



Sustainable Development Management of an Urban Municipality

Tatyana VAZHENINA^{*}, Rada DUKA, Elena KorYakina, Nadezhda Sheveleva

Industrial University of Tyumen, Tyumen, Russia

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Abstract

The results of a study on the sustainable development of an urban municipality are presented in this article. The object of scientific work is the municipality of the city of Tyumen. The subject of the research is socio-economic and administrative relations that contribute to ensuring the sustainable development of urban municipalities. The purpose of the study is to develop recommendations and proposals for managing sustainable development of the city of Tyumen. The following hypothesis is put forward by the authors in this paper: there is an assumption that updating recommendations on the effective management of the sustainable development of the city of Tyumen in order to improve the state of the three aspects of sustainable development or to maintain them at an optimal level in the long term is an important principle of the administrative apparatus of the city. An optimal balance of economic, social and environmental condition of the city is possible with systematic management of these aspects of sustainable development. In this paper, the authors studied some methods for assessing the sustainable development of an urban municipality and proposed an improved method for assessing the sustainable development of a city. The authors also evaluated the sustainable development of an urban municipality using the city of Tyumen as an example. The activities and recommendations for managing the sustainable development of the city of Tyumen were proposed.

Keywords: Sustainable development, Tyumen, Sustainable development assessment, Sustainable development management, Urban municipality, Factors for sustainable development provision, Ecological environment, Social environment, Socio-economic development, Resource potential.

1 Introduction

The relevance of the research topic is that at the present time municipal government plays an important role in the context of public administration. The state as a whole is governed through the management of municipalities. The need to manage sustainable urban development is caused by two opposite outcomes of events: urbanization of cities occurs, and a large concentration of people in one place prevails as a result, and in contrast to this fact, complex and contradictory socio-demographic, economic, technological, environmental and other problems emerge, affecting both the city itself and the state (1).

The concept of sustainable development focuses on ensuring a balanced synthesis of three aspects of sustainable development. It sets targets for determining the priorities of socio-economic development of territories and actively eliminates problem areas of the municipalities' uneven

development. Therefore, it is important to properly and effectively manage their social, economic and environmental development in order to ensure comfortable living conditions in the city (improving the quality of life and incomes of the population and, as a result, replenishing budgets (2)), increasing the efficiency of production activities of economic entities of the municipality, rational use of natural resources. Management of an urban municipality should be aimed at strengthening the autonomy of local authorities, which, on their part, should search for the possibility of self-development based on their own resources (3).

1. As a result, there is an objective need to manage the sustainable development of an urban municipality, providing favorable conditions for the socio-economic development of the city, developing its resource potential and innovative technologies, as well as creating a conceptually new structure of consumption and production, while maintaining ecological balance in the context of constant progress (4).

2. The object of the study is the Tyumen city municipality.

3. The subject of the research is the socio-economic and administrative relations that contribute to the sustainable development of urban municipalities.

Corresponding author: Tatyana VAZHENINA, Industrial University of Tyumen, Tyumen, Russia. Email: vazhnaiy82@yandex.ru.

4. The aim of the study is to formulate recommendations for the effective management of Tyumen city municipality sustainable development.

Statistical materials of the Territorial Body of the Federal State Statistics Service for the Tyumen Region, the Administration of the Tyumen Municipal District, monographs and periodicals, materials of scientific and practical conferences and seminars on the problem of sustainable development of territories became the informational background of this paper.

2 Materials and Methods

In order to assess the sustainable development of the city of Tyumen, a method for assessing the sustainable development of urban municipalities by Bogomolova and Mashentsova was applied. Based on this method, factors that ensure sustainable urban development are assessed (5). According to the authors of this method, the state of the social sphere of the city and its infrastructure, as well as the environmental component, both directly depend on the economic condition of the territory.

The social sphere of an urban municipality includes the quality of life of the population, the ecological situation and the economic development of the territory. The following rule applies for this aspect of sustainable development: "city development becomes sustainable when the city's economy becomes independent and less prone to peak points of a crisis. Such a city becomes autonomous and does not depend on the economy of other cities and the country as a whole".

Important spheres of city life are industrial, economic and cultural and recreational ones. They determine the priority of the characteristics of the territory relative to other factors of sustainable development, as well as the place of the territory among the functional classification of cities.

Thus, based on the above, the authors identify six main social, economic and environmental factors that ensure sustainable development: territorial management or the administrative apparatus; the economic condition of the territory; the state of the cultural sphere; economic development rates; the manufacturing sector; the state of the social sphere associated with the state of the city's ecology.

These factors directly affect the sustainable development of an urban municipality and also contribute to improving the competitiveness of the city, being key areas for comparing the studied city with other cities, as well as for possible changes in any factors in the future. All factors are interrelated and are part of one system (6). In the framework of the system approach, any change in one of the factors will inevitably entail a change in the rest of them (7).

Environmental factors that correlate with social factors include the biological, climatic and environmental features of the territory, and also describe the presence of natural resources, compliance with environmental standards in all sectors of the city's activities, which influence the purity of the entire hydro, bio and atmosphere (8).

The above factors characterizing the general situation in the city are of an exceptionally qualitative nature. The authors of the urban municipality sustainable development assessment method selected five indicators that influence factors in order to assess this situation in the city. The

indicators are generalized, are measurable, and reflect the current characteristics of all the presented factors of the sustainable development of the city allowing visual assessment of the studied urban municipality state. The authors identified five main indicators based on six factors of the territory development that describe the state of sustainable development of the city:

1. City functionality. This indicator includes industrial, cultural and economic spheres of the city. The set of city functions determines its level of development (the level of functionality is higher when the city performs more functions: multifunctional, mesofunctional, monofunctional cities). This functionality allows characterizing the city in its main areas of activity and niche affiliation.

2. The ratio of wages to the subsistence minimum. This indicator gives an idea of the quality of life of the population and reflects the socio-economic situation of the city, based on the ratio of the minimum necessary funds for living to the funds that can be spent for other purposes. In other words, the ratio of wages to the subsistence minimum in quantitative terms makes it possible to determine the amount of free cash per capita, the solvency of the population and its material well-being.

3. The ratio of retail trade turnover to the subsistence minimum. This indicator represents the percentage of free cash of the population that is spent on purchases and entertainment, and also reflects the level of solvency of the population. The economic security of the population is expressed through the following dependence: the higher the values of this indicator, the higher the purchasing power. This implies the conclusion about the quality of life of the city and its economic climate.

4. Average life expectancy. This indicator reflects the quality of life of the population in socially significant directions. Average life expectancy is a fairly versatile indicator that includes a set of individual characteristics. One of these individual characteristics is the quality of health care and its availability, the second is the state of the environmental situation in the city, which contributes to the increase in life expectancy, or, on the contrary, affects it negatively. The ecological condition of the city is determined by the quality of the prevailing lethal diseases. Also, in the event of a deep study of the issue, in the context of many factors affecting the average life expectancy, this indicator can be considered in detail, including a group of indicators on the birth rate and infant mortality, mortality in general, and diseases that more often lead to deaths within a certain territory of the city into analysis. Combining all these individual indicators will allow describing the social sphere of the city in detail.

5. Officially registered unemployed number per thousand people. The indicator reflecting the state of the economic sphere of the city and the current state of its economy. It is the main indicator of the labor market. If the unemployment rate is 7% or higher, this indicates a period of economic recession and entry into a crisis, while if the unemployment rate does not exceed 4%, it is considered low and is within the natural rate of unemployment and indicates a period of economic recovery.

The degree of influence of all the above indicators on the state of the city's sustainable development factors is described in Table 1 with a detailed gradation of each of the indicators and their weight. With the help of such gradation, it becomes possible to translate the qualitative factors of sustainable development of the territory into quantitative (measurable) indicators. Each indicator has its own weight and individual rating scale. Determining the value and choosing the appropriate weight on the scale of assessment are based on socio-economic and statistical research. This feature makes the method of assessment cost-effective and affordable, and the assessment of the state of factors of sustainable development is objective and eliminates the human factor. The gradation used for the assessment has clear boundaries and is suitable for any city. On the basis of this method for assessing the sustainable development of an urban municipality, cities of any country may be compared with one another, which makes this method of assessment universal.

The aggregate weight of indicators of sustainable development factors should ideally be 1 (reference value), which means the maximum compliance of values and the sustainability of development of all factors (9) (Table 2). The method of assessing sustainable development by Bogomolova and Mashentsova covers the assessment of socio-economic aspects of sustainable development mainly, indirectly covering the environmental aspect through the influence of the environment on the average life expectancy of the city's population. This method of assessing the actual environmental aspect is insufficient and cannot disclose the state of the environment, hydrosphere, biosphere or atmosphere more comprehensively. Adding an additional criterion to the main method of assessing the sustainable

development of the city is appropriate since the proposed criterion allows for a complete and comprehensive assessment of the state of the city and correct formulation of recommendations for the effective management of an urban municipality. In order to track the impact of production facilities on the city's environment, to assess environmental indicators of the city's territory adequately and in detail, an additional criterion should be introduced into the existing method of assessing sustainable development, the one that influences six major socio-economic factors. This factor is called the impact of industrial facilities on the environment (10).

Significant environmental aspects (11) of the activities of enterprises are identified, realistic environmental policies are developed, environmental goals and objectives are determined, and necessary environmental protection measures are planned and implemented when assessing the environmental impact of the production facilities of the city. The identification of environmental aspects includes an assessment of the significance of the designated environmental aspects for the enterprise, determination of the individual sectors of the enterprise's environmental impact degree. The identified environmental aspects show a significant environmental impact, which requires the immediate adoption of appropriate measures in order to reduce it or maintain it at an optimal level where the reduction is not possible. The importance of environmental aspects is determined by the following main factors: the degree of environmental impact, the state of the environment in the affected area, compliance with the requirements of established standards and current legislation, and the stakeholders' priorities.

Table 1: Indicators characterizing the level of the city's independence and influencing the state of the sustainable development factors

No.	Indicator	Indicator weight			
1	City functionality	Monofunctional	0.03	0.15	
		Mesofunctional	0.07		
		Multifunctional	0.15		
2	Ratio of wages to the subsistence minimum	Wages = from 1 [SM] to 2.9 [SM]	0.05	0.25	
		Wages = from 3 [SM] to 4.9 [SM]	0.1		
		Wages = 5 [SM] and more	0.25		
3	Ratio of retail trade turnover to the subsistence minimum	Up to 100 [%]	0.04	0.2	
		From 101 [%] to 200 [%]	0.09		
		Over 201 [%]	0.2		
4	Average life expectancy	Up to 60 [years]	0.05	0.2	
		From 61 to 70 [years]	0.12		
		Over 71 [years]	0.2		
5	Number of officially registered unemployed in Russian cities (per thousand people)	Up to 10 [thousand people]	0.2	0.2	
		From 10.1 to 70 [thousand people]	0.07		
		Over 71 [thousand people]	0.04		
Total		1			

Table 2: Interpretation of sustainable development factors

Aggregate factor weight	Value
> 0.9	Presence of sustainable socio-economic and environmental development of the city. Characteristics of all five indicators show favorable conditions for life in the city. The cumulative weight of all indicators corresponds to the maximum value.
0.5-0.9	The socio-economic and environmental development of the city is stable and uniform. The total weight of all indicators corresponds to the average value.
< 0.5	A crisis of the socio-economic and environmental development of the city. All its main areas of life are in a critical condition and require fundamental changes. The cumulative weight of all indicators corresponds to the minimum value.

An assessment method according to Markin et al. (10) is used in order to assess the impact of industrial facilities on the environment. The essence of this method is as follows:

1. In order to assess the impact of industrial facilities on the environment, firstly, the impact index should be found, that is, the assessment of the level of impact on the environment in points (Eq.1):

$$II = A \times S \times I, \quad (1)$$

where A is an evaluation summary in points in terms of the amount of emissions of harmful substances into the environment, S is an evaluation summary in points for the spread of harmful substances in the environment, I is an evaluation summary in points by influencing factors (impact) of harmful substances on the environment.

The degree of environmental impact is a major importance factor of environmental aspects. Assessment of the impact of the enterprise on the environmental situation of the city includes determining the degree of impact, identifying the main impact factors and their quantitative characteristics. An enterprise may submit a consolidated list of environmental factors by the type of its activity, without any special research. In order to quantify the impact factors, instrumental measurements of exposure parameters are made (concentrations of pollutants, emissions, wastewater, and consumed resources) or calculation methods are used based on specific norms.

The second stage of the environmental impact assessment of production facilities is the determination of the impact degree. In other words, it is the ranking, which determines the comparative "importance" of impact factors and priorities for solving the identified problems. A special methodology has been developed for the ranking of environmental aspects, taking into account the specifics of the enterprise. The methodology is based on the scoring method for assessment and development by the Danish company COWI. This method is simple and allows creating an acceptable general description of the company's impact on the environment, and, first of all, it is used to identify the priority areas of environmental activities in the enterprise. The degree of impact of each factor is determined by three parameters: A –

characterizes the amount (volume) of the environmental impact of harmful substances, S – features of the spread of the impact of harmful substances in the environment, I – the danger degree of the impact of harmful substances in the environment.

Each impact factor is evaluated on a three-point scale, depending on the value of the specified parameters. The final score, which characterizes the rank of this impact factor, is obtained by multiplying the scoring values by three parameters. An increase in the result indicates an increase in the degree of impact of this factor on the environment. Scoring is dimensionless in its quality characteristics and does not reflect the value of any physical quantities. It only describes the scale of the problem being evaluated and the degree of importance of its solution.

2. The third stage of the environmental impact assessment of industrial facilities is the definition of scoring criteria. Based on the Russian and European experience in the field of environmental protection, criteria for determining points from one to three were developed for each of the three parameters of impact types. The development of the criteria is based on:

- the relation of the impact types to the established regulations, standards and permits;
- the impact spread nature: global, regional, local;
- the impact hazard degree is determined by the hazard class of pollutants, reversibility or irreversibility of impact.

The convenience of an additional criterion is that the environmental impact of industrial facilities can be assessed using 12 indicators proposed by the authors. However, any indicators can be chosen for the city under assessment, depending on the uniqueness of the city and its features. The scoring criteria for assessing the environmental impact of production facilities on the environment are the following (Tables 3-6):

(1) Air Emissions: This indicator is characterized by the features of spread and the danger level of emitted pollutants, the sum of annual emissions, which is formed during the operation of individual technological facilities (compressor and pumping stations, oil and gas pipelines, oil tank farms, production sites).

Table 3: Scoring of pollutants emissions into the atmosphere by production facilities

Parameter	Criteria	Score
A	It is determined based on the volume of annual emissions and the nature of the pollution sources location. Due to the different potential for pollution of surface air with the same amount of emissions, different criteria are established for functional areas that include point or distributed emission sources	
	The amount of substances emitted exceeds 1,000 [tons per year]	3
	The amount of substances emitted is 100-1,000 [tons per year]	2
S	The amount of substances emitted is less than 100 [tons per year]	1
	The amount of substances emitted exceeds 2,000 [tons per year]	3
	The amount of substances emitted is 200-2,000 [tons per year]	2
I	The amount of substances emitted is less than 200 [tons per year]	1
	Substances of hazard class 1 – extremely dangerous, highly toxic	3
	Substances of hazard classes 2 and 3 – high and moderately hazardous, methane	2
	Substances of hazard class 4 – low hazard	1

Table 4: Wastewater discharges scoring by production facilities

Parameter		Criteria	Score
A	The amount is determined depending on the volume of the annual wastewater discharge generated during the operation of individual technological objects and the excess of this volume over the established standard	The amount of substances discharged exceeds 10 [tons per year]	3
		The amount of substances discharged is 1-10 [tons per year]	2
		The amount of substances discharged is less than 1 [ton per year]	1
S	The spread depends on the degree of purification and the nature of the wastewater receiver	Discharge of polluted wastewater into surface water bodies and terrain without treatment	3
		Discharge of polluted wastewater into underground horizons, filtration fields, evaporation ponds, or into surface water bodies after local treatment facilities in excess of established standards	2
		Drainage of wastewater to wastewater treatment plants of third-party organizations or discharge of treated wastewater into surface water bodies and underground horizons	1
I	The impact is determined depending on the hazard class of the waste, same as for air emissions (see paragraph "1. Air emissions")		

Table 5: Scoring of disposal of waste that pollutes the environment by production facilities

Parameter		Criteria	Score
A	The amount is determined based on the volume (weight) of the annual waste production	The weight of waste exceeds 100 [tons per year]	3
		The weight of waste is 10-100 [tons per year]	2
		The weight of waste is less than 10 [tons per year]	1
S	The spread depends on proper waste management	Waste is stored at the enterprise for more than 3 years or is placed at unauthorized dumps	3
		Waste is disposed of at the plant or placed at licensed landfills	2
		Waste is stored at the enterprise for less than 3 years in accordance with the established requirements	1
I	The impact is determined depending on the hazard class of the waste, same as for air emissions (see paragraph "Air emissions")		

Table 6: Scoring of topsoil disturbance by production facilities

Parameter		Criteria	Score
A	The amount is determined depending on the area of disturbed land	The area of disturbed land exceeds 1 [hectare]	3
		The area of disturbed land ranges from 0.1 to 1 [ha]	2
		The area of disturbed land is less than 0.1 [ha]	1
S	The spread depends on the impact depth.	Removal of the whole soil profile	3
		Removal of only the upper humus soil horizon	2
		Soil surface impact only	1
I	The impact is determined by the possibility of restoration (remediation) of the soil profile and fertility	The impact will lead to complete soil degradation and removal from crop rotation	3
		Remediation is obstructed or can be done with deviations from norms, leading to a decrease in soil fertility	2
		The impact is easily eliminated by remediation without reducing soil fertility	1

(2) Wastewater Discharges: Wastewater is determined by the nature of the output either to its own or to municipal wastewater treatment plants, transfer to other organizations, discharge to water bodies, ponds, evaporator plants or filtration fields. Wastewater is characterized by the sum of annual discharges, the content and the hazard class of pollutants. (3) Waste: The indicator is characterized by the assessment of waste types, the list of which is determined in accordance with the current classification. (4) Topsoil Disturbance. Assessment is carried out according to the following criteria.

Using the above criteria, the environmental aspects of the enterprise's activity are assessed for each type of impact. A general ranking list of the environmental aspects of an enterprise is compiled based on the results of this assessment.

Thus, by supplementing the basic method for assessing sustainable development according to Bogomolova and

Mashentsova (5), this criterion, which influences the main factors of sustainable development, will allow examining the study object, adequately and effectively applying the program of management of the territory's sustainable development, as well as provide with an opportunity to identify "weak" spots and effectively eliminate them.

3 Results and Discussion

The development of Tyumen is happening at a significant pace, so it is extremely important to maintain a balance of all the aspects of sustainable development of this municipality. The choice of the city of Tyumen to assess sustainable development is due to the growth of industrial enterprises and their negative impact on the environment, as well as due to the impact of economic and environmental changes on the social sphere.

In order to ensure the sustainable development of the economic, industrial, cultural, recreational and, consequently, ecological sphere of the city's life, the following six main socio-economic categories are distinguished:

- territory management or administrative apparatus;
- economic state of the territory;
- state of the cultural sphere;
- pace of economic development;
- production sector;
- state of the social sphere.

To ensure that these categories are not of a qualitative nature and that they can be adequately assessed, one should select five main measurable factors affecting those categories:

- city functionality;
- ratio of wages to the subsistence minimum;
- ratio of retail trade turnover to the subsistence minimum;
- average life expectancy;
- officially registered unemployed number per thousand people.

For a more complete assessment and tracking of the sustainable development trend over time, a time series from 2014 to 2017 was selected for all the factors of sustainable development of the city of Tyumen. Thus, the first factor of the sustainable development of the urban municipality is the city functionality (Fig. 1). Based on Fig. 1, one can conclude

that the city of Tyumen is actively developing its functionality, as evidenced by the main areas of the city's activities. The greater the set of functions of a city, the higher its level of development, the more competitive the city is, both for the population and for the state as a whole. The second factor of the sustainable development of the urban municipality is the ratio of wages to the subsistence minimum of the city of Tyumen. In the city of Tyumen, the size of the subsistence minimum is established by a decree of the Government of the Tyumen Region (Table 7). In order to compare the subsistence minimum, five categories of activities in state and municipal property organizations were selected. The time interval considered was from the fourth quarter of 2014 to 2017, as long as a series of absolute values dynamics was taken for the ease of comparison (12).

Based on Table 7, it can be concluded that the subsistence minimum of the presented categories of the population annually increases at different rates. Nevertheless, the increase in the subsistence minimum indicates inflation and the gradual fall of the ruble, and every year the population needs more and more money to ensure the normal functioning of the body and to maintain its health. In order to assess the quality of life of the population, its solvency and the amount of free cash per capita, the average wage over the 2014-2017 period should be considered in absolute values (Table 8).

Table 7: The size of the subsistence minimum for the period from the 4th quarter of 2014 to 2018

Population category	Subsistence minimum, [rub.]			
	2014	2015	2016	2017
Able-bodied population	8,942	10,203	10,378	10,744
Pensioners	6,814	7,777	7,933	8,193
Children	8,559	9,912	10,031	10,390
Per capita	8,470	9,692	9,855	10,197

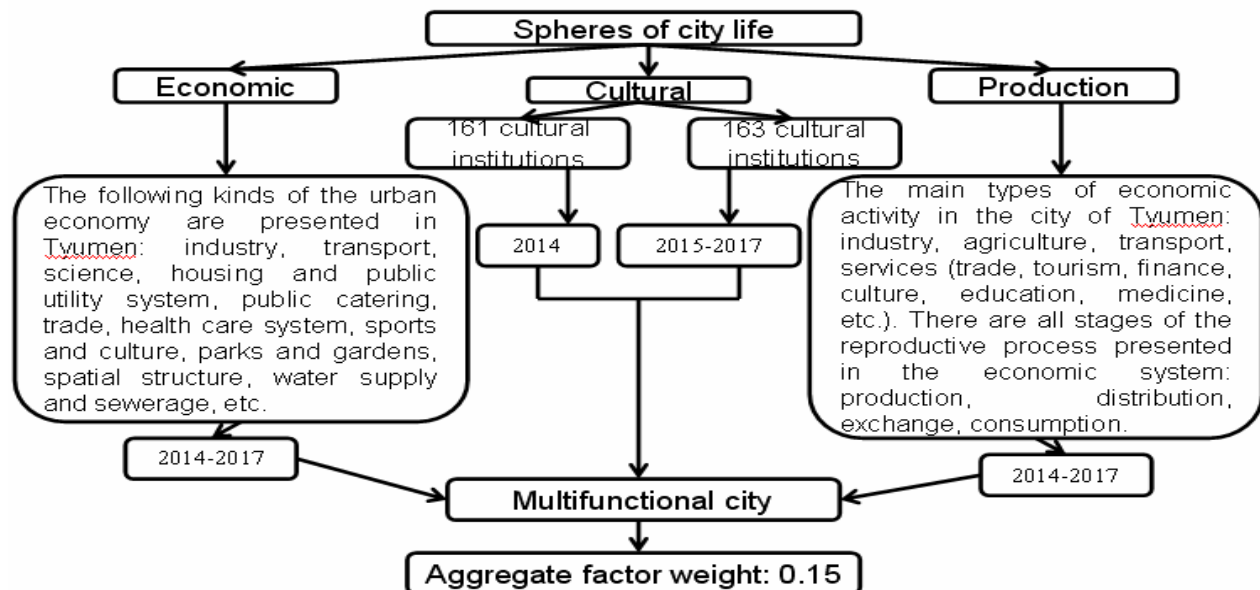


Fig. 1: Analysis of the functionality of the city of Tyumen for 2014-2017 (compiled by the authors).

According to Table 8, there is a tendency to an increase in wages of all categories of workers, which is caused by the increase in the subsistence minimum by the Government of the Tyumen Region, as well as by a gradual increase in prices for goods and services. Table 9 presents the ratio of the average wage (Table 8) and the subsistence minimum (Table 7). Based on the Table 9 data, one can conclude that the wages of workers in the selected categories are greater than the subsistence minimum. The ratio of wages to the subsistence minimum indicates the quality of life of workers in different professions and specialties, their level of solvency, as well as the consumption of high-priced goods and services and luxury items. The third factor of the sustainable development of the urban municipality is the ratio of retail trade turnover to the subsistence minimum in the city of Tyumen. For the evaluation of the city by this factor, the period of the fourth quarter of 2014 to 2017 was taken in absolute terms. In order to determine the retail trade turnover relative to the subsistence minimum (Table 7), the subsistence minimum of the able-bodied population was taken on the basis of the availability of free money resources for this category of the population with the maximum replenishment of the consumer basket (13). The ratio of retail trade turnover to the subsistence minimum is presented in Table 10. The fourth factor of the sustainable development of the urban municipality is the average life expectancy of the population (14). For the analysis and assessment of this factor, a time series of 2014-2017 was taken (Table 10). The fifth factor of the sustainable development of the urban municipality is the officially registered number of unemployed per thousand people (Table 10). For the analysis of this factor, a group of persons in the age category from 15 to 72 years was selected. For the analysis of this factor, the period from the fourth quarter of 2014 to 2017 was chosen in absolute terms (15).

Summarizing all the indicators of the factors of socio-economic development of the city and the influence of

ecological environment, a general conclusion about the sustainable development of the city of Tyumen can be made (Table 11).

Thus, the socio-economic and environmental development of the city of Tyumen is stable and uniform. However, for the sustainable development of the city, the sum of all factors should be > 0.9 . In the city of Tyumen, the sum of all factors is 0.72. This indicator falls within the boundaries of the total weight of factors from 0.5 to 0.9, which means that there are unrecognized errors in the development of the city. Perhaps there is a lack of resources in the budget for the implementation of programs in the field of the city's sustainable development (16). In order for the city to have resource reserves that will lead to its development at the expense of its own potential and will reduce the influence of external factors on its operation, it is necessary to improve the indicators of sustainable development so that the total weight of sustainable development factors of Tyumen tends to 1.

In the first part of the adapted method for assessing sustainable development, the city of Tyumen has already been assessed previously (Table 11). For the assessment of the second part of the method, namely, the assessment of the impact of industrial facilities on the environment of the city of Tyumen (Table 16), a time series from 2014 to 2016 was chosen.

Thus, all the analyzed environmental aspects of Tyumen tend to decrease over the period in question. When ranking them by scoring each environmental factor based on the assigned points, it can be said that the total waste of enterprises, household garbage and harmful substances have the lowest degree of environmental impact. The impact index by 2016 was only 4 and 6 points, respectively. Greater impact on the environment was provided by wastewater discharges and soil cover changes due to urban planning; the impact index is 8 and 12 points, respectively.

Table 8: Average wage in the context of the activities of workers for the period from the 4th quarter of 2014 to 2017

Professional field	Average wage, [rub.]			
	2014	2015	2016	2017
Doctors and medical workers with higher education	51,509.7	51,876.7	52,629.0	57,308.0
Research scientists	47,964.2	46,721.9	52,482.9	56,803.5
Teachers of preschool educational institutions	40,077.0	39,348.1	39,382.7	40,215.6
General education institutions teachers	45,399.0	46,773.6	48,170.2	50,271.2
Teachers of HPE organizations	48,383.8	49,129.9	55,098.8	66,761.0
Social workers	22,336.0	21,716.3	22,863.4	31,262.7

Table 9: The ratio of the average wage in the context of the activities of workers and the subsistence minimum for the period of the 4th quarter of 2014 to 2017

Professional field	Ratio of wages to the subsistence minimum				Factor weight
	2014	2015	2016	2017	
Doctors and medical workers with higher education	5.76	5.08	5.07	5.33	0.25
Research staff	5.36	4.58	5.06	5.29	0.25
Teachers of preschool educational institutions	4.48	3.86	3.79	3.74	0.1
General education institutions teachers	5.08	4.58	4.64	4.68	0.1
Teachers of HPE organizations	5.41	4.82	5.31	6.21	0.25
Social workers	2.50	2.13	2.20	2.91	0.05

Average weight factor	0.1
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Table 10: Indicators of the city of Tyumen sustainable development factors

Retail turnover for the period from the 4th quarter of 2014 to 2017				
Indicator	Years			
	2014	2015	2016	2017
Retail trade turnover, thousand rubles	474,951,416	328,250,121	360,200,778	362,339,617
Ratio of retail trade turnover to the subsistence minimum, [thousand rubles], for the period from the 4th quarter of 2014 to 2017				
Ratio of retail trade turnover to the subsistence minimum	53,114.7	32,171.9	34,708.1	33,724.8
Factor weight	0.2			
Indicator average weight	0.2	Indicator optimal weight		0.2
Unemployment rate of the city of Tyumen for the period from the 4th quarter of 2014 to 2017				
Unemployed	38.3	43.2	40.2	36.2
Unemployment rate	5.5	6.2	5.6	4.8
Factor weight	0.07	0.07	0.07	0.07
Indicator average weight	0.07	Indicator optimal weight		0.2
Average life expectancy of the population of Tyumen for 2014-2017				
Average life expectancy	70.3	71.4	72.1	72,7
Factor weight	0.12	0.2	0.2	0,2
Indicator average weight	0.2	Indicator optimal weight		0.2

Table 11: Indicators of factors of socio-economic development that affect the level of independence of the city

No.	Factor	Factor characteristic	Factor weight
1	City functionality	Multifunctional	0.15
2	Ratio of wages to the subsistence minimum	Wages = from 3 [SM] to 4.9 [SM]	0.1
3	Ratio of retail trade turnover to the subsistence minimum	Over 201[%]	0.2
4	Average life expectancy	Over 71 [years]	0.2
5	Officially registered number of unemployed in Russian cities (per thousand people)	From 10.1 to 70 [thousand people]	0.07
Total			0.72

Thus, based on the data on industrial environmental impact factors, one can conclude that annually, starting in 2014, the level of air pollution in the Tyumen city by the industrial complex and the transport component of the city has been decreasing. The trend to reduce the impact of urban planning on topsoil and also to reduce discharges of wastewater polluting the water bodies of the city is observed. These improvements in the ecological sphere of the city along with stable socio-economic development are due to innovative activities in the field of environmental management, investments in funds aimed at protecting the environment and the rational use of natural resources (17, 18). So, the study of environmental impact factors shows how important are the caring attitude to the ecology of the territory and smart nature management in the context of economic and social development (19). Impact factors clearly represent the very effect of the economic aspect on the environmental one, in particular, the impact of any production facility on the environment. This method of assessing the impact of industrial facilities on the environment is very important, since any new project of the city, or a new organization established by entrepreneurs, directly or indirectly concerns the ecology of the territory, and ecology, in turn, is an important factor in the social aspect of sustainable development. Based on the improved method of assessing the sustainable development of the city of Tyumen, it can be concluded that the social, economic and environmental aspects of the city's sustainable development require effective modern management to achieve the highest

indicators of its sustainable development factors (20). As a result, the city will receive even more autonomy in its development and become less susceptible to both internal and external destabilizing factors, which means the increase in its stability.

In order to manage the sustainable development of the city of Tyumen, a scenario approach was chosen, where recommendations for managing the sustainable development of the city, as well as the program for managing sustainable development, are presented for all three aspects at once (21). Modification of one aspect entails modification of the remaining aspects, and, as a result, a change in the system as a whole. Based on this causal relationship, it can be argued that the modification of all three aspects of sustainable development may entail a threefold modification of the system of sustainable city development, according to the synergy principle. In order to achieve sustainable development of the city of Tyumen and effective management of all three aspects, as well as to provide favorable conditions for life in the territory (22, 23), one should adhere to the program of measures to ensure sustainable development, which includes all management functions, namely planning, organization, motivation and control (Fig. 2). Planning, as a function of the city's sustainable development management, includes recommendations for improving the sustainable development of the city through the management of three aspects of sustainable development (Table 17). The recommendations are of a medium-term nature; therefore, the deadlines for their

implementation are 3-5 years. Funds for the implementation of these recommendations for sustainable development can be allocated from the city budget, as well as through federal subsidies and by attracting foreign investment (24).

By adhering to the program for sustainable development management, the city of Tyumen will be able to achieve high results in the field of such development: the successful

application of the sustainable development concept within the city. The concept uses new energy sources, renewable resources, resource-saving technologies, cleaner production, ecological housing construction, organic farming, promotion of environmentally friendly products and goods, active use of "smart consumption" of resources, formation of the "green economy" structure of production and consumption (25, 26).

Table 16: Assessment of the environmental impact of industrial facilities, 2014-2016

Parameters	Values			Score*		
	2014	2015	2016	2014	2015	2016
Environmental impact parameters of harmful substances						
Impact amount	3,000 [tons/year]	1,500 [tons/year]	780 [tons/year]	3	3	2
Impact spread	3,000 [tons/year]	1,500 [tons/year]	780 [tons/year]	3	3	2
Impact (hazard class)	3-4 class			2	2	2
Impact index	18	18	6			
Environmental impact parameters of wastewater discharges						
Impact amount	16.5 [tons/year]	13 [tons/year]	10 [tons/year]	3	3	2
Impact spread	Discharge of polluted wastewater in excess of established standards			2	2	2
Impact (hazard class)	2-3 class			2	2	2
Impact index	12	12	8			
Environmental impact parameters of total enterprise and household waste						
Impact amount	115 [tons/year]	95 [tons/year]	80 [tons/year]	3	2	2
Impact spread	Waste is stored at the enterprise for less than 3 years in accordance with the established requirements, is used at the enterprise or is transferred to other enterprises			1	1	1
Impact (hazard class)	2-3-4 class			2	2	2
Impact index	6	4	4			
Parameters of the topsoil impact of town planning work and other activities						
Impact amount	Disturbed land area exceeds 1 hectare			3	3	3
Impact spread	Removal of the whole soil profile		Removal of only the upper humus soil horizon	3	3	2
Impact (hazard class)	The impact will lead to soil degradation		Remediation is obstructed or can be done with deviations from norms	3	3	2
Impact index	18	18	12			

* Evaluation is made on a three-point scale, where 1 is a low threat, 3 is a high threat.

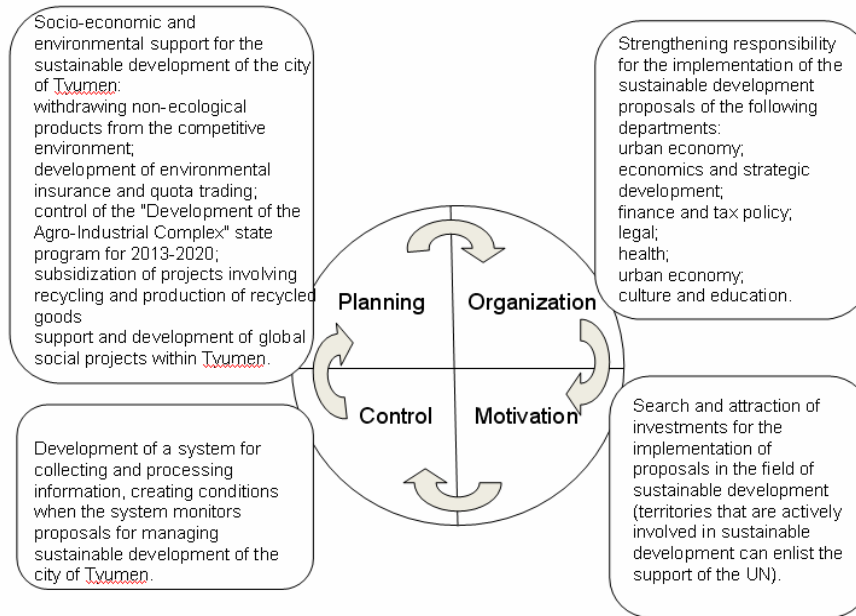


Fig. 2: Proposed measures to ensure the sustainable development of the city of Tyumen (compiled by the authors).

Table 17: Recommendations for managing the sustainable development of the city of Tyumen

Sustainable development aspect	Recommendations
Economic	- withdrawing non-environmentally friendly products, technologies, and equipment from the competitive environment, investing in sectors of the economy involved in recycling, manufacturing products and providing services related to improving the environmental situation of the city, renewable resources, cleaner production, resource-saving technologies; - development of environmental insurance and quotas trading in various areas of environmental management, licensing activities that affect the ecology of the territory. The introduction of fines and monetary compensation in favor of the administrative apparatus of the city for discharging harmful substances into the environment, for deforestation, the establishment of high barriers to opening and operation of enterprises that cause great harm to the environment; - effective control of the Tyumen region state program "Development of the Agro-Industrial Complex" for 2013-2020 by compulsory reporting on each of the activities, as well as the unification of documents for monitoring the status of activities. The priority is the active attraction of investments in Tyumen for the effectiveness of this program. It provides for the effective control of the following subprograms: development of agro-industrial production of the Tyumen Region in 2013-2020; development of agricultural land reclamation in the Tyumen Region for 2016-2020; sustainable rural development until 2020.
Ecologic	- ensuring the safety of the environmental component of the city and the environmental protection, subsidizing projects that involve recycling and production of recycled goods for subsequent use of such goods in everyday life or in the future production. The city authorities support the reconstruction of production facilities during the transition to low-waste and resource-saving technologies, the improvement of engineering, transport infrastructure, and the energy complex of the city using innovative solutions; - preservation of landscape and biological originality, increasing the stability of ecosystems, maintaining the purity of rivers, urban gardening and preserving the historical and cultural urban planning heritage; - development of draft laws in the field of improving the state of the city's ecology, introducing relevant regulatory indicators of the maximal permissive concentration of harmful substances taking the state of the city's territory into account.
Social	- development of legislative mechanisms to ensure that financial resources are consistent with the scope and terms of compulsory medical services for the population, ensuring public participation in health issues; - improvement of the system of public territories, centers, and social infrastructure facilities,

	improvement of the spatial structure of the city territory, ecological housing construction, reconstruction and improvement of residential and industrial areas, implementation of tax and subsidized support for cooperative housing development; - supporting global social projects within the city of Tyumen, increasing the level of social literacy in all aspects of sustainable development, the actual organization of educational process in educational institutions, in line with the latest achievements in culture, science, technology, and engineering, "smart consumption" of resources.
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4 Conclusion

Based on the improved method of assessing the sustainable development of the city of Tyumen, it can be concluded that the social, economic and environmental aspects of the sustainable development of the city require effective management to achieve the highest indicators of sustainable development factors. As a result, the city will become autonomous, less prone to both internal and external destabilizing factors. Recommendations on the city's sustainable development management, as well as the sustainable development management program, should be made for all three aspects at once, because modification of all three aspects of sustainable development may entail a three-fold modification of the city's sustainable development system. In order to apply the recommendations in the field of sustainable development of the city of Tyumen and achieve sustainable socio-economic and environmental development, the city's administrative apparatus will need to set target implementation dates of 3-5 years and financial means to be received from the city budget, as well as from federal subsidies and attraction of foreign investments. In case of the optimal synthesis of these recommendations for the management of sustainable development of the city of Tyumen, it is possible to achieve high results in the management of all aspects of sustainable development and compete with cities of regional and federal importance in the considered indicators.

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