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SMART CITY. "A TRIAD OF DEVELOPMENT AGENTS"

Abstract. *Large Russian city agglomerations enter the period of structural and spatial transformations. The Samara region is included as a pilot site into the "Smart City. Successful Region" Federal Programme and has been actively developing the conceptual offers for the project financing factory. Along with theoretical innovation strategies of the 21st century such as democratisation, clustering, gentrification, digitalisation of economy and some others, the scientific society of the Samara region has been developing a strategy called "the triad of development agents". The socio-spatial basis of the strategy is a smart university, a smart city and a smart park-plant. The scientific and design potential of Samara State Technical University (SamSTU) is considered for the "smart" university, the "smart" park-plant is the industrial park of SamSTU and its partners at the site of one of the former industrial enterprises. The "smart city" includes administrative and public organisations of urban development, activists of urban social movements. The central historical planning zone of the city of Samara is proposed as the territorial-spatial basis of urban development. The spatial structural elements of its three model projects are offered: a smart block, a smart street and a smart square, which integrate more than 30 innovative, including "green" technologies in the areas of resource conservation, public services, preservation of architectural heritage, media technology, transport-pedestrian infrastructure and fiscal taxation systems. The choice of "smart" technologies is fundamentally tied to the digital form of economic activity in the territory.*

Keywords: *"smart" city, urban structure, central historical planning zone, triad of development agents, park-plant, pilot projects.*

The largest urban agglomerations of the country, including the third largest in Russia Samara-Tolyatti agglomeration (about 2.5 million urban residents), are entering a period of active structural and spatial transformations. The Samara region is included as a pilot site in the "Smart City. Successful Region" Federal Programme and has been actively developing proposals for the project financing factory.

Both theoretical and implemented strategies of "smart" cities that have been formed so far, integrating areas of modern urbanisation - ecologisation, informatisation, democratisation, clustering, gentrification, digitalisation, etc., put forward several fundamental models of urbanisation in the 21st century. One of such theoretical models, which the regional scientific school has called the "Triad of Development Agents", is currently being developed in the scientific community of the Samara region as the most adequate to the emerging goals and objectives of transforming a large industrial city of Samara into a post-industrial metropolis taking into account all opportunities offered by information and communication technology.

Identification and specialisation of Samara in the system of global markets currently means the following priorities: aerospace manufacture, automobile production, neural network technologies, and also provides for the development of priorities for future markets: technologies in healthcare and energy fields.

The trends in the strategic development of post-industrial economy were outlined in the Strategy of Socio-Spatial Development "Samara – 2025", which includes innovation, urban ecology, business environment, communications, transport, tourism, space, community, culture and education (Zhivaia strategiia…, 2014).

The largest city is a unity of socio-spatial and territorial-spatial structures ensuring the continuous development of the city in the dialectical contradiction. Digital economy is becoming one of the stages in the development of urban planning systems (Esaulov, 2013, 2017).

According to the authors, the socio-spatial activity basis of the model is the "Triad of Development Agents", which consists of a smart university, a smart park-plant and a smart city (Fig. 1). The territorial and spatial basis of urban planning transformations is the central historical planning zone of the city of Samara.

In the socio-spatial structure, Samara State Technical University, its research and design potential, is considered as the "smart" university. The "smart park-plant" is the industrial park of SamSTU and partners located in the territory of one of the former factories in the structure of the historical core of the city. The "smart city" includes administrative bodies and public organisations of urban development, activists of urban movements.

Smart University

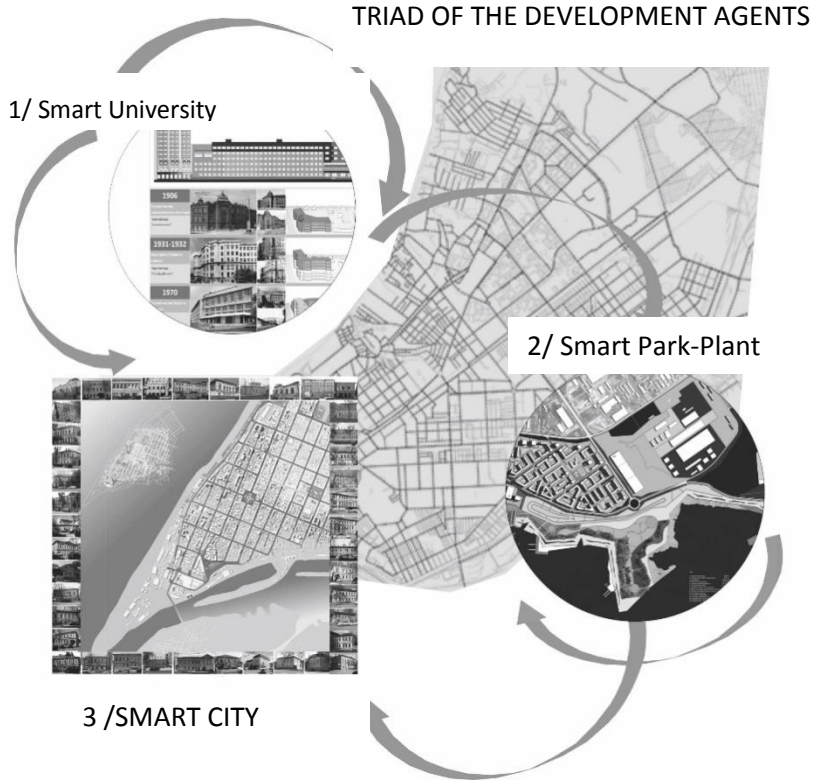

Figure 1. Triad of the development agents as a model of the "Smart city. Successful region" pilot project

Spatial-planning elements of the three pilot projects in the central historical planning zone of the city are distinguished in the spatial structure as the smart block, the smart street and the smart square. About 30 innovative urban green technologies have been gradually integrated into their urban structure: from public utilities, resource saving, restoration of heritage, media technologies, transport and pedestrian infrastructure, fiscal taxation system.

The "smart university" is the basic institution of higher education - Samara State Technical University – which acts as a developer of patented advanced information, innovative and other technologies. The University, where there is a significant potential for scientific research, patents, implementations, and innovative projects, has a key position in this "triad". In the concept of the pilot project, the extensive intellectual potential of the university was used, a package of scientific developments was collected, which were reflected in the technologies proposed for implementation within the project. Moreover, the mission of the university as one of the

development agents was also to consolidate the efforts of scientists, practitioners, production workers working in various specialised organisations and companies already engaged in the introduction of the latest technologies in the city and the region. Due to this, the team of developers of the pilot project concept was significantly expanded to include regional leaders of innovative entrepreneurship, as well as groups of active citizens.

The "smart park-plant" is an innovative production base for the implementation of the project and the release of an innovative product. In the industrial era, Samara was developing as the largest industrial centre of the country, where the change in the post-industrial benchmarks in the economy caused the degradation of the former industrial and public storage areas of the city and the residential areas serving them. The "park-plant", being integrated into the structure of these often abandoned territories, can give them a new impetus to development. Thus, the concept of the "smart city" can be localised not only within the central historical planning zone, where similar territories also exist, but also cover a significant part of the second, Bezymyansky, city centre. In this case, the popularity of the pilot project among citizens will significantly increase and from the local sites provided for by the project concept, it will be possible to move on to the coverage of the urban planning structure of the metropolis as a whole.

The "smart city" is a historical zone of the metropolis as an experimental platform for testing advanced technology, most highly rated by various segments of the population of the city and the region, socially recognised by administrative bodies and public organisations of urban development, activists of urban movements. The territorial and spatial basis of town planning transformations is the central historical planning zone of the city of Samara (the unique integral territory is about 800 hectares within the boundaries defined by the state body for the protection of cultural heritage). This position of the authors of the concept is important and even decisive. The active, dynamic life of a huge country cannot be concentrated only in some large metropolises. They should disseminate innovative approaches to urban design, architecture of buildings and structures throughout the country, support the harmonious spatial development of Russia. At the same time, to give the regional identity of the historical and architectural heritage only to small towns and medium-size cities, so that they can preserve their history and cultural identity, in the authors' opinion, is also not the right vector in preservation of the historical, architectural and urban planning heritage. The historical centres of large cities should not become a place of "notopia", i.e. a modern concentration of high-rise buildings with the latest achievements of innovative construction technologies: from high tech and eco-tech without architectural reference to the urban planning and historic-architectural context of the development of cities with a half-thousand-year history (Akhmedova, 2017). Currently, this trend is being actively discussed in Russia and, in particular, in Samara, where the social movement for the preservation of the historic-architectural identity of the city is very developed (Vavilonskaya, 2017). The latest construction and restoration technologies should be used and find active implementation in this very most valuable and important environment for the intercultural process.

The triad of agents suggested in the concept has become determining in the development of the priority objectives of the pilot project, including:

- Attraction of highly profitable objects in the central historical planning zone;
- Justification for the selection and implementation of information and other innovative technologies in the central historical planning zone;
- Launch of model projects on selected "pilot sites" in the main planning elements of the city, i.e. "Smart Block", "Smart Street" and "Smart Square";
- Coordinating the activities of agents for the development of smart technologies, raising the level and role of education;
- Beginning of the development of information technology, the design and construction of the "Data Centre" for managing the databases of the smart city.

Approbation of three model projects in the structure of Samara central historical planning zone involves the introduction of innovative technologies at the level of three spatial-planning elements of the city: a smart block, a smart street and a smart square. At the level of the block as a private space, the advantage of the technologies being introduced will be noticeable, first of all, for the residents of the block, which should become an experimental platform for working out those technologies that can be implemented at the level of living space. Such a project location is necessary from the standpoint that the dissemination of best practices and technologies to all territorial-planning units of the city is impossible to do at the same time due to the high cost of the project and limited budget. However, to limit the location of the project only by a residential area as an experimental platform for its implementation would be not enough and would limit the range of implemented technologies. The street and the square as public spaces represent those planning elements of the city that are in demand by a much larger number of citizens and the technologies introduced into their structure can receive a wide positive assessment of the urban society as a whole. Moreover, the choice of socially significant public spaces (streets and squares) for testing model projects cannot only significantly expand the range of implemented technologies, but also significantly increase the popularity of the "Smart City. Successful Region" pilot project among the population.

Three model sites adjusted to the tasks of innovative development of the three elements of the urban spatial planning structure, suggest the differentiated introduction of the developed technologies (Fig. 2).

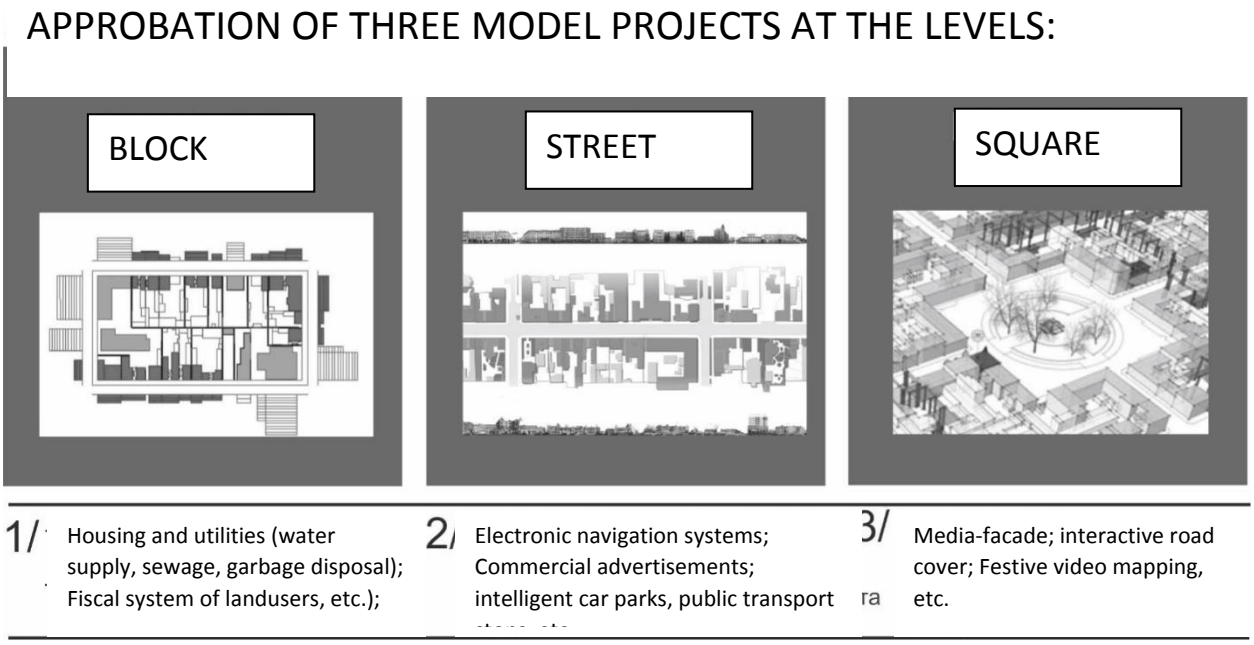

Figure 2. Model sites for approbation of the "Smart City. Smart Region" pilot project

Thus, at the block level, new technologies can be implemented in the housing and utilities field (primarily modern ones, including alternative, sewage systems, water supply, water disposal, power supply, as well as the collection and use of rainwater, intelligent garbage disposal systems and underground parking, other technologies), in the creation of a fiscal system of land users, etc.; at the street level - in the system of electronic navigation, commercial advertising, intelligent parking and public transport stops, etc.; at the level of the square - in the system of media facades, interactive road cover, festive video mapping, etc.

The choice of specific model sites for the implementation of model projects is determined by the urban planning, socio-economic, and strategic objectives of the development of the central historical planning zone (Figure 3).

The “Smart Block” is associated with the need to further promote the strategic renovation project of the central historical planning zone development “5 blocks”, which was elaborated under the patronage of the Ministry of Construction of the Samara Region with the financial support of the Social Fund for Housing and Mortgage. Among the five residential areas to be renovated, the priority number is considered the area number 77 or block "E", according to the renovation project. This block can become one of the model sites for the “Smart City. Successful Region” pilot project.

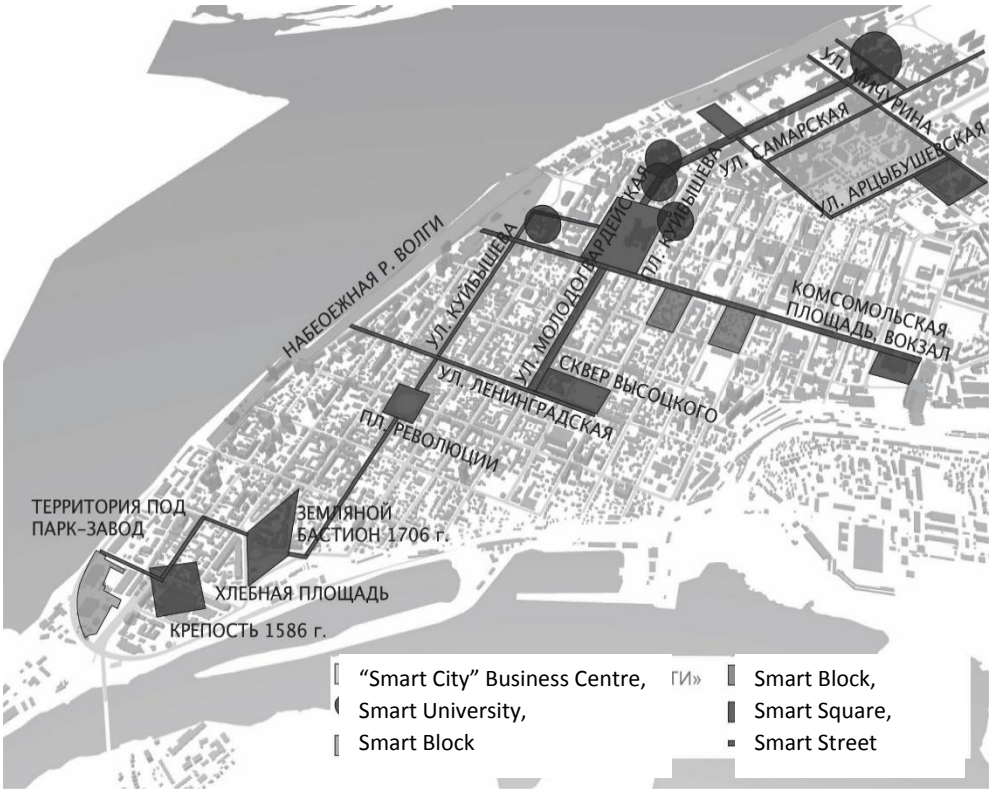

Figure 3. Selection of model sites for the central historical planning zone development in the city of Samara

“Smart Squares” and “Smart Streets” are determined by the town-planning code of the city, which historically constituted of “square and crossroads”. The latter was formed by a longitudinal street and a cross descent to the Volga River. According to the concept developed by the authors, Molodogvardeyskaya street was chosen as a longitudinal street and Krasnoarmeyskaya street was chosen as a cross descent, as it connects the landscaped embankment with the railway station. Krasnoarmeyskaya street also meets the narrow side of the residential area No. 77. Both streets are located within the central historical planning zone of Samar. Along Molodogvardeyskaya street many educational buildings and laboratories of SamSTU, one of the development agents, are located. Moreover, the buildings of the key administrative structures of the region and the city are concentrated along Molodogvardeyskaya street: the Regional Administration, the Department of Urban Development, the Gubernskaya Duma, the Corporation for Regional Development, etc. The street is the central axis in relation to the main square of the city: Kuibyshev Square with the building of the Opera House. It is known that the economic well-being of the city centre, the look of squares, streets and individual buildings, “is considered to be an important indicator of the activity and initiative of its administrative bodies” (Rypkema, 2016, p.60). This is why Molodogvardeyskaya and Krasnoarmeyskaya streets have been chosen as linear model sites for the implementation of the pilot project.

"Smart Squares" include: Kuybyshev central city square, which hosts all festive activities of the city and which became the core of the fan zone at the World Cup 2018 and Khlebnaya Square as one of the first city squares. The latter is located the confluence of the Volga and the Samara rivers and has preserved the rhombic form of the Samara bastion of 1706, the fortifications of which were uncovered by archaeologists in 2014. Next to Khlebnaya Square there is an area provided for the location of the park-plant, as well as the site of the first Samara fortress of 1586, where, according to the Strelka plan design, a large cultural and entertainment centre of the city should be located, in the forms of which it is planned to fix the "memory of the place" (Fig. 4). In close vicinity there is an empty concrete dominant of an elevator, which is intended for transformation into a data centre, from where it is planned to exercise control over the work of all the systems of the Smart City.

According to the Higher School of Economics (HSE), the key criteria which can determine the compliance of a historic city with the concept of the "smart" one can be: a) technology, b) environmental friendliness, c) management, d) mobility, e) heritage, g) human (population) (Ilyina, 2014). In their concept, the authors relied on this group of criteria, which is considered consecutively further.

It is planned to develop technology taking into account regional specificity and those developments, patents and innovations that have already been created on the basis of Samara State Technical University. Among the developments of SamSTU, the most promising are:

- technologies of pre-engineered buildings that can be used for the relocation of citizens from dilapidated and emergency housing in the central historical planning zone of the city and involve the use of integrated modules of the frame and fencing structures with the use of energy-efficient materials;
- the use of the BIM-technology in the design and operation of buildings, management of engineering networks, search for alternative resources for buildings;
- improvement of technologies for the restoration of monuments, including examination and monitoring of the state of structures, manufacture of formwork for the restoration of decorative mouldings of facades and interiors;
- design, installation and maintenance of the control systems, including access and monitoring, "smart parking" with identification of car number, information about parking spaces available and parking schedule;
- RFID technology for controlling the schedule and routes of garbage disposal;
- security technologies, such as unified passes, registration and analysis of the use of collective spaces (parking lots, playgrounds, etc.).

The estimated cost of implementing each of the control systems with equipment depends on the scale of the project and can amount up to10 million rubles if technologies and design work can be carried out on the basis of one of the development agents, for example, design and production work can be performed at the site of **the smart park-plant** (Fig. 4).

According to the concept, one of the locations of the "Smart Park-Plant" within the Samara Centre of Emergency Response Centres is the territory of the warehouse complex of buildings of the former Valves Plant, where the industrial park of SamSTU and its business partners can be located. The adaptation of the site for the park-plant and the use of warehousing facilities implies the following: the capital building No. 1 (3,400 m^2) could accommodate smart home technology, BIM technology, intelligent transport and parking, infoboxes production, water recycling, etc.; concrete storage shed (3,800 m^2) for the production of pre-engineered buildings, formwork, energy-saving materials, wind power generating sets; metal storage sheds No.1 and No. 2 (460 m^2 each) for warehouses of components and raw materials, equipment; capital building No. 2 (250m^2) as a household unit. The total area for the development of the site of the future park-plant is 2.6 hectares and covers an area of 118 x 220m. The estimated number of jobs is 700 people.

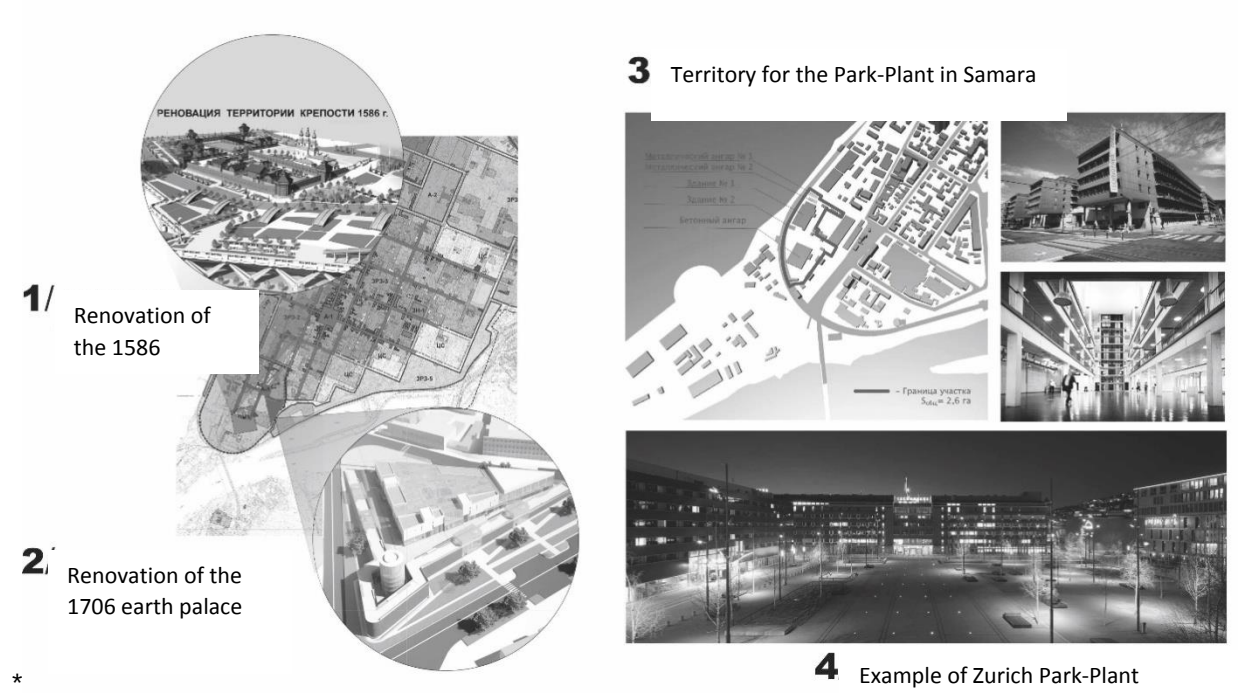

Figure 4. “Smart Squares” with interactive expositions of historic fortresses of Samara and the “Part-Plant” as the development agent of the pilot project

Environmental friendliness as the second key element is associated with the efficiency of the use of all types of natural resources, with the “green economy”. Reasonable energy consumption and energy efficiency, renewable energy, the growth of the share of alternative energy, including those using solar and wind energy, the creation of a favourable microclimate inside and outside, including through the use of vertical landscaping, the creation of interdependent infrastructures - technical, transport, construction, landscape, etc. Environmental friendliness as a term is connected with ideas about the house, the design of which can be based on the use of a number of different concepts called: “passive house”, as the building which does not need heating, and requires little energy; “active house” as a building with a positive energy balance, independently producing energy for its own needs in more than enough amounts; “smart home” equipped with high-tech devices.

Management is the most important element of urban planning in a large city. The structural elements of the three pilot projects in the central historical planning zone will have all the necessary information and operational means of “smart control”. It is planned to gradually introduce about 30 innovative urban “green” technologies from such fields as the utilities, resource saving, heritage restoration, media technologies, transport and pedestrian infrastructure, fiscal taxation system into the urban environment of the smart block, smart street and smart square. The choice of “smart” technologies, “imported alien” ones and those developed at SamSTU with partners, is ultimately focused on the digital economy of the areas of activity in the CIPS (sustainable urban environment, taxes, tourism, hotel industry, comfortable “smart” housing, etc.). Town-planning transformations are based on the framework of the town-planning code of the city of Samara, which has been repeated four times and is transmitted to the future development (Vavilonskaya, 2014).

Mobility implies the improvement of transport infrastructure, with the use of innovative technologies, namely: the creation of an intelligent transport system (ITS); optimization of the road network; underground automated parking; “Smart ticket” system for payment in public transport, parking and other services. Designing a mobile transport system and individual transport infrastructure objects may become the object of design and research of one of the design centres of the base university.

Heritage, the attitude to it and its state, the integrity of the environment, which is not destroyed, but is enriched by the introduction of innovative technologies, becomes more informative, more accessible, more comfortable, is also one of the key criteria of the "smart city". The seeming conservatism of proven technologies of restoration will be enriched by the use of state-of-the-art equipment and innovative work methods. Therefore, based on Samara State Technical University with the support of the Ministry of Culture of the Russian Federation, the Administration of the Samara Region, including the State Cultural Heritage Protection Agency, the Engineering Restoration Centre was created in December 2017 as a regional centre of competence in the field of heritage preservation technologies. In accordance with the roadmap, the main types of work of the Engineering Restoration Centre are:

1) educational services for training restoration architects, engineers, process engineers, cost engineers, restoration stone setters, cutters, plumbers, dry wallers, moulders, etc.;

2) scientific design work and studies on the preservation of objects of architectural heritage on the basis of a licensed design scientific restoration workshop and laboratory of chemical and biological research in restoration;

3) production activities on the basis of the five production workshops planned in the Centre, namely the art casting restoration workshop, the restoration materials science workshop, the carpentry restoration workshop, the ceramic sculpture and glass workshop;

4) restoration works carried out in the planned construction site;

5) expert technical support of restoration works (services of technical support of restoration objects, technical supervision and monitoring of the state of the historical environment surrounded by new construction and reconstruction facilities; consulting services; implementation of conclusions and scientific reports on design documentation and production of preservation of architectural heritage objects, creation of a regional restoration council.

It is planned to equip the workshops, the laboratory and the construction site with modern innovative equipment, which will ensure high accuracy, productivity and scope of work. The Centre should become a unique precedent not only in the scale of the region, but also of the Russian Federation as a whole, in terms of the complexity and high technology of the tasks being solved.

The proposal to develop the Engineering Restoration Centre of the SamSTU was elaborated on the basis of the Action Programme of the Samara Region Government for 2018. The programme provides for the development of an Activity Plan for the development, renovation and preservation of the historic centre of the city of Samara and protection of cultural heritage sites. The Activity Plan is aimed at the regeneration of the historical settlement and provides for Samara to obtain the appropriate status. The plan takes into account the specificity of the historical settlement, the necessary types of project activities and the formation of an information system to support urban development. The plan also includes the development of historical and cultural reference plan, the draft border and the subject of protection of the historical settlement, the project of the joint protection zones. An inventory of monuments is planned with the aim of clarifying their object-by-object composition, updating the master plan in terms of the historical settlement regulations, developing draft layouts and surveying historic blocks, as well as city economic feasibility for territorial development.

Man, as a member of urban society, is the last key element of the "Smart City" (Fig. 5). Their development, socio-cultural activity and scientific and educational potential are the main value and capital, the key to the attractiveness and success of any city (Hollis, 2016; Glaeser, 2014). Creating innovative opportunities for the implementation of human capital in a historic city should be based on urban programmes for the development of education, science and culture. Such programmes involve the development of human potential in the following areas: participation technology, volunteer movement; educational activities, preparation of popular, educational and scientific publications on architectural heritage; the launch of new educational programmes of higher and vocational education in the field of restoration; development of a restoration production base (Mastenitsa, 2011). The programme serves to unleash the scientific

potential and creative thinking of creative youth. The development of technologies of the "smart" city is inextricably linked with the attitude of the population to high technology. According to the monitoring of the HSE, it turned out that the demand of Russians for high technology is still relatively low, but interest is gradually increasing (Esaulov, 2013).

Figure 5. Key elements of the "Smart City. Successful Region" pilot project

Figure 6. Selection of objects and technologies for implementation within the “Smart City. Successful Region” pilot project.

Comments :

1. Transport stops with information counters
2. Infobox
3. Media Centre
4. Electronic payment for underground parking
5. Media-facades
6. Data Centre

1. Cycling lanes illuminated by the principle of photo cells
2. Automated printers for printing short stories
3. Smart dustbin towers
4. Electronic navigators
5. Information booths
6. Wi-Fi routes under the trapdoors
7. Sensors of pollution, noise and wind

Conclusions

The authors expect the following results and effects of the pilot project:

1. Formation of the teams of the development agents’ triad “CITY-UNIVERSITY-PLANT”. Enhancement of the formation of the activity urban community with various mentality (general, scientific and pragmatic), but aimed at achieving the same goal, i.e. sustainable development as “non-controversial” (Esaulov, 2012) preservation and renovation of the historical urban environment and increasing the quality of life of the citizens.

2. Selection of the site and industrial partners for the Park-Plant, its gradual transformation into a technology park open to the urban community in the best world traditions.

3. Development of SamSTU structural divisions: Engineering Restoration Centre, Centre for Environment Sustainable Development, other research centres. Design, support and approbation of model projects “Block−Street−Square”.

4. Regeneration of the historical environment as a catalyst for further development and the priority of the functions of culture and tourism within the central historical planning zone, the renovation of the territory of the former environment identifiers - Samara fortresses with the placement of interactive exhibits, large objects of business and cultural tourism.

5. Justification of the choice of the city route for the introduction of information and other innovative technologies with the prospect of its further development: river station - both ancient fortresses - Kuybysheva Street - Molodogvardeyskaya Street. The route gives the idea of the potential of the historical environment of a large city, includes cultural, administrative and educational objects, including most of the buildings of Samara State Technical University, and as a result, is highly visited by both tourists and residents of the region.

6. Creation of the smart city in the periphery of the central historical planning zone, which is the brand of the pilot project, re-identification of the environment due to the unique public and business architecture.

7. The phased formation within the central historical planning zone of Samara of a holistic innovative urban environment in which more than 30 "smart technologies" are integrated (Fig. 6): transport stops with information counters, infoboxes, electronic parking payment services, media facades that expand the city information field; data centre for server and network equipment; a media centre (electronic library), bicycle lanes on photocells and automatic printers; smart bins with waste pressing and online filling control; information booths with telephone, displays and phone charging function; electronic navigators with the ability to build and print routes; Wi-Fi routers; climate sensors, etc. (Akhmedova, 2009).

The expected result of the implementation of the Concept and Pilot Projects is the sustainable urban environment in the central historical planning zone of the large city focused on the digital economy, implementation experience with the potential to spread to urban and regional areas and settlements in the Samara region, and, possibly, in general for the Russian Federation, the high quality of life for the population while maintaining the historical and town planning identity of Russian cities.

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