The concept of transforming Naberezhnye Chelny urban planning structure

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Abstract. Naberezhnye Chelny is a unique Soviet city built at the Kama Automobile Plant in the 70s of the 20th century. The city has a linear planning structure, reproducing the “ideal model” of the Soviet industrial city. The transition from a command to a market economy, modern social and economic characteristics of the city, changes in the way of life of citizens require structural and functional, planning, environmental transformations. The objectives of the study are: 1) to conduct a comprehensive urban planning study of the territory; 2) define strategic goals and directions of spatial development of the city of Naberezhnye Chelny. A study of the current urban planning documentation and socio-economic situations in the city, a public discussion of urban problems made it possible to identify main problems, the solution of which should form the basis of the concept of urban planning of Naberezhnye Chelny today. Part of these problems is directly related to decisions of the 1972 master plan and part is related to the emergence of the real estate market in the early 90s of the 20th century. To solve the identified problems directions for further urban planning of the city were determined.

Keywords: industrial monotown, planning structure, urban planning, Naberezhnye Chelny, linear city, polycentricity.

1 Introduction
The purpose of the research is to determine the key directions and content of territorial-planning transformations of a large industrial city formed in the Soviet period, considering modern socio-economic processes, territorial resources and global urban planning trends of cities of this type. The city of Naberezhnye Chelny is considered as the object of study. For setting goals and defining approaches to the prospects of urban planning of settlements it is necessary to designate specific socio-economic and urban features of the city, in the period of its formation, development and current status. Socio-economic characteristics of the city, due to common Soviet-era industrialization and intense urbanization of the country:

1) Monotown
The city began to develop with the construction of the Kama automobile plant in 1969. The KAMAZ plant was a complex of production facilities of large workshops -factories of automobile profile: foundry, forging, pressing, car assembly, engine and repair and tool. The main products were heavy-duty cars of various modifications, powerful automobile diesels. The proximity of car factories in Gorky, Ulyanovsk, Izhevsk, Tolyatti, as well as in other cities facilitated the organization of the new largest production in Naberezhnye Chelny.

2) The city was created in Soviet times as part of the implementation of the regional economic and geographical concept of the organization of territorial production complexes (TPC) - the largest industrial centers of the Soviet Union with giant enterprises. The city of Naberezhnye Chelny was created as part of the Nizhnekamsk TPC, which also included the cities of Nizhnekamsk, Elabuga, Mendeleevsk. Thus, Naberezhnye Chelny has always developed in close coordination with the production base of nearby settlements. Already then industrial and transport ties had already formed in the region, as the basis of a modern agglomeration structure.
If from the point of view of economic development the city of Naberezhnye Chelny has common features with many cities of the Soviet period, then from the point of view of design concept it has a number of urban planning features:

- Naberezhnye Chelny belongs to the group of "new" cities, i.e. created from almost zero point in a short period of time.
- Method of construction of urban buildings on a specially formed industrial base of construction ("construction conveyor").
- Special planning structure of the city: from an urban planning point of view, Naberezhnye Chelny is a unique urban planning experiment. The city is the most comprehensive interpretation of the theoretical concept of the flow-linear model of urban planning of N. Milyutin. The length of the city along the coastline is more than 20 km.

The city has a clear linear planning structure located in the following order: 1) a strip of the residential zone with objects of the primary two-level social infrastructure is located along the water area 2) the next is the strip of the green sanitary protection zone, including recreational facilities, structures, passage areas for production, 3) further strip for industrial use, 4) further, longitudinal transit and transverse dead-end automobile (for residential and industrial areas) and railway (for industrial areas) transport links (Figure 1).

![Figure 1. Planning model of Naberezhnye Chelny: 1 – Kama river, 2 – recreation zone, 3 – residential zone with objects of the primary two-level social infrastructure, 4 – green sanitary protection zone, including recreational facilities, structures, passage areas for production, 5 – Avtozavodsky industrial district.](image)

The study applied general scientific methods of analysis – analysis and systematization of data based on the study of literary sources, the study of domestic and foreign experience in urban transformations of industrial cities. The modern trends of the spatial planning organization of large cities and the formation of urban frame-forming systems are considered.

The concept of sustainable development is considered as a general strategy for large cities [1, 2]. The global goals of sustainable urban planning are identified [3]. The characteristic directions of the spatial and territorial development of cities in the context of sustainable development are also identified. A significant number of studies are aimed at addressing the issues of polycentric urban planning. Several works consider a polycentric approach at different scale levels (region, city, district). The authors consider different evolution patterns of urban spatial structure [4, 5], the dynamics of polycentric evolution and the changing roles of existing and new employment centers in determining
commuting patterns [6]. Some studies associate polycentricity with decentralization of production (is more linked to the decentralization of manufacturing industries) [7], while others consider polycentricity in a comprehensive manner [8, 9]. A methodology is also offered for identifying and forming centers of functional concentrations that are formed in the middle and peripheral zones of the urban structure as the core of the planning (or administrative) areas and equalize the functional imbalance characteristic of the monocentric model.

The centers become “catalysts” for urban planning and gradually “attract” adjacent urban structures [9].

As the most important aspect of the sustainable development of the city, researchers single out the formation and development of the transport and communication framework at the regional level (metropolitan area) or at the city level [10]. Formed transport and communication framework defines the effective use of resources of the territory. To date, the formation and development of the transport frame on the spatial planning level – a hot topic for many studies [10, 11].

In matters of sustainable development in the territorial aspect, the inclusion of the city in the agglomeration processes plays an important role [12, 13]. The authors studied a number of studies on urban metropolitan areas of Russia [14].

Many researchers note that for large industrial cities issues of urban planning ecology are of great importance [15, 16] and the creation in cities of a full-fledged green framework associated with the “green” territories of the suburban zone [17, 18]. The ways of reorganization of the existing system of a natural complex of the large industrial city are directed to the solution of the acute environmental problems [19].

Researchers consider single-industry settlements the solution of socio-economic, territorial issues [20]. For large cities, the problems of the modern functioning of industrial areas [21, 22], development prospects and the role in the economy [23] are relevant. Researchers see redevelopment [24], the introduction of the mixes concept [25] in the urban environment and increasing the comfort and quality of the urban environment [26, 27] as tools for solving urban problems of large industrial regions and cities.

Reviewed studies devoted to Russian cities with a similar planning organization and way of life of the inhabitants – Magnitogorsk [19], Tolyatti [28] Volgograd [29]. The experience of planning transformation of European cities in their transition to a postindustrial society was also studied [30, 31].

The authors studied the research directed to the historical aspect of the emergence of the urban concept in the 20th century, actively used in the Soviet period urban planning [32, 33].

Analysis of publications relating to the history of the formation and development of Naberezhnye Chelny showed the scarcity of materials [34]. Only a few isolated materials on narrow sectoral issues of the development of Naberezhnye Chelny are available in the public domain [35, 36]. Complex studies of the current state of urban planning and environment are absent.

2 Materials and methods

The study applied general scientific methods of analysis – analysis and systematization of data based on the study of literary sources, the study of domestic and foreign experience in urban transformations of industrial cities. The chronological stages of the development of the city were also studied in order to identify spatial development trends. The authors analyzed the strategic planning and legal documents drawn up for the city of Naberezhnye Chelny. The paper conducted comprehensive field investigations of the city and a sociological study – a survey of city residents, interviews with experts, analysis of "urban" social networks and local media publications.

2.1 Urban planning documents of Naberezhnye Chelny

The city of Naberezhnye Chelny is in the north-east of the Republic of Tatarstan on the left bank of the Kama. The city is the second largest in the Republic of Tatarstan (after the city of Kazan). Today, the population of the city is more than 533 thousand people. The city's area is 171 sq. km.
In the 60s of the 20th century, the development of urban planning program documents determining the development of the city began. In 1960-1965, several documents were developed, according to which a project was created to develop the north-eastern part of the Tatar Autonomous Soviet Socialist Republic of the Nizhnekamsk industrial region. Among these documents, it is possible to note the technical and economic report (TER) developed by the Giprogor Institute in 1962. It included a project for the development of production of the Tatar Autonomous Soviet Socialist Republic and a district planning project for the Naberezhnochelninsky industrial district of 1965.

On August 14, 1969, Resolution No. 674 “On the construction of a complex of automobile plants in Naberezhnye Chelny of the Tatar Autonomous Soviet Socialist Republic” was adopted. The resolution of the Council of Ministers of the USSR “On measures for the construction of the city of Naberezhnye Chelny” was adopted only a year later in 1970. The construction of the plant was announced by the All-Union shock construction site. At that time, the construction of the “New City” of Naberezhnye Chelny was going on. It was a large-scale social experiment – construction of the plant, the complex of medical and educational institutions, sports facilities and cultural institutions were built on a grandiose scale at the same time.

The main city-forming industry was determined by the automotive industry, and the estimated population was set to 350 thousand people with an implementation period of up to 2000.

The master plan of 1972 assumed a linear development of the planning structure of the city. The residential zone of the city was formed in the form of the rhythm of enlarged residential microdistricts (inter-main territories), stretching along the Kama coast, penetrated by wide longitudinal transport routes. The industrial zone of the complex of KAMAZ plants was located south of it parallel to it.

The new city arose near a small historical settlement that existed for several centuries on this site at the confluence with Kama of small flat rivers – Melekesca and Chelninki. By the time the construction of the giant automobile plant began, the historical settlement had only 35 thousand inhabitants.

The strict linear layout of the planning structure, along with the enlarged residential districts, has become the most important testing ground for the accelerated construction of mass housing by industrial methods.

During the construction, 17 typical designs of residential buildings were used, which were created directly in the field of housing construction. At the same time, more than 100 thousand people were employed in the construction of the car plant and residential areas.

Within 10 years, more than 60 thousand apartments were built in multi-family housing, as well as kindergartens and schools. In 1976, the first KAMAZ rolled off the assembly line of the car plant. By the end of 70th years the city's population exceeded 300 thousand people.

The master plan of Naberezhnye Chelny (1972), prepared by a creative team of architects under the guidance of academician B.R. Rubanenko, envisaged the creation of a single city center on the territory of the New City, in the form of a linear esplanade raised to the platform for festive processions, flanked by a system of public buildings. All this was located along the high elevations of the ridge of the Kama watershed, visually indicated on the panorama of the city by the rhythm of the pointed 25-storey residential buildings located there. However, the priorities of industrial construction and the need to provide housing for the first builders of the city and car plant workers forced to postpone the construction of the city center facilities for a distant future, the time of which never arrived.

The current master plan of Naberezhnye Chelny is the third urban planning document, designed for a population of 550 thousand inhabitants after the master plan of 1972 and the master plan of 2009, developed by the Kazan Design Institute of the State Unitary Enterprise “Tatinvestgrazhdanproekt”.

The development of the strategic planning system in the Russian Federation over the past decade has led to the development and approval in 2016 of the Strategy for the socio-economic development of Tatarstan. Within the framework of this document, the city of Naberezhnye Chelny was defined as the center of neo-industrial development of the Zakamsky zone of Tatarstan and the core of the Kama agglomeration. This situation should significantly strengthen the “connectivity” of the city with...
external transport infrastructure and significantly expand the scope of services for the associated population.

As part of the strategy of socio-economic development of the city until 2030 one of the strategic goals has been balanced spatial development and increase the comfort level of the urban environment. The main directions of development are formulated: 1) the identification of the city and the definition of its role in the metropolitan area; 2) the formation of a comfortable urban environment; 3) the development of the information and communication space of the city and the transition to the “smart” city format.

To date, Naberezhnye Chelny still belongs to the category of single-industry towns with difficult socio-economic situation (including in connection with the problems of the functioning of the core enterprises). Despite the fact that since 2010 there has been a steady annual growth of urban population, the survey conducted by the administration of industrial enterprises of KAMAZ in 2019 showed that 83% of school graduates have expressed the intention to leave the city. Basic data on the urban population are presented in table 1 [37, 38].

| Table 1. The population of Naberezhnye Chelny. |
|-----------------------------------------------|
| Year | 2000 | 2005 | 2010 | 2015 | 2019 |
| Population | 514700 | 507900 | 513193 | 524444 | 533907 |

The city is divided into 3 administrative districts: Central, Avtozavodsky and Komsomolsky. The generalized balance of the modern functional use of the city is presented in table 2 [39].

| Table 2. The balance of the use of the territory of Naberezhnye Chelny. |
|---------------------------------------------------------------|
| Indicator | % |
| Industrial, communal and storage territories and territories of engineering structures | 22.7 % |
| Territories under surface water bodies | 12.5 % |
| Residential areas | 11 % |
| Territory of transport infrastructure | 10.5 % |
| Territories of collective gardens | 6.2 % |
| Public and business areas | 3.9 % |
| Recreational areas | 3.5 % |
| Territory of special purpose | 2 % |
| Other | 27.7 % |

2.2 The problems outlined by the 1972 master plan and current tasks aimed at the development of the city of Naberezhnye Chelny

Spatial development issues: Lack of rational polycentric organization of the public center of the city.

The ideologization of the public life of the population gave rise to an interpretation of the core of the city-wide center as a place of political demonstrations, the space for which was reserved by the master plan but was never realized by the building. Instead of this, public services are formed by retail facilities spontaneously located in the city structure.

Task: To revise the principle of the dominant sacred space of the city center as a locally fixed place for political demonstrations during the days of communist holidays, which was laid down in the original master plan of the city.

Direction of development: Formation of a polycentric system of urban central places, consisting of three sites:
- on the territory of Azatlyk Square and 19 microdistrict (the territory reserved for the city center by the master plan of 1972).
- the center in the area of Mezhdurechye, as a result of redevelopment of the existing depressive industrial zone.
- an extensive linear center in the “old” city along Naberezhnochninskynsky prospect and the embankment of the Melekesca river.

**Spatial development issues:** The problem of the total uniformity of the mass development of the residential zone of the city.

The priority of the state’s needs over the needs of the population has led to austerity of funds by minimizing the architectural qualities of residential development, limiting its standardization, for the accelerated launch of automobile production.

**Task:**
- To reveal and form the identity of the urban environment.
- To create individual architectural projects for particularly significant urban areas.
- To keep the possibility of using industrial construction, expanding and diversifying the set of typical housing construction and its reconstruction by using a system of additional elements for the formation of plastic facades (“constructor” of elements).

**Direction of development:**
- Objects of public services,
- Preservation of parameters of residential groups in the existing buildings,
- Transformation of the appearance of buildings in some cases (due to additional elements of the “designer”),
- Organization of public services on the ground floors of the facilities and individualization of the architecture of the lower and upper floors.

**Spatial development issues:** The problem of the dominant transport-oriented trend in the city’s planning structure formation.

The euphoria of total motorization, after the “car of hunger”, mastered by domestic urban planners in the mid-50s, predetermined exaggerated attention of designers of the 1972 master plan to the transport system and overshadowed the questions of the organization of pedestrian traffic.

**Task:** Change the prevailing trend “city for cars” to the trend “city for a pedestrian”.

**Direction of development:** Development of a communications system, a shift in emphasis from the trend of “city for cars” to the concept of “city for a pedestrian”. Creating comfortable pedestrian communications with a developed system of passing services to the population; the formation of safe pedestrian crossings; organization of specialized walking routes for schoolchildren; development of the city’s road network with priority for public transport.

2.3 Problems caused by changes in urban planning policy in connection with the emergence of the real estate market and new trends in urban planning. Relevant tasks and development directions of the city of Naberezhnye Chelny

**Spatial development issues:** The problem of matching the mission and the status of the core of the Kama agglomeration.

**Task:** Selection of the territory for the placement of new neo-industry facilities and a diversified services sector. Creation and development of agglomeration service facilities.

**Direction of development:** Provide territory for the formation of a polytechnic educational cluster (Polytechnic University, colleges, technology parks). Create prerequisites for the development of small and medium-sized businesses in the field of neo-industry (not related to the automotive industry). Among the priority areas we can distinguish food and light industry enterprises, various industries based on the development of subject design.

Creation of agglomeration service facilities that have a high “connectivity” with external transport infrastructure. To form two transportation hubs as the new “city gates”: TH “Vostochny” and TH “Zapadny” based on the existing railway station.

**Spatial development issues:** The problem of the reorganization of the main planning units of the residential zone of the city - inter-main territories (enlarged microdistricts).

Hypertrophic neighborhoods of the city suffer from a low level of improvement, the dominance of unorganized car parking, the lack of cohesion and social responsibility of residents for their place of
residence. This is largely due to the "loss" of the feeling of one's own "private" living space. Changes in the scale of the courtyards and the degree of "privacy" of the courtyard spaces contribute to the rallying of residents and initiate the activation of residents for the improvement of the private territory and its careful operation.

Task: Reorganize inter-main territories (enlarged microdistricts) into hybrid microdistricts formed by quarter-group development.

Direction of development: Reorganization of the planning structure at the local level, through: 1) separation of large areas between highways by quarter-group development, 2) identifying inside MMT reserves for creating open public spaces at the local level, 3) solving the problems of storing vehicles, 4) reorganizing courtyards.

Spatial development issues: The problem of the connection of urban public spaces with the Kama coast.

For a long time, access to the Kama coast in the western part of the city (the hydroelectric power station area) was blocked by zones of the dam and port, warehouses of the grain elevator and the Kama water intake in the area of Mezhdurechye. In the zone of the New City, the connection with water was also partially interrupted by cargo berths and an unsettled steep terrain, in the east, an extensive forest park served as a barrier.

The poor connection of the territories with the water area was significantly affected by the lack of coastal highways, public transport routes and service facilities that could attract the population.

Task: Use the unique opportunities of the city’s natural landscape; to realize the ideas and principles of “access” to Kama, which were provided for, but not implemented, by the first master plan of the city.

Direction of development: The formation of a green framework and pedestrian links with the Kama River in a recreation area along an extended coastline.

3 Results and Discussion
The work was carried out according to the following methodological principle: the analysis of urban planning techniques typical for large industrial cities in the framework of the concept of sustainable development, conducted a comprehensive field investigation of the city, analysis of socio-demographic data, analysis of strategic and urban planning documentation of Naberezhnye Chelny.

In the next phase of work have been identified problems caused by the peculiarities of urban planning at different historical stages. At the final stage of the work, the corresponding tasks were set and the key directions for the spatial and territorial development of the city were identified.

In the original master plan of Naberezhnye Chelny (1972) a few key ideas have been incorporated:
- a linear city with a clear strip of functional zoning - a parallel arrangement of industrial, residential and recreational areas.
- the main planning unit is an enlarged microdistricts (inter-main territory - IMT).
- “designer” of elements of prefabricated housing.
- a representative center as a sacred space - a locally fixed place for festive processions and demonstrations on the days of communist holidays, a “relic” of the Stalinist concept of the city.
- the monumentality of the center, which expressed the power of the socialist state.
- vertical spatial zoning through the use of “platforms”;
- transport-oriented planning and transport-oriented life activities (life on wheels, a mobile city dweller).
- implementation of the national plan of monumental propaganda in the environmental design of the city.

Based on an analysis of the territory’s resources, socio-economic conditions and the development directions of the settlement, global trends in urban planning of industrial cities, the following structurally meaningful blocks of the urban planning concept of Naberezhnye Chelny have been identified:

1. The city of Naberezhnye Chelny as a key core in the structure of the Kama agglomeration.
2. Formation of a green skeleton of the city and linking the fabric of the city with a large water area (creation of exits to the Kama River).

3. Transition to a polycentric urban structure through the formation and development of a system of community centers for planning areas.

4. Evolution of a model for the development of residential territories and the transformation of enlarged microdistricts.

5. The change in the trend “city for cars” to the trend “city for a pedestrian”.

6. Identification of architectural-volumetric and planning identity of the city.

The paper studied the history of the formation of the city, conducted a comprehensive study of urban territory of the city of Naberezhnye Chelny, defined strategic goals and directions of spatial development of the city. The main results of the study are to identify the problems of territorial development of the city and the definition of strategic spatial transformation in Naberezhnye Chelny, in the development of an integrated model of urban planning. The concept-model of spatial and territorial development of Naberezhnye Chelny has been designed as a basis for the evolution and updating of documents for urban and territorial planning.

4 Conclusions

The analysis of theoretical and methodological approaches and design materials made it possible to identify key areas of transformation of large industrial cities. Currently, the key areas are sustainable spatial and territorial development and strengthening the importance of the agglomeration development of regions and cities as active and key nuclei. The following key areas are highlighted in matters of transforming the internal urban structure: transforming the transport and communications framework and transport infrastructure, identifying, building and strengthening the green framework of the city, actively developing mixed-use territories, actively introducing polycentric development into the practice of urban planning, searching for intra-city territorial reserves and redevelopment of industrial facilities and territories, reconstruction of the urban environment taking into account persons. These trends are relevant for the spatial development of a large industrial city of Naberezhnye Chelny. Superimposing on the historically established planning structure, especially the urban planning and socio-economic development of the city, we determined the main directions of urban planning transformations that will be laid down in the new master plan of the city.

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