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PHILOSOPHY OF APPLIED RELIABILITY AND SAFETY OF UKRAINE NEW TRANSPORT INFRASTRUCTURE

Ihor Gameliak, Andrij Dmytrychenko, Ihor Vakarchuk. *«Philosophy of applied reliability and safety of Ukraine new transport infrastructure».* Summarizes experience and identifies strategic directions of the new transport infrastructure; contained methodology of ensuring the development and implementation competitive projects and services of new transport infrastructure; case of competitive projects and services of new transport infrastructure is presented, taking into account legal and educational and research support. Systematization of terminology is the basis for use in the wording of projects and changes to laws and regulations regarding the requirements of reliability and safety of infrastructure facilities and further theory development and practice of infrastructure projects. The use and involvement domestic raw materials and road operators for network development of cement concrete roads in Ukraine from the southeast to the northwest will provide long-term, within 25-30 years, prospect of building this network, which is qualitative guarantee changes in employment, rural development and efficiency of the national economy. Smart Stop Point projects take into account the trends of modern philosophy in architecture and construction, local identity, ethnic styles and motifs, geographical and weather conditions, limitations caused by the COVID-19 pandemic, autonomy, energy efficiency, inclusion, urban connectivity, suburban and long-distance control systems. Proposed a new principles of scheduled repairs of hard coatings with different operation modes and operating conditions are breakthrough in the dual use of certain types materials, products and technologies, both civilian and military, and meets the interests of national security and defense of Ukraine. Designing schemes and urgent measures

for the dispersion of transport and passenger flows in the event of illegal interference in the operation of infrastructure facilities are efficient, effective, safe, can be monitored and connected to urban, suburban and intercity control systems. A comprehensive system of monitoring and control reliability and safety of infrastructure facilities also provides continuous monitoring, assessment and changes in the condition of airfields and road surfaces. Training, retraining, raising and improving the skills of managers and specialists in reliability and safety in transport is an important step to ensure transport functioning road complex of Ukraine.

Keywords: reliability, safety, object of transport infrastructure, object of airport infrastructure, standard, cement concrete, international corridors, highways and local transport networks, traffic and passenger flows, strategic infrastructure projects, smart stop point.

Ігор Гамеляк, Андрій Дмитриченко, Ігор Вакарчук. «Філософія прикладної надійності та безпеки нової транспортної інфраструктури України». Узагальнено досвід та визначені стратегічні напрями нової транспортної інфраструктури; викладено методологію забезпечення розробки та впровадження проєктів та послуг; представлено кейс конкурентоздатних проєктів та послуг, з врахуванням правового та навчально-дослідного супроводу. Систематизація термінології є основою для нормативно-правових актів з надійності та безпеки інфраструктурних об'єктів. Вітчизняна сировина для розбудови цементбетонних доріг України забезпечить на 25-30 років перспективу будівництва, є гарантом зайнятості населення, розвитку села і ефективності національної економіки. Інтелектуальні зупинки враховують філософію архітектури, локальну ідентичність, етнічні стилі та мотиви, географічні, погодні умови, обмеження викликані пандемією COVID-19, автономність, енергоефективність, інклюзію, підключення диспетчерського управління. Нові принципи ремонтів жорстких покриттів за різних режимів роботи, умов експлуатації мають проривний характер подвійного використання, цивільного й військового призначення, відповідає інтересам національної безпеки та оборони України. Схеми, невідкладні заходи щодо розосередження транспортних та пасажиропотоків за умов протизаконного втручання у функціонування інфраструктурних об'єктів відрізняються ефективністю, безпечністю, моніторингом. Моніторинг і контроль надійності, безпеки інфраструктурних об'єктів забезпечує спостереження, оцінку, прогноз стану жорстких покриттів. Підготовка, підвищення кваліфікації спеціалістів з надійності та безпеки важливі для функціонування транспортно-дорожнього комплексу України.

Ключові слова: надійність, безпека, об'єкт транспортної інфраструктури, об'єкт аеропортової інфраструктури, стандарт, цементбетон, міжнародні коридори, автомагістралі і місцеві транспортні мережі, транспортні та пасажирські потоки, стратегічні інфраструктурні проєкти, інтелектуальні зупинки.

Игорь Гамеляк, Андрей Дмитриченко, Игорь Вакарчук. «Философия прикладной надежности и безопасности новой транспортной инфраструктуры Украины». Обобщен опыт, определены стратегические направления новой транспортной инфраструктуры; представлена методология обеспечения разработки и внедрения конкурентоспособных проектов и услуг; кейс конкурентоспособных проектов и услуг, с учетом правового и учебно-исследовательского сопровождения. Систематизация терминологии – основа для нормативно-правовых актов по надежности и безопасности инфраструктурных объектов. Отечественное сырье для сети цементобетонных дорог Украины обеспечат перспективу строительства, гарант занятости населения, развития села и эффективности национальной экономики. Умные остановки учитывают философию архитектуры, локальную идентичность, этнические стили и мотивы, географические, погодные условия, ограничения вызваны пандемией COVID-19, автономность, энергоэффективность, инклюзию, подключение к системе диспетчерского управления. Новые принципы ремонтов жестких покрытий с разными режимами работы, условий эксплуатации имеют прорывной характер двойного использования, гражданского и военного назначения, отвечает интересам национальной безопасности и обороны Украины. Схемы и неотложные меры по рассредоточению транспортных, пассажиропотоков при противозаконном вмешательстве в функционирование инфраструктурных объектов отличаются эффективностью, безопасностью, возможностью мониторинга. Мониторинг и контроль надежности, безопасности

инфраструктурных объектов обеспечивают наблюдение, оценку и прогноз состояния. Подготовка, повышение квалификации специалистов по надежности, безопасности важны для функционирования транспортно-дорожного комплекса Украины.

Ключевые слова: надежность, безопасность, объект транспортной инфраструктуры, объект аэропортовой инфраструктуры, стандарт, цементобетон, международные коридоры, автомагистрали и местные транспортные сети, транспортные и пассажирские потоки, стратегические инфраструктурные проекты, умные остановки.

Introduction. Social change, legal complication, social, environmental and economic factors combined with the exacerbation of pandemic scenarios require to today's problems solution of survival and creative search for the development tomorrow's projects. These processes are especially aggravated in connection with the external aggression of the northern neighbor and military events in eastern Ukraine, which is a threat to the security of our existence and future generations. At the same time, breakthrough technologies in various sectors of the economy are aimed at overcoming negative effects of the environmental crisis. In particular, in the road transport sector - environmentally-oriented construction, repair and maintenance transport infrastructure. Risk management of creating new "green" technologies, cheaper construction, increasing reliability and durability due to resource-, energy-saving and rational use of nature. Unfortunately, due to objective and subjective factors, most effective and rational developments are not widespread in Ukrainian road construction practice. To avoid a no return point, above requires of immediate action to use the acquired system knowledge, make rational decisions and implement cost-effective, reliable and safe technologies in the area of transport and road infrastructure projects. Using many years of experience in scientific developments and their implementation, the authors for the first time combined knowledge systems and practices related automotive and road industries. This study reveals the relationship of educational, scientific and applied activities in the context of a comprehensive solution to urgent

development issues of new transport Ukrainian infrastructure.

Analysis of recent researches and publications. 93 years ago, Ukrainian scientist V.I. Vernadsky wrote about "a sharp and terrible change in nature, reflection on it of the social changes experienced in human life" and the lack of "stability and the impression of age power" [1, p.620]. The issue of security is of particular importance for each sectors of our economy, because security is associated with the possible protection and preservation of life and is identified with the value and criterion development. West-201 [2] proved the areas in which public-private partnerships are appropriate to reduce the scale of economic and social consequences. A major reset [3] claims systematic analysis of the global crisis and a single strategy to create more inclusive and sustainable world of the future. Philosophical discourse on value problem regulation of security and sustainable human development and the analysis of value system and socio-cultural mechanism in [4] offers ways to optimize its functioning in Ukrainian society. Recently, there is a tendency to implement the accumulated knowledge and practices of various security in the educational processes educational institutions on the basis of many scientific and philosophical studies to understand the various threats and dangers in the XXI century. At the same time, the accumulated domestic experience of safety [5] is ignored, which requires a more careful consideration of the acquired thesaurus for the subject area and the use basic principles in creating modern concepts of safety road transport complex. Regulations analysis shows work of transport in Ukraine [6], should be used as basis for developing methods to

ensure and assess reliability and safety of transport systems and services. Implementation of the target program «large-scale construction» requires ensuring a comprehensive and basic country network with a high level road quality and reliability, road safety, deployment of intelligent transport systems, innovative technologies, telematics applications, management and regulatory measures for infrastructure management, efficient use of correlated transport infrastructure resources. with EU requirements [7, p. 192-194]. Also, among the priority state areas are: modernization and development airport infrastructure; development transport corridors; implementation transport initiatives "One Belt - One Road" and "Baltic Sea - Black Sea - Caspian Sea" for the efficiency transport network (TN), improving communication between countries and strengthening macro-regional cooperation and trade [8]. Scientists provide various interpretations essence of transport infrastructure and its features in terms of integration, which summarizes the main purpose of transport infrastructure - to ensure effective links between the subjects of industrial relations [9]. [10] deals with the advanced, synchronous and catching up model of formation, development and expansion of transport infrastructure of Ukraine and an alternative approach with active involvement of business in the implementation of priority projects. Unlike German highways, French highways, Italian highways, there are no European or world-class roads in Ukraine. The negative phenomenon of long-term colonization is that in the Ukrainian lands preference was given to the construction of military roads for the rapid mobilization / evacuation of necessary resources to / from the site of probable hostilities. According to the International Road Federation (Eurostat) and the European Concrete Pavement Association (EUPAVE) in developed countries, the share of cement concrete roads for highways is up to 65%, regional networks up to 40%. In Ukraine, only 1.5% of roads are paved with cement

concrete. At the same time, foreign investors are ready to restore all our roads in 5 years. And then what? Construction of cement concrete roads should become a national idea, a strategic direction, defined by the following advantages: its raw materials (limestone, clay); appropriate capacity for the production of mixtures (in Ukraine, the six largest cement concrete plants in Europe, loaded with only 2/3 of the capacity); service life from 22 years; cement concrete is 2.5 times cheaper than asphalt concrete, which is 100% imported (https://www.youtube.com/watch?v=ILEFjisyui0&ab_channel=Espresso.TV).

At the same time, the Institute of Artificial Intelligence promotes the concept of artificial intelligence through annual, since 2015, seminars and conferences [11]. In the case of joint implementation projects in the management systems educational institutions, enterprises, organizations and institutions, such activities will be included in the Strategy as a basis for the introduction of mechanisms for the development and promotion of competitive products. New trends, expected challenges and next steps for managers of technology and service providers in 2021 are disclosed in [12]. Review of methods of using swarm intelligence algorithms [13; 14] allowed to carry out the comparative analysis application of various techniques swarm optimization for the decision set task of construction and optimization program-configured networks, taking into account various criteria and conditions of optimization. In particular, content on safety control, assessment, risk management, construction, operation, airport rehabilitation and airfield coverage should be identified, for example [15, 16].

At the same time, the coronavirus pandemic and lockdown have made adjustments in our daily lives: from the habit of "non-collective" work to dependence on a regime of complete remote "presence" and created a paradox that is strikingly different from established processes in all sectors economy and business model of educational

and scientific segment in particular. It is urgent to bring the results of education and science to the requirements of economy and to provide transport and road complex with qualified personnel. The precondition for the presupposition of the results of this work was the scientific afternoon research during 2002-2020 at the Department of Airports of the National Transport University (NTU).

The purpose and objectives of the study The purpose of the work is to present case of long-term areas implementation in competitive infrastructure projects / services in Ukraine and their management, taking into account legal and training and research support.

According to purpose, following tasks are solved:

- generalization experience and definition of strategic directions in new transport infrastructure;
- providing a methodology for competitive projects / services by new transport infrastructure;
- implementation competitive projects / services of new transport infrastructure.

Basic material and results. Since 2002, the Department of Airports of NTU has introduced scientific, technical and experimental developments and applied research on:

- technologies of airfield / road cement concrete and asphalt concrete coverings;
- infrastructure network of intelligent public transport facilities;
- operation of airfield / road cement-concrete and asphalt-concrete coverings and their maintenance with use anti-ice chemical reagents;
- diagnostics of airfield / road cement-concrete and asphalt-concrete coverings with use of thermal imaging non-destructive testing defects.

The analysis was performed recent research and publications and generalization of scientific and applied results at the Department of NTU Airports, confirmed by numerous acts of implementation, allowed to establish long-term strategic directions

implementation of competitive projects / services new transport infrastructure of Ukraine for development, design, construction, operation, modernization, modernization objects of transport infrastructure (OTI), objects of airport infrastructure (OAI) and airfield constructions (AC).

1. Long-term priorities Ukraine's new transport infrastructure:

- 1.1. Regulatory and legal support of reliability and safety OTI, OAI and AC;
- 1.2. Development, design, construction, operation, modernization, utilization and monitoring of OTI, OAI and AC;
- 1.3. Optimization transport network and location of OTI and OAI;
- 1.4. Quality control regarding the reliability and safety of OTI, OAI and AC;
- 1.5. Dispersal passenger and transport flows under conditions of illegal interference in the functioning OTI and OAI;
- 1.6. Monitoring and management OTI, OAI and AC projects;
- 1.7. Training and advanced training of specialists in reliability and safety OTI, OAI and AC.

The methodology of realization each long-term priorities united systems of knowledge and practices adjacent motor and road branches, and the principle system knowledge and rational decision-making became the main for introduction economical, reliable and safe technologies concerning projects new transport infrastructure of Ukraine concerning development, designing, construction, operation, modernization, utilization and monitoring of OTI, OAI and AC.

2. Methodology development and implementation projects / services by new transport infrastructure of Ukraine:

- 2.1. The methodology regulatory and legal support on the issues of reliability and safety OTI, OAI and AC is based on the experience since 1994 on development of modern regulatory and technological framework transport legislation of Ukraine in terms of motor transport and road industries,

social standards and social guarantees; resolutions of the Cabinet of Ministers of Ukraine regarding provision of passenger transport services, holding a tender for passenger transportation, development highways; orders of the Ministry of Infrastructure of Ukraine regarding the organization of passenger and luggage transportation, control over compliance with traffic safety rules; state, branch building norms, standards, etc. ;

- taken into account the results of systematization terms, their concepts and definitions as a basis for use in drafting projects and changes to regulations, state, industry building codes, standards for further development theory and practice of infrastructure projects.

2.2. The methodology development, design, construction, operation, modernization, utilization and monitoring OTI, OAI and AC is based on the experience since 1990 on the national idea to building a network cement concrete highways of Ukraine [17] using and involving domestic raw materials and road operators to form efficient network from southeast to northwest and provide shortest cities connections, Fig.1;

- taken into account the long-term perspective construction network of cement-concrete roads for 25-30 years, which is a guarantee of qualitative changes in the sphere of employment, rural development and efficiency of the national economy of Ukraine.



Figure 1 – Integration schemes for international corridors, highways and local transport networks,

Source: developed by the authors

2.3. The method optimization transport network and location of OTI and OAI is based on the experience since 1996 conducting a comprehensive study of demand for transportation under direct contracts for scientific and technical work in the cities:

Dnepropetrovsk, Zaporizhia, Ivano-Frankivsk, Kyiv, Konotop, Kremenchuk, Lviv, Mariupol, Rivne, Simferopol, Chernihiv and since 2005 the study traffic intensity and composition of traffic flows on the roads M-14, M-19, H-07 [18], Fig. 2;

– taken into account passenger flows and traffic intensity, composition of traffic flows for optimization of the transport network and location of BTI and OAI of the new transport infrastructure of Ukraine.

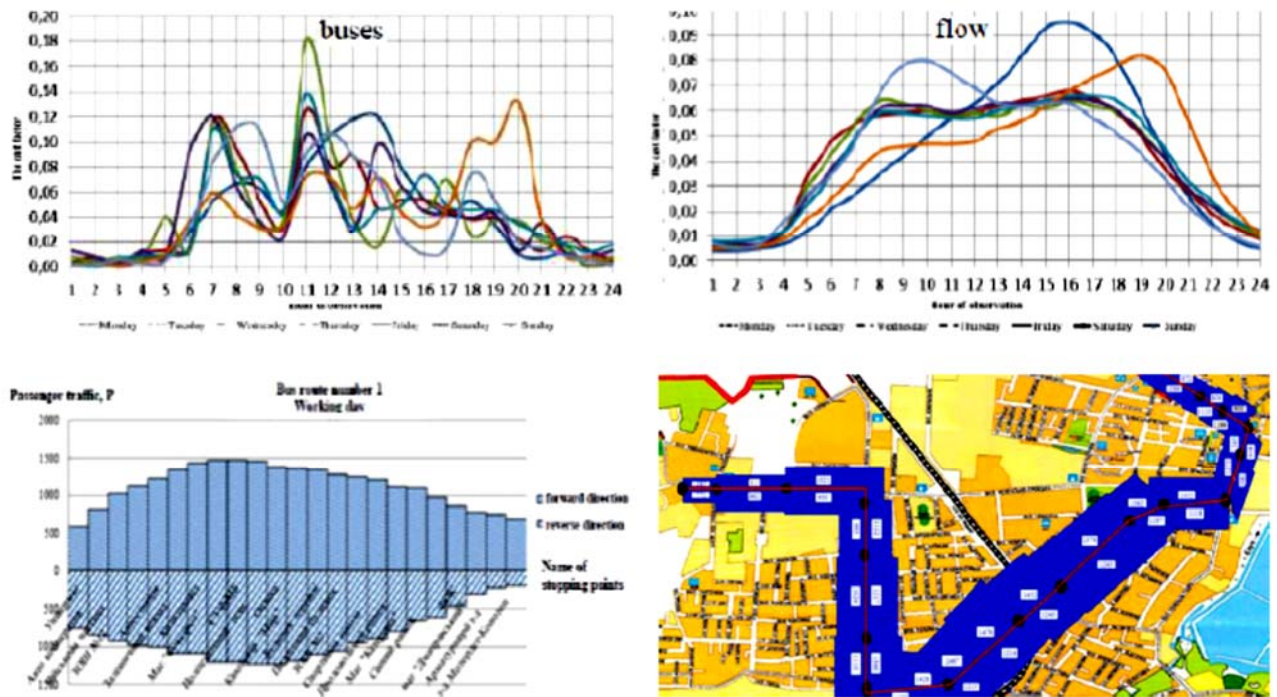


Figure 2 – Examples of research results of traffic and passenger flows
 Source: developed by the authors

2.4. The methodology of reliability and safety OTI, OAI and AC is based on the experience since 2016 on economic contract topics and new principles scheduled repairs of hard coatings and the use basalt-plastic reinforcement in construction of OTI, OAI, AC Donetsk, Zhytomyr, Zakarpattia, Zaporizhia, Kyiv, Kyiv , Lviv, Mykolaiv, Odesa, Kharkiv and Kherson regions;

- taken into account quality control of life cycle from development technical task to production, construction and operation OTI, OAI and AC.

2.5. The dispersal method of passenger and transport flows is based on the conditions of illegal interference in functioning OTI and pre-developed schemes and urgent measures for their dispersal;

- taken into account principles of efficiency, effectiveness, safety, monitoring and connection to the city, suburban and intercity control systems.

2.6. The methodology of monitoring and project management OTI, OAI and AC is based on the experience of diagnostics airfield / road cement concrete and asphalt concrete coatings using thermal imaging and non-destructive testing defects and swarm intelligence technology. On sectoral analytical structure transport and road complex for monitoring and expert assessment by government decisions, development alternative infrastructure projects and programs in related sectors of transport and road management for quality decision-making at the strategic, tactical and operational levels of infrastructure projects and programs, shows in [19];

- taken into account using of innovative technologies and the combination of SWOT-analysis methods and qualimetric approach for making rational design decisions based on expert assessments.

2.7. The method of training and retraining specialists in reliability and safety OTI, OAI and

AC is based on the experience since 2002 by systematic educational, scientific and applied activities of the Department of Airports of NTU on the implementation educational programs "Airports, airfield structures and facilities" and "System Analysis in transport infrastructure";

- synthesis of educational and professional programs "Airports, airfield structures and structures" and "System analysis in transport infrastructure" by the Faculty of Transport Construction of NTU to promote the idea of double diploma / degree after successful completion of joint educational program of certain cycle / level of higher education.

It is necessary to use methods on the basis of the research site in Kyiv region, which has 43 OTI [20, p. 501], where to introduce all the latest technical means and technologies with counter-spread in the areas of "East - West", "North - South". Rationale for the selected region is determined by the geographically advantageous location relative to the main transport routes / international transport corridors and its administrative significance for other regions of country.

Taking into account the urgency of the theory, methodology and applied aspects of complex solution priority directions by new transport infrastructure of Ukraine, a system of technological proposals has been developed, Fig. 3.

3. Technological offers of competitive projects / services:

3.1. The system "Letter of the law, UA" preparation of draft versions and amendments to laws and regulations regarding requirements for reliability and safety OTI, OAI and AC.

Innovative aspects and benefits: systematization terminology is the basis for use in legislation and regulations and further development theory and practice of infrastructure projects.

3.2. System "Recovery Path, UA" for development network of cement concrete highways of Ukraine in order to form an effective network from southeast to northwest and provide the shortest connection to the city.

Innovative aspects and benefits: use domestic raw materials for the manufacture plastic cement concrete, reliability, durability and low cost.

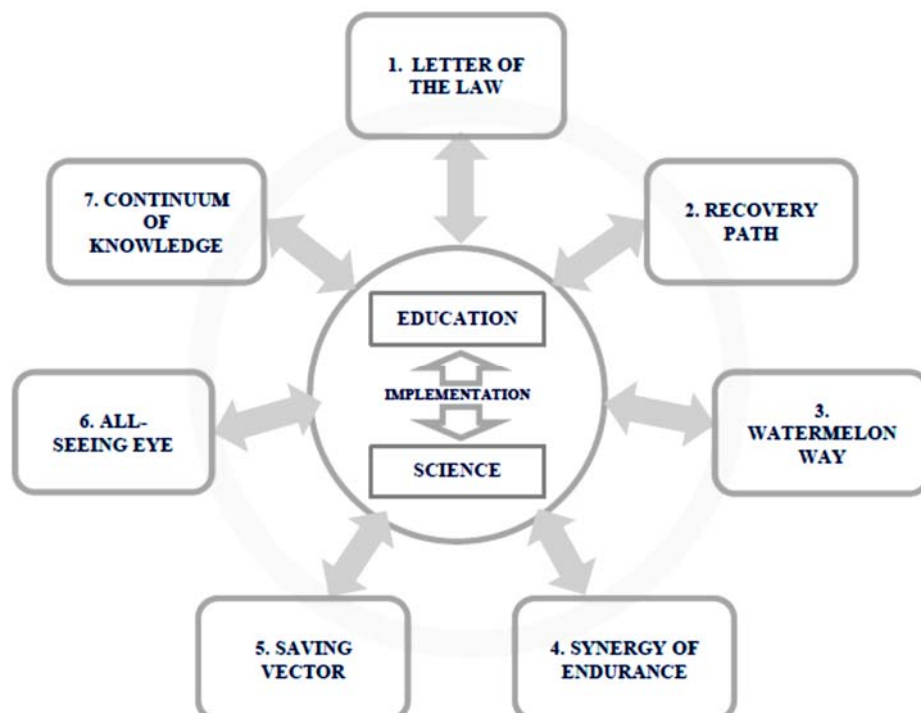


Figure 3 – System of strategic infrastructure projects

Source: developed by the authors

3.3. System "Watermelon Way, UA" design of intelligent stops "Khersonochka" for routes of public passenger transport in the Kherson region, Fig. 4. Possible design for other regions of Ukraine by classes, length, area, volume, capacity depending on the size of passenger traffic, vehicle models and configurations of transport network, taking into account local identity / ethnic styles and motives, geographical / weather conditions,

etc. (taken into account restrictions caused by the COVID-19 pandemic).

Innovative aspects and benefits: the stop works only with the vehicles registered in the system; autonomy; energy efficiency; inclusion; connection possibility to city, suburban and long-distance control systems; trends in modern philosophy of architecture and construction, complementing globalization and localization.

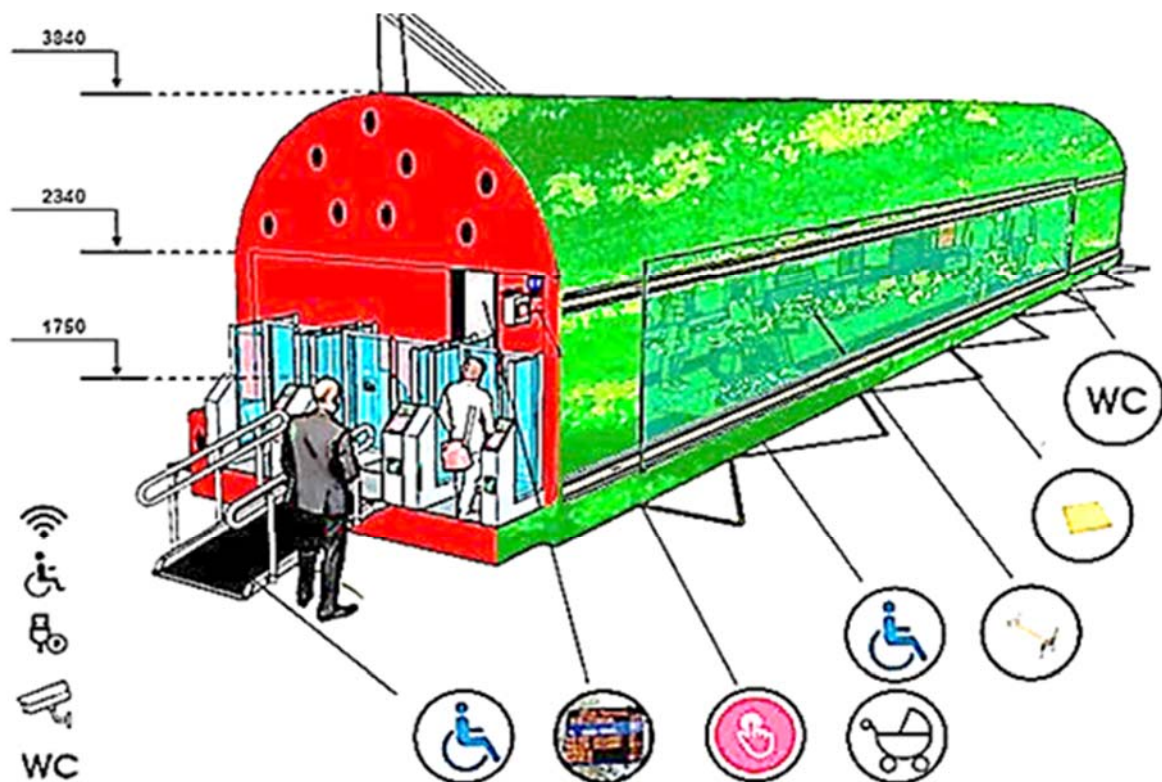


Figure 4 – Smart stop point
Source: developed by the authors

3.4. "Synergy of Endurance, UA" system for reliability and safety OTI, OAI and AC for use in load-bearing structures with different operating modes and operating conditions; has a breakthrough nature of dual use certain types of materials, products and technologies, both civilian and military, and is in the interests of national security and defense.

Innovative aspects and benefits: Offered a new performance principles planned repairs of rigid coverings taking into account with kind and development degree of their destructions. The project implementation will

reduce the cost of road maintenance, increase traffic safety, improve environmental conditions. Advantages of cement-concrete coverings: application of high-strength concretes increases bearing capacity by 18 - 30% that increases covering service life to 3 times; absence of track phenomenon; less heating due to the light surface; possibility of processing and reuse; availability of domestic raw materials. Advantages basalt and fiberglass fittings: full corrosion resistance, lower weight, greater tensile strength, resistance to aggressive environments.

3.5. System "Saving Vector, UA" design of schemes of dispersal of transport and passenger flows under the condition of illegal interference in the functioning infrastructure facilities of transport modes.

Innovative aspects and benefits: Pre-designed schemes and urgent measures for dispersal transport and passenger flows (taking into account the limitations caused by the COVID-19 pandemic) and they are efficient, effective, safe, can be monitored and connected to urban, suburban and intercity control systems.

3.6. "All-seeing eye, UA" system for monitoring and control of reliability and safety OTI, OAI and AC (taking into account the requirements for the use of swarm intelligence algorithms for monitoring the reliability and safety OTI, OAI and AC).

Innovative aspects and benefits: comprehensive scientific and information system of regulated continuous, long-term observations, assessment and changes in the condition of airfield and road surfaces in order to identify negative changes and make recommendations for their elimination or weakening.

3.7. The system of "Continuum of knowledge, UA" training / retraining, training / improvement of managers and specialists in reliability and safety OTI, OAI and AC, taking into account the synthesis of various educational and professional programs to promote the idea a double degree after successful completion of higher education.

Innovative aspects and benefits: implementation of the principles "why we learn - we put into practice" and "talents are not renewed continuously, but are supported by the heritage of generations" for the training of modern, qualified specialists in reliability and safety in transport.

Conclusions. Defining long-term priorities and ensuring the methodology of development and implementation by new transport infrastructure of Ukraine allowed to present a case of competitive infrastructure projects / services, taking into account legal and training support.

1. Systematization of terminology is the basis for use in the wording projects and amendments to laws and regulations regarding requirements of reliability and safety infrastructure facilities and further development of the theory and practice infrastructure projects.

2. The use and involvement domestic raw materials and road operators to build a network of cement concrete roads of Ukraine from southeast to northwest will provide long-term, within 25-30 years, the prospect of building this network, which is a guarantee of quality changes in employment, rural development and efficiency national economy.

3. Smart Stop Point projects take into account the trends of modern philosophy of architecture and construction, local identity, ethnic styles and motifs, geographical and weather conditions, limitations caused by the COVID-19 pandemic, autonomy, energy efficiency, inclusion, connectivity to urban, suburban and intercity control systems management.

4. The proposed of new principles scheduled repairs of hard coatings with different modes of operation and operating conditions are breakthrough in the dual use certain types of materials, products and technologies, both civilian and military, and meets with interests of national security and defense of Ukraine.

5. Design schemes and urgent measures for the dispersion of transport and passenger flows in the event of illegal interference in the functioning infrastructure facilities are characterized by efficiency, effectiveness, safety, monitoring and connection to urban, suburban and intercity control systems.

6. A comprehensive system for monitoring and controlling the reliability and safety of infrastructure facilities also provides continuous monitoring, assessment and changes in condition of airfield and road surfaces.

7. Training, retraining, advanced training and improvement managers and specialists in reliability and safety in transport is an

important step to ensure the functioning of
transport and road complex of Ukraine.

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