy or plan is more complicated. Therefore, in order for Jelgava to become an intelligent or smart city, the concept of sustainable urban development should primarily include the transport infrastructure.

In order for Jelgava to become a smart city in the next 10 years, the development of which is based on sustainable development, three main directions or pillars are put forward (see Fig. 3). The first development direction is sustainable transport infrastructure, which is a large and complex sector, but taking into account the current development directions of Jelgava, the sector is well developed and includes basic smart technologies that can be used as a basis for the development of the city. The second main direction or pillar is an educated and sustainability-minded smart citizen. As it happens with the implementation of any plan, a high level of citizen involvement is also required in the development of a sustainable development strategy. The city’s population needs to be educated as smart and intelligent people who use the principles of sustainable development on a daily basis. The third direction of the development of sustainable urban environment of Jelgava is smart entrepreneurship, which, taking into account the current situation in Jelgava and tendencies in business development, can become one of the main cornerstones in the creation of a smart city.

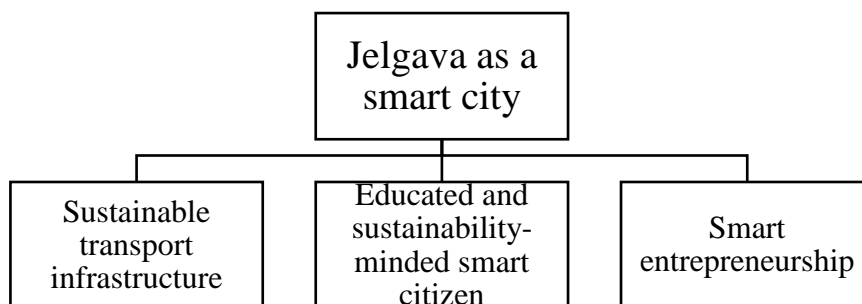


Fig. 3. Main pillars of development of sustainable urban environment of Jelgava (developed by the authors)

As one of the main pillars of the concept of sustainable urban development is sustainable transport infrastructure, which is already well developed in Jelgava, its development should be further implemented in three different interrelated directions: public transport infrastructure, individual vehicle infrastructure, as well as pedestrian and cycling infrastructure (see Fig. 4). As these elements of transport infrastructure are at different condition and require different improvements, the elements should also be prioritized within the pillar itself, taking into account the impact of the improvements on the overall progress of sustainable development. In the current situation, the development level of public transport infrastructure is the weakest compared to individual vehicle infrastructure and pedestrian and cycling infrastructure. In addition, it also has the greatest impact on other elements of transport infrastructure, as improvements in the public transport system will also indirectly improve the overall urban transport infrastructure.

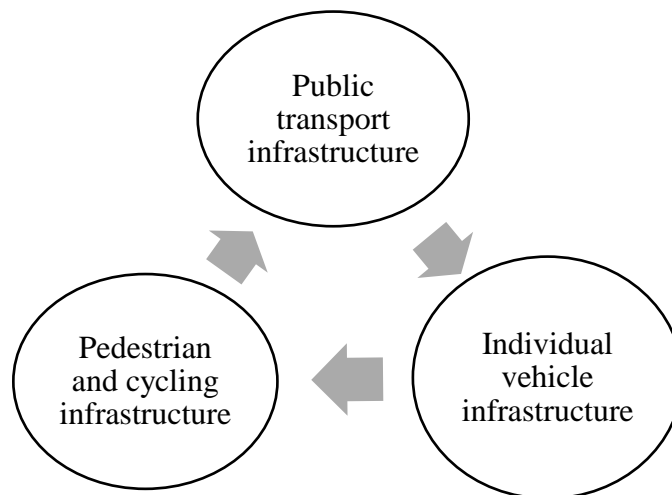


Fig. 4. Sustainable development of transport infrastructure (developed by the authors)

In order to start the organisation and development of the field in the direction of smart transport infrastructure, it is necessary to completely transform the existing public transport system in the next 10 years, using the model of Barcelona as a good practice, as this city rationally combines different modes of public transport, which is the main problem for the city of Jelgava. In order to achieve the goal of this development concept, it is primarily necessary to create a single point of public transport hub, where both the central railway station and the bus station are located. In addition, in this case, the bus routes and their timetable need to be adapted to the timetable of the intercity train, so that passengers can travel flexibly using both modes of public transport. By creating a unified bus and train network, a unified public transport system will be created for the population, which will not require an individual vehicle for daily use, as well as the need for parking lots at the railway station will be reduced.

Apart from the creation of a single public transport hub, over the next 10 years Jelgava will also have to switch to the use of fully environmentally-friendly public transport in the city. To achieve this goal, only buses that run on electricity and hydrogen should be used on city bus routes. This way, Jelgava would also become the first city in the country to ensure public transport only by environmentally-friendly buses. In addition, the municipality needs to launch a project to develop hydrogen and green electricity plants from renewable energy sources in the city area so that city buses can be supplied with environmentally-friendly energy, the costs of which are optimized given the low cost of relocating resources.

With regard to the implementation of the sustainable development of pedestrian and cycling infrastructure, it is necessary to define and also implement their establishment simultaneously with the arrangement of the rest of the city street network. Given that the construction of individual paths without street reconstruction, or at least the restoration of the pavement, is an economically inefficient use of resources in most cases, a practice to include the reconstruction or construction of pedestrian and cycling routes in all street reconstruction works should be adopted. Within the framework of the concept of sustainable development, it is also necessary to create new landscaped paths on 5 high-importance streets in the city over the next 10 years, where historically there has not been infrastructure for pedestrians and cyclists (see Fig. 5). Pedestrian and cycling routes of high importance are on Kalnciema

road to the administrative border of the city, continuing the existing path from Loka highway, Satiksmes Street, Rūpniecības Street, Tērvetes Street and Miera Street. These streets are of high importance in Jelgava with high traffic intensity. In general, it is desirable to adopt the good practice of Copenhagen in the development of pedestrian and cycling transport infrastructure in Jelgava, which is the best option for the situation in Jelgava, both in terms of climate and financial possibilities.

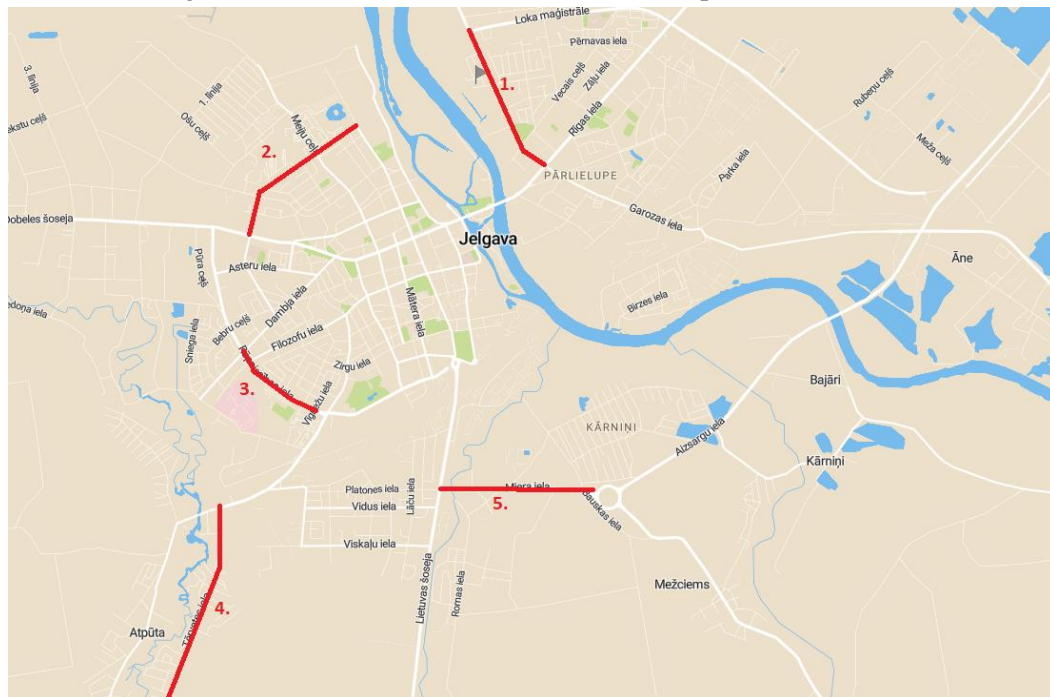


Fig. 5. Potential cycling transport roads in Jelgava (developed by the authors)

In turn, with regard to the third element of sustainable transport infrastructure – individual vehicle infrastructure – the strategy should maintain the priority already set within the long-term development strategy of Jelgava for 2007–2020 – to create a city with a modern and sustainable living environment, within which transport infrastructure must be further developed based on the development of smart technologies on the streets. By developing as many main streets as possible in the city centre and its surroundings, a network of streets can be created that can optimize the number of vehicles in the city centre. However, in order to create a complete city bypass transport network within the concept of sustainable development, the task is to build a multimodal crossing over the Lielupe River in the next 10 years, which would ensure infrastructure development in the city's outer circle and create new business opportunities in the former aerodrome area [16].

The second pillar of the concept of a sustainable urban development strategy is an educated and sustainability-minded citizen. Given that the culture and historical events of Eastern Europe have also influenced the development of society and its attitude towards the role of community, it is necessary to create a united, co-responsible and inclusive society with modern-minded and educated citizens. If improvements are not made in the change of public attitudes and co-responsibility, then social exclusion and spatial segregation among the residents of Jelgava could increase. In addition, taking into account that the aging of the housing stock and the relatively low level of development are also current problems in the city of Jelgava, the risk of social exclusion is particularly high, as people are constantly exposed to social stratification and different living conditions. To solve the problem and have educated and sustainability-minded population living in Jelgava, it is necessary to further develop both the infrastructure of educational institutions and smart technologies in it, as well as the educational programmes. Apart from the development of the education sector, every city resident needs a free urban space with various types of recreational opportunities that helps create a healthy and educated citizen. In addition, under Pillar 1 of the concept of the sustainable development strategy – transport infrastructure –, smart citizens should be encouraged to adopt smart and green solutions in their daily lives.

Taking into account the improvements already made in the city, as well as the planned improvements in the transport infrastructure sector in line with the concept of sustainable urban development, the third pillar of sustainable urban development is smart entrepreneurship. Jelgava has historically been known as an industrial and innovative city with several competitive and recognizable companies both in Latvia and worldwide. As the development and growth of these companies have also improved the transport infrastructure in several business districts, such as Rubeņu Road, Prohorova Street, Garozas Street and Neretas Street, it can be concluded that the two sectors interact closely and their development is closely interlinked, and depend on each other. Therefore, within the framework of further sustainable urban development, it is necessary to develop entrepreneurship – in a smart and sustainable way.

For entrepreneurship development, it is necessary to develop both existing and competing companies that have been operating in Jelgava for several years, as well as attract new companies that could start their operation in the organized and adapted business territories in Jelgava. If the existing business territories or industrial parks have already been filled and it is not possible to establish another production plant, then in the newly planned industrial park territory in the former aerodrome it is necessary to attract companies wishing to operate in the Latvian market, as well as it would be desirable that companies are involved in manufacturing that incorporates smart technologies and environmentally-friendly practices. In a city that is based on the principles of sustainable development, it is particularly important to develop companies with a similar vision and paradigm. As it is planned to develop public transport infrastructure and services in Jelgava in accordance with the sustainable urban development strategy, including more and more public transport powered by electricity and hydrogen, it would be necessary to attract a company that is able to produce and provide the necessary energy resources [16].

In order to create and develop the smart business sector in the city of Jelgava, it is necessary to develop principles that entrepreneurs should strive to follow. The most important principle in the development of smart business is the mutual communication among the involved parties – entrepreneurs, city management, economic and business specialists, developers, etc. This way, joint work would be organized to regulate the field and attract investment throughout the region. It would also be desirable to set up a common system for collecting business data on resource use, indicators characterizing sustainable development goals and other relevant indicators to help attract new enterprises and investors. Smart infrastructure and smart energy are the elements of smart entrepreneurship as well. The development of smart infrastructure involves different types of automated systems that are able to continuously manage and communicate among different types of mechanisms and systems in a company without human intervention, such as energy transmission, transport network and water management systems.

In general, smart cities in different areas and sectors can bring significant benefits in the context of sustainable development when they all operate in a single and coherent system. Thus, it is possible to make improvements both in the development of the urban environment and in other set goals for sustainable development. Achieving the set goals and visions requires a successful and constructive planning process, involving the participants of all groups of society in order to jointly implement the set goals in life.

## Conclusions

The authors have developed the following conclusions.

1. By improving the car infrastructure in Jelgava, additional car units are attracted, which leads to additional traffic jams and causes the need for the infrastructure to be improved again;
2. The city of Jelgava should look for ways to free its central part from cars in order to make it more friendly to pedestrians and cyclists, thus limiting car traffic in this area of the city;
3. Smart cities are municipalities that make extensive use of information and communication technologies to increase operational efficiency, share information with the public and to improve both the quality of government services and the well-being of citizens;
4. The smart city concept is being applied by the world's metropolises that are looking for new ways to become more citizen-friendly and energy-efficient, as cities currently spend significant financial resources to ensure a successful and sustainable operation;



5. Jelgava City Municipality should implement innovative projects that could serve as pilot projects, such as the creation of a bicycle lane on the street or the complete transformation of a street into a pedestrian and bicycle street.
6. Results of the survey “Sustainable Urban Development Strategy in Jelgava” revealed that inhabitants are generally satisfied (3.59/5) with life in Jelgava. Satisfaction rates could be increased by making such improvements in urban area as building a cinema (148 respondents), developing recreational areas (94), developing sports infrastructure (73), developing pedestrian and bicycle paths (68) and developing parks, squares and green areas (62).
7. According to the respondents of the survey, potential community-supported directions of sustainable development would be: 1) Intelligent or smart city with a modern transport infrastructure and technology-based everyday life (supported by 33% of respondents); 2) Environmentally-friendly city with a wide range of recreational opportunities (supported by 32% of respondents); or combination of previously mentioned and other potential directions of sustainable development.
8. In the next 10 years, Jelgava City Municipality must become a smart city, the development of which is based on sustainable development. Therefore, its strategy must include 3 main directions of development: sustainable transport infrastructure, educated and sustainability-minded smart citizen, and smart entrepreneurship.
9. For the development of the urban environment and its elements, Jelgava City Municipality needs to transfer good practices from Barcelona and Copenhagen, where successful solutions have already been implemented that are able to ensure the full operation of the systems, and adapt these good practices to the conditions of Jelgava.
10. Educational institutions of Jelgava in cooperation with the Jelgava City Municipality must create educational programs that inform about the ongoing processes in the city in connection with sustainable development in order to create an intelligent citizen.

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### Author contributions

Conceptualization, R.B., J.Z. and I.G.; methodology, R.B., J.Z. and I.G.; validation, R.B., J.Z. and I.G.; formal analysis, R.B., J.Z. and I.G.; resources, R.B., J.Z. and I.G.; data curation, R.B., J.Z. and I.G.; writing – original draft preparation, R.B.; writing – review and editing, R.B., J.Z. and I.G.; visualization, R.B.; supervision, I.G.; project administration, J.Z. and I.G.; funding acquisition, I.G. All authors have read and agreed to the published version of the manuscript.

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