Innovations in solving current issues in architectural and spatial city environment

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Abstract. Architectural environment is a complex system which requires an integral well-developed approach of space organization. In the area of architectural and space environment there are a lot of unsolved problems. This article refers to one of the most current problems, such as: city parking space management, management of dump disposal spaces, asphalt works, urban greening. These problems can be resolved by using innovations and implementing marketing tools. This article refers to the analysis of existing innovations, based on both domestic and international practices, which occur in architectural and space environment, as well as innovation pros and cons, finding the right problem solutions and proposing of targeted solution for certain some problems.

1. Introduction
City spatial development is aimed at the efficient transport, engineering and technical, social and industrial infrastructure development. It focuses on meeting the need and requirements of a consumer. It is necessary to create conditions for comfortable living and resident servicing that meet environmental, aesthetic and physiological requirements when designing modern cities [1]. There are a number of problems that occur as a result of increased city construction. Using innovations in design and reorganization of the city architectural and spatial environment can help to solve them.

Innovation is the application of better solutions with high efficiency. It is the result of an individual or a scientific community intellectual activity, which can be accomplished by creative search and improvising [2]. Innovative implementations in urban planning and architecture are associated with environmental, economic and cultural society changes as well as spiritual requirement and architectural art [3]. Innovations development is a result of creative, scientific, and technical activity [4]. The main purpose of innovations is to create the most comfortable living environment for citizens [5].

2. Innovation analysis
Here are a few of the most current problems of architectural and special city environment. City parking space management is one the major problem. In some cities around the world attempts have been made to address it. For example, in Miami there is 1111 Lincoln Road, which is a multifunctional structure with a parking space of 300 car parking lots, there are also restaurants, coffee shops, shops and offices. This building is very high and it is quite interesting in terms of its architectural form and color. There are practically no fencing, or walls and it seems like cars are just floating in the air, it
doesn’t seem very safe. There is also an unusual parking Cheesegrater in England which is a pavilion in the shape of a cube. It is covered with reflective panels which produce electricity for lighting which makes it energy efficient. The building has a solid base and seems stable and safe, it also has artistic architectural aspect of structure which adorns urban environment [6]. There are also innovative parking lots in Nottingham and Bristol. In Nottingham for example there is a parking lot with a roof equipped with solar panels, where you can charge electric cars. The city is going to expand the number of such parking lots to provide energy for neighboring houses. The city Bristol is called the “green” capital of Europe, it has a new generation Parking which is equipped with a ventilation system “Eco Park”. This system is able to completely absorb harmful gases, as well as a fifty present energy savings [7].

Today there are also automated parking systems, the main feature of which is that the cars are automatically sent to the floors without a driver. The driver activates the Parking management system with an identification card, which closes the gates and send the car to the parking place. This automated Parking is a structure made of metal or reinforced concrete frame and it looks like a building. This building can be located both underground, above the ground or mixed. There are also mechanical - access parking garages, where the operator sends a car to the upper levels using a remote, while the driver does not take the car to the upper levels himself. Such parking buildings are mobile and can be transported to another location if needed and they consume little energy [8].

Considering this, we can make the following conclusion: there is a trend of automatization and mechanization of Parking. In some cases mechanical- access parking garages are more beneficial, as they can be operated without electricity. The best possible option can also be a combined type of Parking, which are automated, but at the same time have a mechanical descent and car placement system. Many buildings are designed to be energy efficient and have unusual construction solutions. It is possible that soon cars will have their own “houses”. The best parking locations can be next to residential and public buildings. Having a high number of parking levels is not always the best option, it will be difficult to get the cars down on the ground in case of a system failure. In this case two or three floor parking with car evacuation roads is a better option. Today the development of car parking facilities is an important task, but clearing of the air from gas contamination is still a greater problem. There is a parking with a cleaning system “Eco Park” in the city of Bristol. This parking is the most successful innovative solution, other than car parking lots it also has systems for air cleaning and electric power charging.

The problem of garbage space management is also very relevant, so different solutions are currently in the works. Environmentalists say garbage should be sorted by categories. In Great Britain, for example, the so-called electronic waste basket has been invented, the boxes of which are equipped with solar panels and are in constant communication with waste processing points. The operator receives a message when the trash can is full so the tanks can be emptied. These waste baskets can be placed not only on the streets, but also in the buildings.

There is also another interesting invention the so-called “street box for compost”. Temporary use of such boxes are planned to be used during various cultural events. On the permanent basis, such boxes are planned to be installed in parks, squares, gardens, and other public areas. Inside of these boxes there are special biochemical substances that can turn garbage into compost.

There is a garbage shredder Mode All-in-One, which is a portable garbage processor. Its internal shredder is hidden in the unit. It recycles plastic bottles together with lids, it also separates glass form metal. The shredder contains the “all is one function” for accumulated garbage processing [9].

On the streets of London there are garbage bins with LCD screens, which are equipped with a Wi-Fi system and emergency warning system. Their screens show weather, news, stock quotes. The price of such an invention reaches 1.5 million rubles [10].

There are also systems of garbage underground storage. This innovative ECOLIFT system is designed for solid municipal waste storing. The main idea of the system is to use a hydraulic lift. The accumulation of garbage occurs in conventional containers, after that is it transferred to an
underground container. Then the garbage is removed by a lifting mechanism that lifts the containers to the ground. After the garbage is removed the system moves down [11].

There are systems of semi-buried containers. The outer part of the container is made of reinforced concrete, the inner part of hot-dip galvanizing steel. There’s cool temperature inside the container. The containers are equipped with a system of waist tracking. Garbage is removed with a crane [12]. Vacuum chute system or pneumatic system is also an interesting solution for garbage storage. The main idea is to press the garbage in the bins, after that it goes to a garbage distribution point, and then immediately to the landfill [13].

So, it is clear that there are solutions for garbage space management problems. It’s an interesting approach to equip garbage containers with solar panels to generate energy, with liquid crystal screens, Wi-Fi system and emergency warning system. This way garbage containers lose their main function. Now it’s not only a necessary object for living, but it can also benefit residents with their additional useful functions. There are also trends in waste processing directly in the garbage containers, which has a positive impact on the environment. Designers are searching for new form and stylistic solutions for garbage containers, which can improve street spaces.

There is also an important question of asphalt road paving for which there are innovations as well. There are asphalt cracks, potholes which usually appear after the winter period. Water gets into minor cracks and turns into ice, so as a result the asphalt is squeezed out. Affected areas become unsuitable for water re-infiltration after warming, this is the reason why cracks and potholes appear. Scientists propose various ideas to solve this problem.

Various new technologies are introduced, so that the regular bitumen can be replaced with “self-healing asphalt”. This type of asphalt was developed by Delft University specialists in Netherlands. It is a “self-healing workmaterial, which is filled with electrically conductive fiber filters in closed loops configuration. This innovative system operates as electric current is passed through filter fibers, located next to cracks. The electrical circuit begins to generate heat of the required temperature. Due to heating bitumen is melted and compacted. “ETH Zurich” researchers and Swiss research organization “Empa” also proposed solutions for the asphalt recovery problem. The main idea is to use iron oxide nanoparticles, that are exposed to alternating magnetic field, to cover crack areas. After covering, asphalt begins to soften and self-heal. University of Minnesota Duluth scientists began to mix bitumen and iron ore. They created a modified work material which can repair the roadway using a special vehicle.

Pervious pavement material for storm water reduction is an interesting invention. The main idea is that water penetrates the materials through the pores, while simultaneously distributing the flow through the existing surface coating, which allows it to fill the lower layer of soil with moisture. So the negative seasonal factors of road surface freezing and thawing can be reduced. There is also another advantage of this coating: it diverts groundwater from roadway. As a result we can see the beginning of the “urban surface evolution”, transition from grey evolution to green [14].

Based on all the inventions in asphalt recovery, it is clear that scientists are starting to use electric current and iron particles in their developments. This solution does not seem to be the best, most likely another methods have to be found to solve this problem. Meanwhile the invention of water-permeable asphalt appears to be an interesting and mainly useful solution for the environment, where water penetrates into asphalt through pores which allow earth to breathe. It is less damaging for the environment.

Landscaping and greening is one of the most important questions when it comes to organization of comfortable living environment. Here are some of the innovations in this field. There is a roofing system GreenSkin, which is developed by a Belgian company under the leadership of Mark Herman’s. The main idea is to develop a simple technological way to create a roof garden by connecting drainage storage modules in a single coating. The system consists of adjustable supports with a slope compensator and modular soil trays 40x40 cm, where different types of lawns, sedums, and other types of landscaping can be planted. The system allows to form an air layer to protect plant roots waterproofing, it creates waterproofing protection from overheating and ultraviolet radiation, reduces
air pollution, stabilizes air temperature in summer and winter, provides noise protection and sound insulation. It allows installation of different coating combinations and the ability to perform various landscaping design solutions. Finally, it is a low cost system and it doesn’t require irrigation [15].

There are innovative technologies for a smart garden. They are developed for solving the following problems:

- Creating gardens and parks in separate closed zones with unique climate, for plants that need to be preserved;
- Creating balanced humidity, lighting, nutrition and temperature;
- Availability of modular geoplastics for the effective modified zoning development with different climate zones;
- Ability to connect to either a shared or autonomous network [16].

“Smart garden” system allows to control light, sound, fog as well as lawn heating using a conventional smartphone. This system can create different conditions for plants and soil [17].

Various technologies for environmental pollution cleaning are also being developed to create a new image of a future city. For example, green roofs are now located on the roofs of public and residential premises. They can be designed similar to mini gardens and rooftop parks. Green roofs are developed for regulating city ecosystem, urban air pollution cleaning and creating green areas on the roof, as well as building thermoregulation, sound insulation, etc.

There is also vertical landscaping, called vertical parks, where the main idea is to create irregular terraces and loggias at different levels which helps plants to get sunlight during the day. Self-regulating parks is another interesting invention which is aimed at such resource conservation as solar energy and rain water for their further processing and future use. Here the relief of the projected area is presented as a drainage mechanism for plants watering. This park is located in Prenzlauer Berg in Berlin.

Biological purification methods using bacteria and plants for contaminated environment (soil, water and air) are being developed today as well. This method of purification is called bioremediation, while purification method using green plants is called phytoremediation. Phytoremediation method is used in Nanterre, France, in the park "Schmen de l'île" along the side of Seine river. Water is purified by water plants after getting into a park water reservoir and it is further used for urban gardens watering [18].

Based on the innovations it is clear that space greening is rapidly developing and growing. They should be actively implemented in design and reconstruction of architectural objects and environment. Now there are city design trends, with the main idea of architecture and nature interaction [19]. Urban ecology is aimed at architectural and planning studies in interaction with man and society, human and natural environment to create favorable conditions and protection with their further harmonious development [20].

3. Problem solutions

The Parking space problem solution can be Development of a two or three-storied building without electricity use. The cars themselves will drive up to the second or third floor up the existing ramps to save construction resources and electricity. It is important to meet the city appearance esthetic, so Parking buildings should be suitable for the environment. Parking can be equipped with roof solar panels to generate electricity. Equipping such parking with “Eco Park” ventilation system would also be a helpful solution. It is better when parking is located near public and residential buildings. The problem of Parking road asphaltalting can be solved by replacing conventional asphalt with permeable asphalt with breathing zones (for grass growing). Territory ecologization problems problems must be addressed comprehensively: the introduction of roof and vertical greening, the implementation of bioremediation and fitoremediation, plants purifying the atmosphere from emissions, increasing city parkland fountain territories.
4. Conclusions
In conclusion, this article highlights the most important urban space organization problems. Various innovative approaches and developments are proposed to address some of the challenges. Some of them are successful, other require improvements or development of new innovative solutions. There is only a few current problems noted in this article and a few different solutions. Urban space organization is a complex process and it requires a long time to create a common concept. It is a development of a common concept that will be the solution for urban space organization problem. This concept should include organization development of the general city composition, its branding, city improvements, as well as take the needs of consumers, residents and tourists into consideration.

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