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Decision-Making within Smart City: Waste Sorting

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Abstract: The concept of the Smart City is the answer for the majority of the challenges of an increased rate of urbanization. However, the implementation of the ideas of the Smart City faces some difficulties. It is a necessity to correspond to the sustainability pillars and the decisive role of the population in all processes, and correspondently the necessity to comprehend what factors influence the decision-making process. The research goal of this paper is to analyze the factors determining the decision of the population of multi- and one-family houses to sort waste. The data were collected via population survey of the Vidusdaugavas region of Latvia and semi-structured interviews of municipal councils' representatives. Both parties—population and authorities—have mentioned the existence of more negative factors of waste sorting in their life than positive ones. For authorities, the most important externalities of waste sorting have an economic nature, while, for citizens, the factors of convenience are not less important than costs. The problem was considered from the position of municipal authorities and the local population, and the identification of problems and misunderstanding is a possibility to start effective communication between the two parties. Moreover, the analysis of the literature has shown that Scandinavian countries and west European countries, which started their way towards implementing smart sustainable cities significantly earlier than Latvia, had the same stages. The most important factor for constructing a smart sustainable city is the changing the way of thinking of population.

Keywords: smart sustainable city; decision on waste sorting; multi- and one-family houses; interviews and surveys; analysis

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1. Introduction

The world changes very quickly, and one of the components of these changes is the great rate of urbanization. It is forecasted that, by 2050, the level of urbanization will be about 74.87% in the six biggest regions of the world [1]. The growth of the urbanization rate all over the world has contributed significantly to the birth of the concept of the Smart City, which is one of the most promising paradigms of urban development [2,3]. The new life organization has brought new tendencies in all areas of city life, including economy, ecology, and the social sphere. Many issues have appeared which require special attention and very specific activities from city authorities, businesses, and the population. It also brings new trends in economic development [4], as well as new social and ecological tendencies. In response to these issues and the necessity to solve the urgent problems of urban development, the paradigm of the Smart City has appeared.

Nowadays, the Smart City is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and businesses [5–7]. The real challenge for the Smart City is to correspond to the sustainability pillars and to organize all the services for achieving the "green" aims; therefore, waste management becomes one of the most important and urgent tasks for Smart City authorities; the European legislation [8] also gives special priority to waste management.

However, the population, being a constituent part of the Smart City, have the decisive role in all the processes within it [9]. Therefore, the study of the behavior of people can

contribute significantly to all processes in the city. This refers to waste management as well, since the people determine the level of sustainable and green behavior, contributing to implementation of the idea of Smart City.

The goal of this research is to consider the positive and negative factors of waste sorting from the position of Smart City authorities and Smart City population of one region of Latvia, and to draw conclusions to improve waste sorting by households.

The novelty of this research is in analyzing the well-studied operation—waste sorting—not only from the position of the population, their motivators, and their intentions, but also from the position of local municipal authorities. The simultaneous consideration of the waste sorting process from different points of view provides additional insights for the existing problems and misunderstandings and facilitates the elaboration of solutions for the problematic issues. Therefore, the local authorities can improve the situation with waste sorting by population.

Therefore, the value of this research is in practical application. The results demonstrate the existing gaps in problem vision by people and by authorities. The problem recognition allows finding the solution, using the experience of other smart sustainable cities. As a result, the authorities could intensify waste sorting in the Vidusdaugavas region in Latvia.

Another novelty is the analysis produced for the provincial cities, but not big urban centers. Usually, the researches cover entire countries or big cities and the results are quite similar to the investigations in other countries or big cities [10]; nevertheless, the situation in the areas apart from big cities should also be considered [11]. The authors of the research analyze the situation in three small cities in one of the most depressive parts of Latvia, and the results can be interesting for other researchers studying the issue.

It is also interesting that the study has been conducted in the provincial cities of Latvia, which is a typical representative of CEE countries; this fact allows for the assumption that the results could be interesting for the local authorities of other CEE countries in the process of organizing and successfully operating waste sorting procedure.

The research is not oriented on the discussion of various systems of waste sorting, only on factors, important for organizing the process of waste sorting in the region.

2. Literature Review

The Smart City has become an answer to the contemporary challenges of globalization, urbanization, and sustainable development [1,2], though it still requires development and advancement.

One of the most important areas of Smart City functioning is city population. Population is the source of productivity and competitiveness capacity [12–17].

People are sources of improvement of the social sphere of the city, and they also implement these changes. All green innovations, including waste management technologies, are dependent on people and their readiness to participate in the processes. People actively affect the urban environment [9].

Another important tendency of contemporary urban development is the green dimension. The paradigms of the Smart City and sustainable city have many common issues [9,18–20].

One of the points common for smart and sustainable cities is waste management. Some researchers, for example [21], suppose it to be the most important problem of the Smart City. It allows solving such issues such as emissions, rational use of energy, production of energy from alternative sources, changing the urban environment in general, etc.

Waste management improves the general green performance of the Smart City [22] and advances it in solving the most urgent problems of the ecological pillars of the Smart City [23].

Moreover, waste management should be oriented towards solving the issues of circular economy, which can be implemented within the Smart City as well. The city is the main consumer of many products, and, therefore, the city is also responsible for a decreased amount of available natural resources. According to the European Parliament, the natural

resources should be substituted by the recycled materials involved in the production of goods [24]. Waste management consists of several stages, and these stages differ depending on the way that waste is utilized. However, smart waste management presupposes the waste sorting as a mandatory stage [11,25–27].

Waste sorting means the separation of the materials which can be used for further recycling from those which are not recyclable anymore, and should be transported to a landfill for disposal [28]. Moreover, the process of waste sorting is very important, and it must be organized at the place of waste generation; in the case when the waste has been transported unsorted to the collection points, it is of very bad quality: it is wet, dirty, and cannot be subjected to sorting, or sorting will be of very low quality. This presupposes the close attention to waste sorting of the population, and the necessity to determine the factors influencing people's behavior and attitudes towards waste sorting. By sorting waste, we maintain a clean environment and protect the natural resources [29]. The responsible attitude towards environment and waste management as its constituent part has become a way of living for many people, changing human behavior and moral maxims. Therefore, consider the personal moral norms in population behavior regarding waste management and investigate the intention and behavior of population towards waste sorting [11]. Many researchers in their studies write about rational behavior of people as a result of thorough thinking over and planning their activities, and this refers to waste sorting at its full scope [30,31]. Therefore, the importance of changing the way of thinking is very difficult to overestimate. Special efforts should be applied to communication with people and educating them regarding waste sorting and its necessity [11,32,33].

The attempts to organize waste sorting started in the period of WWII, when countries participating in the war initiated campaigns of collecting some unused goods for further recycling [34]. After WWII, some countries continued the same policy, especially concerning paper and metals. Mostly, this was connected with an attempt to have more available resources for production of goods, especially when the purchasing habits of the population changed and people wanted to own more and more products. Only closer to the end of the 20th century did the collection of unused products for further recycling become the sign of a changed way of thinking and new attitudes towards nature, the environment, and ecology. Already in the 1990s, waste sorting had attained its legal basis first in Germany, and a bit later in other EU countries [35,36]

According to [34], nowadays, when the local authorities and governments see the real threat of lack of resources, they take active efforts to create a legal basis for waste sorting. Moreover, the quality of waste sorting has regular improvements [37,38], and this initiative is supported by producers as well. As a result, there is a real possibility to change to circular economy and closed life cycle of a product—from cradle to grave principle in action.

Society gains from circularity greatly, since it contributes to new thinking of city population, changes the priorities towards the healthy way of living, and decreasing the psychological consequences of poverty.

However, the municipal government can receive an additional heavy financial burden, since waste sorting requires a lot of additional resources [11,32].

In general, the economic implication of waste management is very important, though the economic approach towards smart solutions in the Smart City is represented insufficiently [4]. Therefore, this research, considering the economic impact of waste sorting operations, should contribute to the economic substantiation of smart solutions in the Smart City.

Waste management, capable of increasing the green performance of the Smart City, is especially important for Latvia, which has a very high green rating, although it is mostly gained due to using renewable energy sources, which means a high rate of deforestation for the country [39]. Waste treatment contributes to a better position of the country on green lists without causing such serious problems as deforestation; the population of Latvia understands the importance and necessity of it, since wrong waste treatment causes significant problems for the country ecology.

The problem of waste sorting in Latvia has been actively studied in the published works of other researchers. Much attention has been paid to the problem of construction waste [40], waste processing into energy [41–43], waste composition [44], and waste management technologies [45]. The issues of behavior of the population towards waste sorting was studied in such research as [46–49].

3. Materials and Methods

This section refers to the methods employed for analysis of positive or negative factors affecting waste sorting according to municipalities and city population. It was decided to analyze this using qualitative data obtained via surveys and interviews. The research used the primary data. We also used the general scientific methods, providing the necessary level of analysis of the scientific literature referring to the issue, as well as normative and legal acts. The information on the availability of waste treatment services was also searched for on the Internet.

It is important to mention that some studies used for analysis were published quite a long time ago—15 years ago or even earlier. This research was conducted by Scandinavian or West-European scholars and was urgent for the situation in those countries at that period. This fact evidences that Latvia, after joining the European Union, passes the same stages on the way to sustainable Smart City development as these countries in the past periods.

The first part of the study referred to surveying the population. The survey was designed by the authors to evaluate the waste sorting attitude of the population of the region. The data were collected in three different ways: via social network; personal invitations; households received the invitation for online survey in flyers put in mailboxes. The invitations were given to the residents of three Latvian cities of the Vidusdaugavas region: Jekabpils, Aizkraukle, and Madona. In total, 1063 households participated in the study (J*ekabpils*—421 surveys, *Aizkraukle*—379, *Madone*—263). One hundred and seventy (16%) households represented the one-family houses and 893 (84%) households represented the multi-family houses. The survey consists of three parts. The first part contains the general questions about the respondent (age, gender, education, family status). The second part comprises the questions on the household (household type, income), and the third part—about waste sorting impact factors. The questions of part three were divided into three sections: (1) various questions about understanding the necessity of waste sorting; (2) the questions about readiness to sort waste and the reasons for the answer (this section also included open-answer questions); (3) questions about motivators for the population to sort their waste. We used a 5-point Likert type scales (1 = Strongly Disagree, 5 = Strongly Agree) and 3-point type scale (Yes, No, Not Sure). The choice of 5-point Likert scale is based on the fact that the survey is presupposed for municipality residents, and this system is more acceptable for the elderly persons who understand the school time 5-point grading system [50,51].

A structured questionnaire was used for obtaining qualified data from the municipal authorities, which are experts om waste treatment in the region. It was done via direct interviews with the bureaucracy of various levels, and five people, representing the municipal authorities of the region, participated in the study. These questions were different from the questions to the population. The authorities were asked whether it is beneficial or not to sort waste for the municipality, what difficulties they face in this process, what difficulties they forecast for the nearest, middle-term, and long-term future, what should be done to improve the situation, and so on.

The choice of methods was predetermined by the necessity of finding out what factors have an impact on the waste sorting procedure. This process started in cities of Latvia only a few years ago, and it is still not very popular. Therefore, the authors of this research suppose that communication with people is the best way to discover the reasons for participating in waste sorting, and surveying and interviewing seem to be the most appropriate forms.

The obtained results of both surveys and interviews were grouped manually. They will be presented in the Results section.

The research is not aimed at presenting various contemporary structures, systems, and mechanisms of waste sorting used over the world.

4. Results

4.1. Households Survey

The research was implemented in three cities of the region. In Je*kabpils*, we obtained 421 surveys, in *Aizkraukle*—379, and in *Madona*—263. The districts do not differ significantly by structure of population and other parameters. The cities under research have rather many private owned houses for one family. The number of surveys from these households were separated due to the fact that they consider the issue of waste sorting differently compared to the residents of multi-family houses, and, therefore, factors important for them are different. The distribution of survey answers between the multi-family and one-family houses is shown in Figure 1.

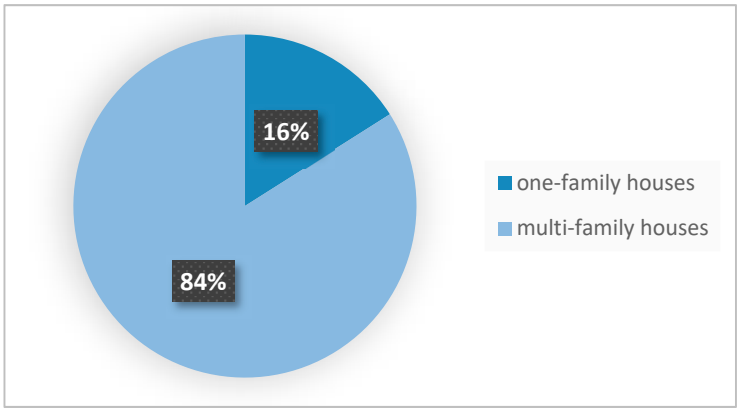


Figure 1. One-family and multi-family houses that participated in the research. (Source: generated by the authors).

4.2. Positive and Negative Factors for One-Family Houses

One-family houses traditionally have a small yard next to the house, and people usually grow, in these yards, some trees, bushes, and plants. This influences their relations to sorting waste. They usually digest the biodegradable waste for use as a fertilizer for their gardens. Therefore, these households implement the initial sorting originally. Another important factor is that these households pay for unsorted waste individually while, in multi-family houses, the tariffs are calculated on average for a person; therefore, for one-family houses, the payment for unsorted waste definitely depends on the volume of this waste and the family efforts towards waste sorting. The payment for unsorted waste is steadily growing each year, while the tariffs for sorted waste are very low or even zero (depending on the district). Therefore, the one-family households in general are very positive towards waste sorting. However, they mention that they spend more time on sorting. According to the municipal acts, the sorted waste should be clean, and cleaning takes additional efforts and time, as well as expenditures on water and hot water. As a result, the benefits of sorting decrease. Another possible problem—they are not quite motivated, since, due to the municipal regulations, there is a certain volume of unsorted waste per month, for which households must pay regardless of whether they have this volume of unsorted waste or not, and this volume is rather big, especially taking into consideration that they do not usually collect biodegradable waste. The next negative factor is the location of containers. On-the-spot collection of sorted waste is not always available for one-family houses. This is why the containers are often placed outside the private territory and can be used by several houses. As a result, this collection spot is very far from some houses, and people are not interested in sorting waste.

As a result, it is possible to assume that, for these houses, we have separated the positive factors stimulating waste sorting processes—possibility to improve the ecological

situation, and decreased expenditures for unsorted waste, as well as negative factors—increased bills for water and hot water, not always convenient location of containers, and not very friendly municipal legislation.

Nevertheless, these houses also emphasize the social impact. They say that their way of thinking becomes greener, and they feel more responsibility for their city and environment. This result is very important for Smart City development.

4.3. Positive and Negative Factors for Multi-Family Houses

These households were significantly less optimistic towards waste sorting compared to one-family houses. The first and the most important factor for these families is the lack of space for several different bins for collecting sorted waste. Another factor—the necessity to collect clean sorted waste. Then, one more negative factor—the location of containers for collecting sorted waste. Here, people had two different arguments: if the containers are next to their house, it is convenient, but they cause another problem. The space next to multi-residential houses is very limited, and people use it as a parking lot. If the municipality places many containers, people do not have the possibility to use this space for parking. As a result, they have to pay more for parking the car in another parking lot, and it is not convenient for them since the car is parked far from their place of living. Therefore, it is a very negative factor for them. The people who live far from these containers do not have the problem with parking, but they do not want to go so far with waste. Therefore, the convenience of sorting waste is very low for this group of households. If the location of containers is really far from the house (for example, there is no space for placing the container next to the house, and the containers are placed so that people from several houses can use them), in this case people refuse to have such a long walk from house to container.

Then, they do not have strong motivation in money terms either. Since the bill for waste is averaged in these houses, people do not want to sacrifice their comfort, efforts, time, and money (bills for water are individual for each family) if they are not sure that other people in the house will do the same.

Therefore, people in multi-family houses discuss evident negative factors affecting waste sorting without any obvious positive ones.

However, they realize that it is very important for the environment and for the city development, and, in general, they support the idea of sorting the waste, just not in their personal case.

Therefore, it is possible to demonstrate the obtained results of the survey (see Table 1).

Table 1. Positive and negative factors of waste sorting for households.

One-Family Houses	
Positive Factors	**Negative Factors**
1. Decreased bills for waste collecting (91%) 2. Changes in green thinking and attitudes towards the Smart City development (64%) 3. Not many efforts spent (53%)	1. If containers are located far from the house, people prefer not to sort the waste (73%) 2. Increased bills for water and hot water (28%) 3. More time spent (26%) 4. Low motivation due to existing laws on waste collection (22%)
Multi-family houses	
Positive factors	**Negative factors**
1. Decreased bills for unsorted waste (12%) 2. Changes in green thinking and attitudes towards the Smart City development (14%)	1. Lack of space in apartment (99%) 2. More time spent on sorting and using containers (38%) 3. Increased bills for water and hot water (26%) 4. Increased costs of car parking (32%) 5. If containers are located far from the house, people prefer not to sort the waste (58%) 6. Low motivation due to existing laws on waste collection (lack of individual approach) (75%)

Source: generated by the authors.

As we can see, the positive factors prevail for inhabitants of one-family houses, while, for multi-family houses, only few people mention the positive effects, and the majority concentrate on the negative factors.

There is one fact which can be improved rather easily, and the increased motivation could increase the positive attitude towards waste sorting among the population. This is municipal legislation. People mention different aspects of legislation—lack of personal approach (multi-family houses) and the obligatory minimum amount for which the household must pay (one-family houses); however, these can be improved. Many researchers, for example [52–54], consider the legal factors as ones determining the process of waste sorting by the population.

There is one more factor which was not considered as a positive or negative one, but which is very important for the general attitude of people towards waste sorting. Only 14% of respondents know well about the process of treating the sorted and unsorted waste. This means that people do not understand the real impact of waste sorting on the ecology of the city. Another important factor—in open answers, people mentioned that they do not believe that the waste after sorting is really delivered to different places; 12% of households are sure that the sorted waste is delivered to the same landfill where the unsorted waste is placed. This fact also evidences that the municipalities are not quite successful in educating the population on this issue.

The importance of information for the process has been studied by [55–57].

The importance of infrastructure, the position of collection points, and the distance from them to the spot of waste generation were mentioned by many researchers [56,58–62].

Some researchers [63–65] also discuss the idea that the efforts, necessary for the process, are also very important; if there is no need to apply a lot of effort, the population is more willing to sort the waste.

The study of the factors influencing the behavior of the population in waste treatment and sorting started at least three decades ago. Nevertheless, this research has revealed almost the same factors which are significant for the process of waste sorting. One of the possible explanations for such a result is the fact that Latvia started its way to sustainable and green Smart Cities quite late compared to the Scandinavian and West-European countries, and it practically repeats the way which these countries passed two or three decades ago. This gives hope that Latvian cities will manage to overcome the existing problems and to achieve the substantial positive results.

4.4. Positive and Negative Factors Mentioned by Local Authorities

The vision of the situation from the point of view of municipal authorities differs significantly. They mentioned the advantages and disadvantages of waste sorting in their cities which were not discussed by the population.

In total, five representatives of the city councils of the cities under consideration were interviewed. The cities are situated in the same region of Latvia; therefore, it is quite expectable that the answers of the municipal councils' representatives are quite similar. This fact supports the idea that the situation with waste sorting, as well as problems associated with it, is similar in Latvia not only for residents, but also for authorities.

First of all, all respondents spoke about the possibility of decreasing the placement of waste in landfills, which allows for using the space in landfills more efficiently. Since landfill construction is a money-consuming project, the volume available for placing the waste is very important for the cities of the region. The existing capacities were constructed with the employment of the European funds, and the cities also received a loan in the amount of 2.0 million, which they are still repaying. Therefore, this outcome of waste sorting is very motivating for the municipalities.

Another very important factor is the increased responsibility of the population. The people who are involved in waste sorting are very responsive to the initiatives of the municipalities, and are ready to participate in many events, which makes the activities of municipal authorities more fruitful. The active participation of people in the events

organized by the municipality creates possibilities for raising more money for these events from different funds, more active position for future elections, etc.

One more positive result of waste sorting, according to the municipal authorities' representatives, is an increased level of knowledge of the population. It is difficult to measure knowledge in some units; nevertheless, the waste sorting makes people look into the procedures of waste treating, and to understand the processes connected with circular economy. More and more young people of school or university age are involved in waste sorting. Certainly, there can be a reversed order—first, people start understanding the behavior of waste in nature and in the economy, and only then do they start sorting waste. However, many people first get involved in waste sorting, and only then do they start thinking about the results of this activity. In any case, the process of waste sorting is certainly closely connected with additional knowledge and new competences of the city population.

Unfortunately, only these factors are supposed to be positive by municipalities. All other factors are negative. Negative factors concern such pillars of sustainability as environmental and, especially, economic issues, which are the direct aim of waste sorting as a stage of the recycling process.

The following factors were considered as negative ones:

Sorting presupposes transportation of each type of waste. The special vehicles capable of collecting all types of waste simultaneously are not available for the municipalities of these cities, since they are not very rich, and the population density is rather low. As a result, instead of one vehicle collecting waste, five of them are in the streets of the cities. Another influencing factor—the low incomes do not allow municipal authorities to buy new vehicles, and they usually buy old ones which emit more pollutants. Correspondingly, these transportations "contribute" to increased emissions and to traffic jams, which, in return, "invest" in heavy emissions.

The economic impact is even more significant for the authorities. First of all, the municipality buys five vehicles instead of one. The municipalities prefer this way of solving the transportation problem, since these vehicles are cheaper, while the more contemporary models are more expensive. As a result, the municipality pays more for these five vehicles, but can change the vehicle park gradually.

Then, operating costs for five vehicles instead of one are higher, and this also contributes to negative economic impact.

Another factor creating certain difficulties for the municipality is the necessity to cooperate with several companies responsible for waste sorting, cleaning, recycling, disposing, etc. All these processes require great attention. The municipal authorities should allocate resources for managing and controlling the processes, which is a costly procedure. Then, it is necessary to provide the audit for companies dealing with sorted waste, which also presupposes costs.

Then, since there is a complex and prolonged process of sorting the waste, starting from management of Public Relations and finishing with the control over ecological situations in the places of waste collection and recycling, then, the municipality should provide a certain level of project management, which is also money-consuming.

A very special point is information for the population. It should be prepared with special care, since it is oriented not only on provision of information, but on educating people, convincing them of the importance of environmental protection and the necessity of their involvement in the process, and increasing their responsibility and responsiveness towards the initiatives of municipal authorities. Correspondingly, the process is very time consuming, labor intensive, and costly.

However, the most significant factor influencing the negative attitudes of the municipalities is the fact that the sorted waste in this region is collected by private companies which have agreements with the government. As a result, the authorities have all the problems associated with waste sorting and placement of unsorted waste in the landfill, while the private companies receive the advantages and fruits of commercial use of sorted waste.

The positive and negative impacts of waste sorting by the version of the representatives of municipal authorities are summarized in Table 2.

Table 2. Positive and negative factors influencing waste sorting, mentioned by municipal authorities.

Positive Factors	Negative Factors
1. Decreased waste disposal at landfill, and increased opportunities for prolonged using the capacities of landfill 2. Higher responsibility and responsiveness of population to the initiatives of municipalities 3. Increased level of education of population	1. No profit from the commercial use of sorted waste 2. Increased number of vehicles involved in waste collection 3. Increased traffic due to increased number of vehicles involved in waste collection 4. Increased emissions due to increased traffic and possible traffic jams 5. Necessity to introduce new control functions 6. Project management costs 7. Costs of work with population

Source: Done by the authors based on the semi-structured open-question interviews with representatives of municipal authorities of the cities of the Vidusdaugavas region, Latvia.

The diagram in Figure 2 schematically demonstrates the positive and negative factors affecting waste sorting for different types of households and for municipal authorities of the cities of the Vidusdaugavas region, Latvia.

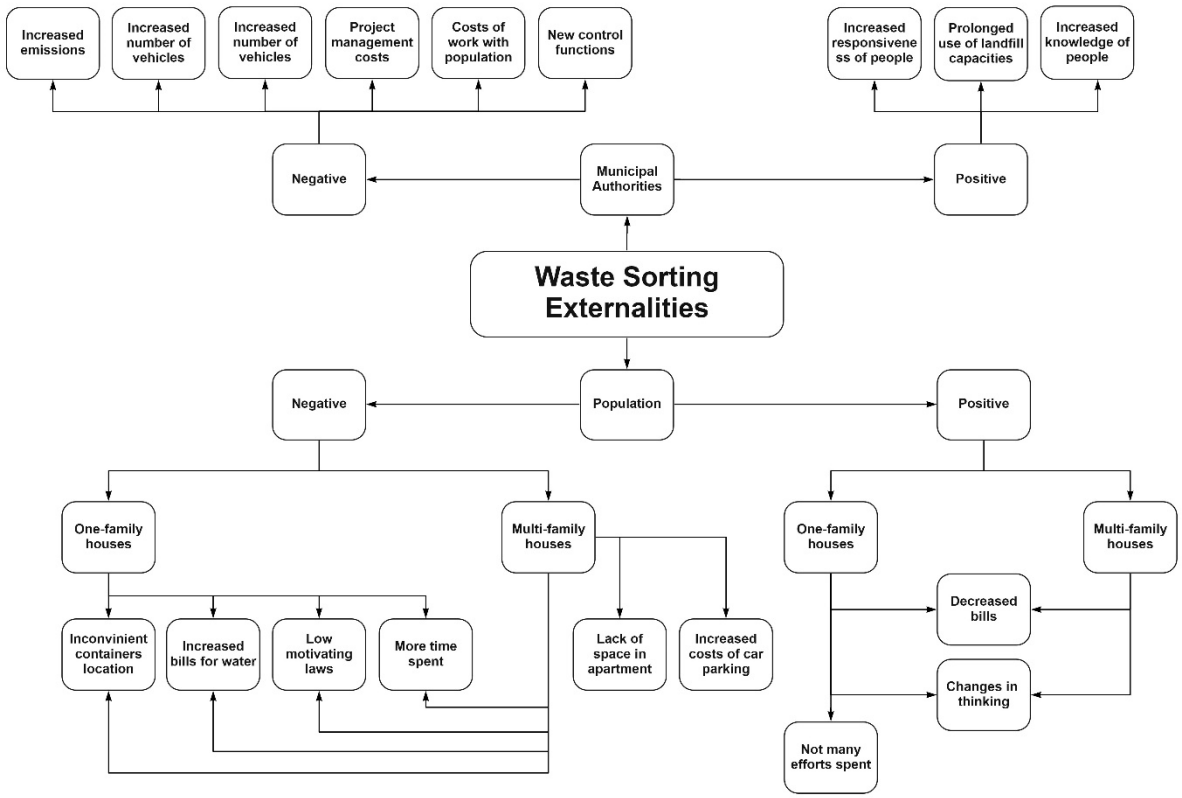


Figure 2. Positive and negative factors affecting waste sorting for different types of households and for municipal authorities (source: generated by the authors).

5. Discussion

The research has demonstrated that, at the existing level of the process organization, the negative effects of waste sorting are significantly higher than the positive ones for both the population and municipal authorities.

The importance of implementing the principles of circular economy to organize the urban environment suitable for Smart Cities is not doubtful; the new way of thinking is eminent for both researched levels—people and authorities.

Nevertheless, the cities of Latvia face serious problems in their way towards green processes. The presented research reveals the existing problems and identifies their sources within only one sphere of the sustainable Smart City—waste sorting. Moreover, the situation is similar to other CEE countries [66,67].

The research considers the problem from two different points of view—households, involved in waste sorting, and municipal authorities, organizing the process.

Both parties mention more negative factors than positive ones. For households, the economic factors and convenience factors have almost equal significance. The authorities mostly note the factors increasing the costs.

However, the research has shown the possible ways of solving the situation.

First of all, it is very simple to solve the issue with municipal regulation for one-family houses, it is enough to give the families a certain flexibility in determining the volume of unsorted waste for which they pay monthly. Nowadays, the minimum volume is determined by the law, and if households do not produce a lot of waste, they do not have any incentives to sort the waste, since they continue paying more money for unsorted waste [68].

It is not so simple to solve the problem with multi-family houses, however, many countries and many cities are quite successful in solving this problem, their legal acts are very friendly towards people who are ready to change their way of living. The procedures of personalized approach to waste sorting in multi-family houses exist, and municipal authorities can study the experience of other countries and implement the most suitable ones in their cities. Certainly, it will be an additional financial burden for these authorities.

Another negative factor for households is the inconvenient location of containers and the limited space for them in the vicinity of houses. One of the ways to solve this problem is the approach used by many supermarkets—they place compact containers which do not occupy a lot of space. Certainly, this means that the sorted waste should be collected more often, however, this process can be regulated by municipalities. In any case, compact containers could be placed next to the house entrances, and they do not occupy a lot of space, which households usually use as parking.

The authors believe, if municipalities are to change these issues, the households will be more tolerant towards other inconveniences associated with waste sorting. The most important thing is the general attitude of people towards green issues—they understand the necessity to change their behavior, and this means that the problems can be solved.

However, the problems which the municipal authorities face require different ways of acting. Almost all negative factors mentioned by the authorities' representatives refer to the resources and increased costs.

In considering them one by one, the low level of management of the processes within the region's cities becomes evident. Certainly, the municipal authorities do not have the possibility of solving all the problems at their level. They are restricted by the decisions at the state level. The situation seems to be even more difficult if we remember that, at the international level, Latvia, due to low density of population and small size, is supposed as one region, and all the regional development initiatives at the European level are applied to Latvia as a whole; centralization in this case does not always take into consideration the interests of the regions within the country.

Nevertheless, there are numerous funds and programs oriented towards the development of smart sustainable cities, and it is viable for the municipalities to receive financing for the municipal projects (and very often the municipalities use this opportunity very actively).

Then, the municipalities can rearrange their attitudes towards the processes within the region and use another management policy. Here are some suggestions for improving the situation for municipalities.

One of the most logical and important changes is switching the priority from private companies, gaining from sorted waste, to municipalities. If municipal authorities have the main burden of dealing with unsorted waste, they should also use the advantages of receiving revenues for sorted waste as well. This change can provide the municipal authorities with necessary financial funds for implementing all necessary changes on the way to clean and sustainable Smart Cities.

Then, if the municipality buys a modern, well-equipped technological multi-camera vehicle, it will spend more money than if it buys an old, used vehicle capable of collecting only one type of waste. Nevertheless, in total, the municipality will gain a significant advantage in operating costs, in administrative costs, in maintenance costs, and so on. It will also decrease the problems associated with using several vehicles on the roads and city streets.

The gained funds can be used for implementing a contemporary stimulating policy of waste sorting for multi-family houses; such programs are used in other countries.

The households, stimulated for waste sorting, will be involved in the process more actively, contributing both to improving the financial state of the municipality and to improving the situation with ecology, important for a smart sustainable city.

There are many examples of successful solutions. They cannot be supposed as full and comprehensive, since the countries have made only the first steps in arranging the process. Nevertheless, there are many interesting examples. For instance, contemporary reverse vending machines detect the type of waste, making the process significantly more advanced and creating sensor-based solutions for optimal resource productivity [34,69]. There are many attempts to create Smart Bins with sensors based on cloud platforms that are capable of controlling various stages of waste collection and waste sorting [70–72].

There exist many studies relating the various IoT properties [73], which can be used for waste sorting and waste collection. There are also examples of implementation of a vacuum waste collection system in one of the cities of Romania [74], which can be interesting for the cities of the Vidusdaugavas region: city Sibiu is not big; however, it implements the latest technologies and has a very advanced level of thinking of the population (a large part of the people in the city are students, which are very sensitive to the new tendencies in Smart City sustainability). Therefore, the city is quite close in many points to the cities of Latvia.

There exists the entire list of parameters which should be considered in the process of waste management organization [75,76]. Sweden also uses the automated vacuum waste collection system. Nevertheless, the implementation of this system is fraught with difficulties: the system is not oriented on all types of waste; then, it is rigid and requires one to be very careful with existing cables, pipes, and other communication and infrastructure objects [77,78]; therefore, it is advised to use it at the beginning of constructing the housing area, and it is difficult to use in big cities. However, cities of the Vidusdaugavas region are not big, and they can find some interesting ideas in the existing experience of other cities.

There is also a certain contradiction with previous research. For example, [47,79] suppose that people do not adjust their behavior in waste sorting with the general idea of waste generation; however, the authors emphasize that people in the three considered cities of Latvia recognize the danger of waste generation and they are ready to change their waste sorting behavior towards the environmentally friendly ones, they need just minor support.

Therefore, the research is in line with the results of the previous studies, but makes important adjustments in relation the cities of Latvia. Thus, for the first time, the problem was considered from the point of view of local authorities and, at the same time, the local population. This made it possible to identify the existing problems and misunderstandings between the parties. We see this enhanced understanding of the problems as a sure way to start effective communication.

In addition, the research was implemented under the danger of Covid 19, and epidemiological settings create the conditions for certain changes in the paradigm of resource use and waste. For example, supermarkets were forced to solve the problem of selling

goods from open shelves, and people began to buy products in individual packages and use medical facemasks and disposable gloves. The volumes of plastics increased greatly, and the issue of its processing gained additional significance. Nowadays, the problem of medical waste is confronting not only hospitals but also individuals. The issue of the correct distribution of garbage has become aggravated. However, the availability of information for people has also increased, and people have become more careful and have changed their mindset towards the environment, and, as a result, they have changed their attitudes and behavior towards their personal role in environmental processes.

6. Conclusions

The research considers the factors influencing the waste sorting process within the Smart City. The issue is studied from the point of view of the population and also municipal authorities, which is the new approach, allowing identification of the existing problems and misunderstandings. People and authorities from three provincial cities of Latvia participated in the study, and this is also very important, since other analyzed works deal with behavior of people from big industrial centers.

The research was conducted in the form of survey (population) and semi-structured interviews (authorities' representatives).

The results showed that people living in multi-family houses experience more negative effects of waste sorting compared to people of one-family houses. The factors of convenience and economic factors affect the behavior of the population in their decisions of sorting waste.

The local authorities are concerned mostly the economic factors of waste sorting process.

Latvia is a country of Eastern Europe, entering the European Union in the XXI century only, and, therefore, all the processes connected with waste management started in Latvia later than in the countries which are older members of the EU. The results of this research could be interesting for the scholars from other CEE countries that are facing similar difficulties with waste sorting. The analysis of other research on the issue demonstrated that the same factors influence the process of waste sorting in Latvia nowadays as the factors affecting it in Scandinavian and West-European countries two or three decades ago; the list of literature supports this idea—many articles on the issue, written by Scandinavian and West-European researchers, were published 15 or even more years ago, and now this problem is not so urgent for them. This fact allows concluding that, in the future, Latvia will achieve the level of waste sorting existing in these countries. The most important factor supporting this idea is the changed way of thinking of people and their general attitude towards green issues—they understand the necessity of changing their behavior. Further, changes in thinking are the most difficult, time consuming, and unpredictable process. The cities of Latvia can be proud of successfully overcoming this stage on their way to sustainable Smart Cities.

The study results provide important and useful data, which local municipalities can use for the development of waste sorting and collecting systems in their smart sustainable cities; therefore, the survey should be repeated after a year in order to analyze the administrative factors implementation.

Further research will deal with the analysis of existing systems of waste sorting used in other countries and cities of the European Union, and determining the systems or separate stages which can be adopted by small cities in Latvia, basing on the obtained results of this research.

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