FOUNDER

Kyiv National University of Construction and Architecture

Certificate of the State Registration
KB № 23029-12869P dated 27.12.2017

ISSN 2617-0264 (print)
ISSN 2664-2697 (online)

DOI: 10.31493/tit1921

Published twice a year

INTERNATIONAL SCIENTIFIC JOURNAL

TRANSFER OF INNOVATIVE TECHNOLOGIES

Founded in December 2017

2019 Vol 2, No 1

Original works and authoritative reviews of innovative technologies in construction, architecture, other fields of science and technology. New solutions and methods for measuring, predicting and studying the properties of materials, structures, technological processes. Different aspects of design, production and operation of industrial, civilian objects, infrastructure. Problems of energy, ecology, computer and information technology

The journal is included in the List of scientific professional editions of Ukraine in accordance with the Order of the Ministry of Education and Science of Ukraine

Approved by Academic Council of Kyiv National University of Construction and Architecture
21 June 2019, protocol No 24

Languages of the publications Ukrainian, Russian, English, Polish

Content

П’ята міжнародна науково-практична конференція «Transfer of Innovative Technologies 2019»

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Отримано 18.06.2019 та прийнято до публікації 23.06.2019
https://doi.org/10.31493/tit1921.0001

Анотація. У травні 2019 року проведено V міжнародну науково-практичну конференцію *Transfer of Innovative Technologies*, яка стала логічним продовженням форуму *Underwater Technologies*, що протягом чотирьох років поспіль проходив у Київському національному університеті будівництва і архітектури під гаслом «Вплив води на довкілля та інноваційні технології».

Основну увагу прикуто інтеграції вітчизняних та закордонних фахівців в розробці теорії, проведенні досліджень, створенні нової техніки і технологій, застосуванні новітніх енергоощадних екологічно безпечних технологій. Розглядались оригінальні ідеї, пропозиції, нестандартні рішення, креативні проекти. Запропоновано інноваційні методи дослідження та прогнозування властивостей матеріалів, конструкцій, технологічних процесів, нові підходи щодо проектування, виробництва і експлуатації промислових, цивільних об’єктів, інфраструктури, проблеми енергетики, екології, комп’ютерні та інформаційні технології. Представлено оригінальні роботи й авторитетні огляди з інноваційних технологій у будівництві, архітектурі, інших галузях науки і техніки.

Надійшло понад сотню заявок, у тому числі від науковців, виробників та фахівців з Польщі, Литви, Білорусі, Австралії, Китаю за тематичною спрямованістю: Архітектура, Інфраструктура, Будівництво, Інженерія, Інформаційні технології.

Підбито підсумки конкурсної програми за номінаціями: *Презентація, Інноваційний проект, Публікація*. Кращі роботи рекомендовано до публікації в міжнародних наукових журналах *Підводні технології: промислова та цивільна інженерія* і *Transfer of Innovative Technologies*. Досягнуто домовленості між КНУБА, Сілезьким технологічним університетом (Забже, Польща) та Університетом науки і технологій Цзянсу (Чженьянг, Китай) про спільне видання наукових журналів. Наголошено на важливості міжнародної співпраці у різних галузях і трансферу інноваційних технологій.

Ключові слова: науково-практична конференція, трансфер інноваційних технологій, конкурсна програма, спільні видання.

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будівельних машин
д.т.н., проф.

22-23 травня 2019 року в Київському національному університеті будівництва і архітектури відбулася V міжнародна науково-практична конференція «Transfer of Innovative Technologies» (Рис.1, 2). Співорганізаторами виступили Міністерство освти і науки України, Інститут телекомунікацій і глобального інформаційного простору Національної академії наук України (Київ), Польська Академія Наук, Національний університет кораблебудування імені адмірала Макарова (Миколаїв).

Голова організаційного комітету конфе-

ренції – ректор КНУБА д.е.н., професор Петро Куліков, співголова – Директор представництва Польської Академії Наук в Києві dr hab, prof. Henryk Sobczuk, заступник – д.ф.-м.н., проф. Олександр Безверхий (НТУ, Київ). Науковий комітет очолювали д.т.н., проф. Михайло Сукач, співголова – директор ІТГІП НАНУ, чл.-кор. НАНУ, д.т.н., проф. Олександр Трофимчук, заступник – проректор НУК імені академіка макарова д.т.н., проф. Володимир Блінцов.

Конференція проводилась за трьома секціями: *Архітектура, Інфраструктура* (керівник народний архітектор України, д-р архітектури, проф. Тамара Панченко); *Будівництво, Інженерія* (керівник академік Національної академії педагогічних наук України, д.т.н., проф. Віктор Баженов); *Інформаційні технології* (керівник чл.-кор. Національної академії наук України, д.т.н., проф. Олександр Трофимчук).

Форми участі: очна (проект, презентація), заочна (стендова доповідь, реклама), online (skype зв'язок, повідомлення), публікація (в міжнародних наукових журналах). На обговорення конференції винесено результати конкурсної програми за номінаціями: *Презентація, Інноваційний проект, Публікація*. Учасники конференції отримали *Сертифікати*, найактивніші – *Подяки*, переможці конкурсів – *Дипломи* за відповідними категоріями.

До організаційного комітету надійшло 126 заявок на участь в конференції, у тому числі 8 із-за кордону, в яких прийняли участь 5 фахівців з Польщі, 1 з Литви, 3 з Білорусі, 1 з Австралії, 2 з Китаю. Протягом двох днів презентовано понад 40 доповідей та інноваційних проектів, з них англійською мовою 12, польською 5. Робочу програму конференції опубліковано на сайті http://library.knuba.edu.ua/node/37841.

Розглянуто та обговорено матеріали 4 докторських і декількох кандидатських дисертацій. До конкурсів допущено 15 робіт (по 5 за кожною категорією). Кращі з них рекомендовані до видання у міжнародних наукових журналах *Підводні технології: промислова та цивільна інженерія* і *Transfer of Innovative Technologies*. Робочими мовами конференції були українська, російська, англійська та польська. Під час її проведення розгорнуто виставку публікацій за тематикою (Рис.3).

Рис.1. Запрошення до конференції
Fig. 1. Invitation to the conference

Рис.2. Робоча програма V TIT 2019
Fig. 2. Working program of the 5th TIT 2019

Рис.3. Виставкові матеріали
Fig. 3. Exhibition materials

Науково-практичну конференцію відкрив д.т.н., проф. Михайло Сукач, який передав привітання до її учасників ректора КНУБА, заслуженого працівника освіти України д-ра екон. наук, проф. Петра Куліков, а також проректора з наукової роботи, заслуженого діяча науки і техніки України д.т.н., проф. Віталія Плоского про зміцнення наукових і творчих зв'язків між фахівцями споріднених вищих навчальних закладів, повідомлення проректора з науково-педагогічної роботи та міжнародних зв'язків д.і.н., проф. Володимира Ткаченка про спільні видання міжнародних наукових журналів. Директор представництва Польської Академії Наук dr hab, prof. Henryk Sobczuk зазначив проблеми використання альтернативних енергетичних джерел в контексті сучасної економіки світу, а проректор КНУБА з навчально-методичної роботи д.т.н., проф. Геннадій Тонкачеєв наголосив на новітніх технологіях в контексті сучасного будівництва (Рис.4).

Рис.4. Відкриття V міжнародної науково-практичної конференції *Transfer of Innovative Technologies 2019*
Fig. 4. Opening of the 5th International Scientific and Practical Conference on *Transfer of Innovative Technologies 2019*

На **пленарному засіданні** виступив президент Академії будівництва України, заслужений діяч науки і техніки д.т.н., проф. Іван Назаренко, який зупинився на проблемах освіти і науки в сучасних умовах розвитку інноваційних технологій. Dziekan wydzialu organizacji i zarzadzania Politechnika Slaska (Zabrze, Polska) dr hab. inz, prof. Krzysztof Wodarski розповів про освіту в області управління інноваціями на прикладі технічного університету в Польщі (Рис.5).

Д.ф.н., проф. Олександра Рубанець (Національний технічний університет «Київський політехнічний інститут імені Ігоря Сікорського») говорила про концептуалізацію основних характеристи інформаційних технологій в науковому дискурсі, д.е.н., проф. Олена Борзенко (Інститут економіки та прогнозування НАН України) – про вплив урбанізації на економічну, соціальні сферу та негативні наслідки урбанізації (Рис.6).

Спільну доповідь англійською мовою на тему «An analysis of the synchronization process of two neural networks based on the algebra of complex numbers» представили Pavel Urbanovich, Ivan Biryuk з Білоруського державного університету (Мінськ) та Marcin Plonkovski з Католицького університету (Lublin, Poland). Проблеми створення та виробництва універсальних землерийних і дорожніх машин розкрив д.т.н., проф. Володимир Мусійко із Національного транспортного університету.

У **секційних засіданнях №1** приймали участь провідні фахівці з Архітектури та Інфраструкури – Тамара Панченко (Territory planning and tourism development in the coastal zone of Ukraine та), Віктор Яценко (Концептуальні засади формування нового типу інтегрованих територіально-просторо-вих систем розселення України), Віктор Тімохін (Сінер-

Рис.5. Виступи президента Академії будівництва України проф. Івана Назаренка і Dziekana wydzialu organizacji i zarzadzania Politechnika Slaska prof. Krzysztofa Wodarski

Fig. 5. Speeches by the President of the Academy of Civil Engineering of Ukraine prof. Ivan Nazarenko and the Dean of the Faculty of Organi-zation and Management of Silesian University of Technology prof. Krzysztof Wodarski

ргетичний підхід до реорганізації та розвитку складних містобудівних систем), Надія Шебек й Віталій Чернятевич (Вплив природних і техногенних чинників на формування понтонних поселень в акваторії українських водосховищ), Валерія Товбича й Галини Кравчук (Формоутворення модульних структур через призму архітектури на морських акваторіях). Інноваційні ідеї розглянуто в матеріалах Маргарити Дідіченко (Динамічність композиційних перетворень в сучасному архітектурно-місто-будівному середовищі), Ірини Булах (Проблеми розвитку мережі лікувальних дитячих комплексів в Україні) (Рис.7).

Рис.6. Пленарні доповіді (Олександра Рубанець, Олена Борзенко, Володимир Мусійко)
Fig. 6. Plenary reports (Oleksandra Rubanets, Olena Borzenko, Volodymyr Musiyko)

Рис.7. На секції з Архітектури, Інфраструктури (Віктор Тімохін, Надія Шебек, Ірина Булах, Валерій Товбич)
Fig. 7. At the sections on Architecture, Infrastructure (Victor Timohin, Nadiya Shebek, Irina Bulakh, Valeriy Tovbych)

Заступник декана факультету організації та менеджменту проф. Aleksandra Kuzior та професор Katarzyna Dohn Сілезького технологічного університету (Рис.8) презентували свої доповіді за темами «Bariery w rozwoju transportu intermodalnego w obszarach transgranicznych» та «Innowacyjne narzędzia zarządzania smart city».

Докторську дисертацію апробірував к.т.н., доцент Олексій Приймаченко. Надали свої матеріали Микола Осєтрін і Олексій Дворніченко (Методологію оцінки ефективності нерегульованих перетинів на вулично-дорожній мережі міста Києва), Ганна Васильєва (Методи підтримування рівня транспортного обслуговування), Ольга Петруня (The meanings and techniques of lighting in the car service), к.т.н., доцент Олександр Будя із Дерджавного коледжу туризму та господарства (Особливості впровадження в Україні інноваційних технологій глобальної дистрибюції послуг та логістики).

Рис.8. Делегати Сілезького технологічного-гоуніверситету (Польща)
Fig. 8. Delegates of Silesian Polytechnic (Poland)

Представник компанії «Амкортек Україна» (Ашдод, Ізраїль) Dmytrii Kokarev надав інформацію про сонячні батареї як елементи енергетичної безпеки України; Олександр Кобзар (ТОВ «УкрНПЦивільбуд») акцентував на впливі та взаємозв'язках геологічних процесів на формування міського середовища; канд. архітектури, доцент Андрій Голуб (представник чеської кампанії "Inspireli Awards" в Україні, Прага) оприлюднив тему «Sustainable tourism development in Ukraine».

Заявки до оргкомітету конференції подали студенти, магістранти, аспіранти з КНУБА (Євгеній Басак, Леніє Мустафаєва, Євгеній Приходько, Яна Барандич, Вероніка Дзиба, Галина Драгомирова, Михайло Комаров, Ярослав Рекуха, Іван Тимченко, Олександр Вощан, Олександр Юрковець, Галина Кравчук), Національної академії образотворчого мистецтва і архітектури (Альберт Десятинчук, керівник д-р архітектури, доцент В.Г.Чернявський) та інші.

На **секції № 2** (Будівництво, Інженерія) представляли докторські дисертації к.т.н., доценти Володимир Супонєв з Харківського національного автомобільно-дорожнього університету за темою «Практичне впровадження наукових основ створення грунтових порожнин установками статичної дії для прокладання інженерних комунікацій»,

Олег Мачуга з Національного лісотехнічного університету України «Розвиток наукових засад енергетичного підходу в розв'язувані проблем взаємоді машин із робочим середовищем» (Рис.9), Лідія Дзюба (НЛТУ України, Львів) «Розвиток наукових засад динаміки верстатів для розпилювання деревини» та отримали відпоідні сертифікати.

В роботі прийняли участь також фахівці з Китаю: Wenhang Li, Jiayou Wang, Jianxin Wang (School of Materials Science and Engineering, Jiangsu University of Science and Technology, Zhenjiang, Jiangsu Province, PR China) з доповіддю «The mechanism of underwater flux-cored wire cutting».

Співробітники Інституту електрозварювання імені Є.О.Патона Володимир Сидорук, Сергій Максимов, Денис Крижановський та Анатолій Гаврилюк надали інформацію щодо розробки способу стабілізації процесу дугового зварювання електродами, які плавляться, та інших споріднених процесів, а також Володимир Лебедєв, Геннадій Жук, Володимир Пичак – про вирішення проблем підводного механізованого і автоматичного зварювання мокрым способом різних металоконструкцій.

Результатами досліджень за темою «Продукування явища сплеску як засобу дисипації енергії гравітаційної хвилі» поділилися співробітники Інституту гідромеханіки НАН України к.т.н. Евген Горбатенко і Ірина Братасюк і Національного університету водного господарства та природокористування (Рівне) д.т.н., проф. Леонід Дворкін разом з Вадимом Житковським і Юрієм Степанюком за темою «Рекреаційно-порошкові бетони із застосуванням техногенної сировини».

Національний університет кораблебудування імені адмірала Макарова представлено доповідями Андрія Сірівчука «Синтез регулятора глибини занурення автономного підводного апарата з радіобуєм», Володимира Блінцова, Павла Майданюка «Роботизована технологія моніторингу портової акваторії», Андрія Войтасика «Розробка структури системи автоматичного керування підводного апарата з компенсацією невизначеностей».

З цікавою ідеєю про альтернативні підводні джерела дешевої енергії виступив директор Міжгалузевого науково-технічного

Рис.9. Обговорення докторських дисертацій к.т.н. доцентів Володимира Супонєва (ХНАДУ, Харків), Олега Мачуги (НЛТУУ, Львів)

Fig. 9. Discussion of doctoral dissertations PhD Ass. Professors Volodymyr Suponev (KhNADU, Kharkiv), Oleg Machuga (NLTUU, Lviv)

Рис.10. Учасники секції з Будівництва, Інженерії
Fig. 10. Participants of the section on Construction, Engineering

підприємства «Лана» к.т.н. Микола Гарницький. Фахівці з Національного транспортного університету (Київ) Юрій Лазарчук та Андрій Коваль доповіли про шляхи підвищення продуктивності універсальних землерийних машин безперервної дії, що працюють в режимі віяльно-поступальної подачі, а також про особливості формування динамічних моделей землерийних машин безперервної дії.

Д.т.н., проф. Михайло Сукач представив теоретичні основи розрахунку нового виду пружних елементів – скобоподібних пластинчастих ресор; к.т.н., доцент Володимир Рашківський разом із д.т.н., проф. Геннадієм Тонкачеєвим поділились досвідом зведенням вертикальних будівельних монолітних конструкцій самопідйомною опалубною системою, а Іван Солодей, Максим Вабіщевич і Руслан Стригун (КНУБА) обґрунтували застосування напіваналітичного методу скінчених елементів для дослідження динамічного деформування системи тіл з урахуванням великих пластичних деформацій.

Більшість презентацій стосувалась новітніх розробок і пропозицій в царині математичного моделювання та визначення параметрів робочих процесів будівельних машин і обладнання, застосування новітніх розробок з матеріалів і конструкцій машин, проектування приводів і робочих органів машин, дослідження експлуатаційних характеристик, сервісного обслуговування техніки, оцінки ефективності застосування машин, інноваційних розробок із забезпечення якості виробництва машинобудівної продукції, сертифікації продукції та ін. (Рис.10).

Д.х.н., проф. Віктор Малишев, разом із колегами Д.Б. Шахнінин і А.І. Габом (Відкритий міжнародний університет розвитку людини «Україна») презентували нові електрохімічні технології одержання та регенерації вольфраму з йонних розплавів, а також нові електрохімічні технології нанесення композитних гальванічних покриттів.

Окремі доповіді надані англійською мовою (Dmytro Mishchuk «Development of the mathematical model a single stage pulse hydraulic drive»; Ihor Kosminsky «Determination of the rational pressure value during the formation of a fiber-concrete mixture»; Oleksandr Lapenko, Natalia Makhinko (National Aviation University, Kyiv) «Basic provisions for the analytical calculation of vertical cylindrical containers» та ін.).

Активну участь в роботі конференції приймали студенти, магістранти і аспіранти Артем Азенко, Роман Бордюг, Володимир Слюсар, Максим Лучук, Микола Ходневич, Андрій Бойченко, Костянтин Марчук, Євген Зозуля, Олександр Сівак, Володимир Сліпецький, Артем Давиденко, Сергій Козловець, Ігор Лугін, Єлізавета Сисолятіна, Богдан Войтенко, найактивніших з яких відмічено Сертифікатами учасника конференції.

До роботи **секції №3** (Інформаційні технології) залучено іноземних гостей: ScD, prof. Pavel Urbanovich, Evgeniya Blinova, Nadzeya Shutko, Artciom Sushchenia (Belarusian State Technological University, Minsk) з доповіддю «Copyright protection for textual and graphical electronic content using steganography methods», prof. Lilla Knop (Wydział Organizacji i Zarządzania Politechniki Śląskiej, Zabrze, Polska) – «Inteligentne specjalizacje w procesie rozwoju innowacji w regionie».

Постійний учасник конференцій із Австралії PhD of Math. and Phys., Snr.Res. Ass. Vladislav Bogdanov (Progressive Research Solutions Pty. Ltd., Sydney) і на цей раз підтримав аудиторію доповіддю «Impact a circular cylinder with a flat on an elastic layer», а викладачка Київської гімназії східних мов №1 Vira Chzhen поділилась інноваційними технологіями у навчанні китайською мовою (Рис.11). Представник Інституту кібернетики НАН України к.е.н. Вікторія Кондратенко опікувалась математичним моделюванням функціональних елементів психіки людини; д-ри наук, проф. Наталія Зубрецька і Сергій Федін (НТУ) – моделюванням системи нечіткого логічного управління точністю та стабільністю технологічних процесів механічної обробки деталей; Vira Molchanova (Priazovskyi State Technical University SHEI, Mariupol) – тематикою ”The methods of homotopic skeletonization of bit-mapped drawings of parts of sea transport”.

Д-ри ф.-м.н., проф. Валерій Гавриленко (НТУ) і Анатолій Обшта (Національний університет «Львівська політехніка») повідомили про «Decomposition of operator equations based on aggregation-iterative approach», а Максим Омелян з Національного університету державної фіскальної служби України (Ірпінь) – про нормативно-правове регулювання трансферу технологій.

Аспірант Національної академії образотворчого мистецтва і архітектури (Київ) Михайло Комаров (керівник д-р архітектури доцент В.Г.Чернявський) підготував доповідь про вплив модернізації технологій виробництва кіно на архітектурно-функціональну складову студій. Оксана Ковальчук (НТУ) і д.ф.-м.н. проф. Олег Лимарченко з Київського національного університету імені Тараса Шевченка доповіли результати

Рис.11. На секції з Інформаційних технологій (Вікторія Горленко, Vira Chzhen, Вікторія Кондратенко)
Fig.11. On sections of Information Technologies (Victoria Gorlenko, Vira Chzhen, Victoria Kondratenko)

дослідження коливання системи трубопровід-рідина в нелінійному діапазоні збурень.

Надійшло багато матеріалів від магістрантів Національного транспортного університету, в яких підтверджено високій рівень підготовки й компетентності авторів, професіоналізм та обізнаність за тематикою власних досліджень. Коло інтересів достатньо широке, насамперед це: моделі, методи та інформаційна технологія забезпечення групової анонімності даних (Максим Маціпура), моделі та інструментальні засоби інформаційної технології підтримки університетських бізнес-інкубаторів ІТ-компаній (Влад Коломієць), аналіз ефективності методів Рунге-Кутта для задач розрахунку надійності складних систем (Станіслав Цабо), метод проектування швидкодіючих паралельних обчислювачів для розпізнавання образів у рухомих зображеннях (Руслан Безименний), розробка web додатку для управління біткойн гаманцем із застосуванням технології блокчейн (Владислав Бойчук).

Цікавими виявились доповіді про інформаційну технологію управління високотемпературними виробничими процесами за даними відеоспостереження (Георгій Дудар), інформаційно-аналітичну систему обліку членів громадського суспільства львівське товариство у Києві (Віктор Порощай), дослідження оцінки ефективності нейронних мереж при обробці зображення (Микола Сорока), а також оцінки ефективності нейронних мереж при обробці зображення (Владислав Кривенко), розпізнавання символів та образів з використанням сучасних технологій (Юрій Центіло), методи класифікації користувачів соціальних мереж з метою детектування шкідливих акаунтів (Микита Дьячков), навчання динамічних нейронних мереж на задачах довгострокового прогнозування (Єгор Волков), прийняття рішень в ситуаціях, що виникають в умовах невизначеності (Богдан Прокопюк).

Привернула увагу тематика про використання фреймворку YII2 для розробки автоматизованої системи збору даних (Антон Коваленко), створення дистанційних інтернет систем навчання (Костянтин Грінченко), модернізацію системи гальмування потягу для підсилення безпеки пасажирів метрополітену з використанням технологій штучного інтелекту (Дмитро Улітін), розробку і впровадження системи попередження про небезпеку на шляху колійного транспортного засобу з використанням технологій штучного інтелекту (Олександр Шеверда), інформаційне суспільство та його філософію (Микола Сергеєв).

Оригінальними рішеннями відрізнялися презентації щодо обґрунтування синте-

Рис.12. Переможці конкурсів (Володимир Супонєв, Олексій Приймаченко, Тамара Панченко)
Fig. 12. Contest winners (Volodymyr Suponev Olexiy Prymachenko, Tamara Panchenko

Рис.13. Подяка організаторам конференції (Петро Куліков, Олександр Кащенко, Володимир Ткаченко)
Fig. 13. Acknowledgment to the conference organizers (Petro Kulikov, Alexander Kashchenko, Vladimir Tkachenko)

зу діалогової моделі на основі рекурентної нейронної мережі (Олександр Войцеховський), дослідження архітектури системи комплексного аналізу даних на основі біг-дата технологій (Роман Шеверун), застосування технології блокчейн для управління біткоін гаманцем (Андрій Басюк), віртуалізації даних (Роман Роздолянський), розробки і реалізації імітаційної моделі фасеточного зору (Ірина Рибак), дослідження ефективності обробки великих об'ємів даних на прикладі використання хмарного та виділеного серверів у мобільному додатку (Артем Самчук), Application of data mining technologies in the scientific, technical and humanitarian areas (Viktoriia Horlenko).

Учасники V міжнародної науково-практичної конференції *Transfer of Innovative Technologies 2019* отримали відповідні Сертифікати. Дисертанти, матеріали який пройшли апробацію на конференції, найближчим часом захистили свої роботи.

За рішенням конкурсної комісії переможцями 2019 року визнано: в номінації *Презентація* – к.т.н., доцента Володимира Супонєва (ХНАДУ, Харків) за роботу «Практичне впровадження наукових основ створення грунтових порожнин установками статичної дії для прокладання інженерних комунікацій»; в номінації *Інноваційний проект* – к.т.н., доцента Олексія Приймаченка (КНУБА) за роботу «Дослідження планувальних рішень розташування вулично-дорожньої мережі на розповсюдження шуму»; в номінації *Публікація* – д-ра архітектури, проф. Тамару Панченко (КНУБА) за роботу «Розвиток екологічного туризму в Україні» (Рис.12).

За сприяння трансферу технологій Подяки оргкомітету (Рис.13) отримали ректор КНУБА Петро Куліков, проректори Денис Чернишев та Віталій Плоский; за міжнародну співпрацю – проректор Володимир Ткаченко; за пітримку інноваційних технологій – декан архітектурного факультету Олександр Кащенко; за підтримку творчої молоді – завідувачі кафедр Віктор Тімохін та Надія Шебек.

На підтвердження важливості міжнародного співробітництва в галузі вищої освіти і наукової діяльності, під час проведення конференції досягнуто домовленості про те, що Сілезький технологічний університет (Забже, Польща) разом з Київським національним університетом будівництва і архітектури стануть співзасновниками міжнародного наукового журналу *Transfer of Innovative Technologies*, а представник SilTU (dr hab Prof. Aleksandra Kuzior) – членом міжнародної ради цього видання. Вже багато років відбувається співпраця у сфері видавничої діяльності й проведення спільних конференцій із Польською Академією Наук (відділ в Любліні та предствництво PAN в Києві).

Аналогічну Угоду про співзасновництво міжнародного журналу *Підводні технології: промислова та цивільна інженерія* укладено з Університетом науки і технологій Цзянсу (Китай), згідно з якою Сторони беруть на себе його спільне видання, а китайські науковці PhD Prof. Jiayou Wang (Jiangsu University of Science and Technology, Zhenjiang) та PhD Chuanbao Jia (Shandong University, Jinan, Shandong) стали членами міжнародної редакційної ради.

Сторони погодились співпрацювати в дусі взаєморозуміння, зміцнення дружніх відносин і зв'язків, вигідних для обох Сторін, та спільно здійснювати такі заходи: обмінюватись досвідом, інформацією в галузі досягнень науки і техніки, програмами досліджень, бібліографічною та інформаційною літературою, а також проспектами та іншими інформаційними матеріалами, які пропагують технічні та наукові досягнення; приймати до розгляду наукові статті, матеріали конференцій, проектних рішень професорсько-викладацького та наукового складу навчального закладу-партнера для публікації в міжнародних наукових журналах *Підводні технології: промислова та цивільна інженерія* і *Transfer of Innovative Technologies*; залучати на безоплатній основі своїх представників із числа висококваліфікованих фахівців відповідних галузей до рецензування наукових статей та сприяння висвітленню результатів науково-дослідницьких робіт. Члени редакційної колегії журналів керуються принципами наукової етики видання, політикою відкритого доступу, вільного поширення наукової інформації та глобального обміну знаннями задля загального суспільного прогресу.

Учасники прагнуть до розробки й реалізації науково-дослідних проектів, що лежать у сфері інтересів обох Сторін. Установи зобов'язуються фінансувати спільні програми через різні джерела фінансування, зокрема через дослідницькі програми, у тому числі рамкові програми ЄС та ін., організовують спільні наукові конференції та семінари, сприяють участі своїх співробітників в наукових заходах, організованих університетами-партнерами. Уточнений зміст вищевказаних завдань є предметом щорічних колективних обговорень і рішень університетів, зокрема на міжнародних науково-практичних конференціях. Фінансу-

Рис.14. Делегати міжнародної конференції V TIT 2019
Fig. 14. Delegates to the 5th TIT 2019 International Conference

вання завдань обидві Сторони здійснюють із врахуванням можливостей своїх країн. Права інтелектуальної власності, що випливають зі спільної діяльності, розподіляються між двома сторонами пропорційно до їхніх зобов'язань.

На конференції підбито підсумки видавничої діяльності міжнародної редакційної колегії КНУБА. Так, з 2015 року видано 9 випусків журналу *Підводні технології: промислова та цивільна інженерія* і 3 випуски журналу *Transfer of Innovative Technologies*, які є друкованими органами однойменних конференцій. За цей час опубліковано результати наукових досліджень понад 100 авторів, з яких 6 захистили докторські (ScD) і понад півтора десятки – кандидатські (PhD) дисертації. Журнали є фаховими, проіндексовані у 8 наукометричних базах, мають DOI, імпакт-фактор, понад 80 % контенту друкується англійською мовою. Журнали рецензовані, мають міжнародну редакційну раду, персональні двомовні сайти, дотримуються політики відкритого доступу і з наступного року номінуються до бази Scopus.

Прийнято рішення про проведення шостої міжнародної науково-практичної конференції *Transfer of Innovative Technologies* у квітні 2020 року (Рис.14). Оркомітет подякував учасникам за плідну роботу, побажав наснаги й успіхів в подальшій науковій діяльності.

Fifth international scientific and practical conference «Transfer of Innovative Technologies 2019»

Mykhailo Sukach

References. In May 2019, the 5th International Scientific Conference on Transfer of Innovative Technologies was held, which became a logical continuation of the Underwater Technologies Forum, which for four consecutive years was held at the Kyiv National University of Civil Engineering and Architecture under the slogan "Impact of Water on the Environment and Innovative Technologies".

The main focus is on the integration of domestic and foreign experts in the development of theory, research, the creation of new technology and technologies, the use of the latest energy-efficient environmentally friendly technologies. Original ideas, new proposals, non-standard solutions, creative projects were considered. Methods of research and prediction of the properties of innovative materials, structures, technological processes, new approaches to the design, production and operation of industrial, civilian objects, infrastructure, energy, ecology, computer and information technologies are proposed. Original works and authoritative reviews on innovative technologies in construction, architecture, other fields of science and technology are presented.

More than a hundred applications were received, including from scientists, manufacturers and experts from Poland, Lithuania, Belarus, Australia, China, in the thematic areas: Architecture, Infrastructure, Construction, Engineering, Information Technology.

The results of the competition program by nominations are summarized: Innovation project, Presentation, Publication. The best works are recommended for publication in international scientific journals Underwater Technologies: Industrial and Civil Engineering and Transfer of Innovative Technologies. Agreement was reached between KNUBA, Silesian University of Technology (Zabrze, Poland) and Jiangsu University of Science and Technology (Zhenjiang, China) for the joint publication of scientific journals. The importance of international cooperation in various fields and transfer of innovative technologies is emphasized.

Keywords: scientific-practical conference, transfer of innovative technologies, competition program, joint publications.

Territory planning and tourism development in the coastal zone of Ukraine

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Received on 31.01.2019, accepted after revision on 02.06.2019
https://doi.org/10.31493/tit1921.0101

Abstract. The Black Sea Region of Ukraine with the length of 2,8 thousand km can be identified as one of the most long-range regions in regard to the sustainable tourism development. The potential opportunities of the possible tourism development and improvement can be caused by the following main factors: incomplete level of the development of tourism resources; attractiveness for the population of such regions as East Europe, North and Central Asia that have transport connection and traditionally use the Black Sea coast for summer rest without language barrier; enlargement of the tourism field for the tourists from the countries of Central and West Europe; developing of the quality of the tourism service as a result of the realization of the privatization of the tourist complexes; improvement of the environmental safely level that is already observed and can be continued as a result of the implementation of the environmental measures; development of the transport system, improvement of the access and visa regime; difference between the costs for tourist services.

The Law of Ukraine "On Tourism", established the legislative preconditions for tourism transformation. Also provided the essential change of the governmental scheme in the field of tourism with the aim so approach its formation to the one of the one of the priorities in the branch of economics. At the same time the real problems and constraints exist which restrain the sustainable tourism development in the Ukrainian, part of the coastal zone. There is a necessity for the development of some parts of the tourism services which are the obligatory components of the market economy system and which formerly were not developed or were solved without taking into account economic measures.

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They are: the establishment of the marketing system for the provisions of the tourism activities, including the establishment of the sale system, advertisement, arrangement of the services structure in accordance to the requirements, certification of the tourist complexes in regard to the world service level; development of the tourist infrastructure, provision of the necessary, information about the quality of environment and value of recreated resources. There is a need to conduct the environmental sanitation of the tourist complexes on the base of their privatization.

Keywords: Territory planning, coastal zone, tourism development, description of the Azov-Black Sea region.

INTRODUCTION

Activation of urbanization processes, substantial changes in socio-economic relations, intensification of anthropogenic loadings on natural systems, violation of the ecological balance on territories of the coastal zone of the Black and Azov Seas of Ukraine condition the necessity of defining a clear town-planning strategy of their development, a balanced

structure of land-use, ecologically-oriented ways of territorial organization and nature management in this region.

In accordance with the Resolution of the Cabinet of Ministers of Ukraine "On adoption of the State Regional Development Strategy for the period till 2015", measures are envisaged for restructuring the economic base, modernization of the infrastructure, development of city agglomerations, tourism and recreation, including in this region. This conforms with "Guiding Principles for Sustainable Spatial Development of the European Continent (CEMAT)" (the Ministry of Regional Development of Ukraine, 2007); with the Decree of the President of Ukraine "On activities for development of tourism and resorts in Ukraine" (No.136/2007 of February, 21, 2007).

The fundamental town-planning project developed in 2006 by the Ukrainian State City Planning Research Institute "DiproMisto", "Scheme of Territorial Planning of the Coast of Black and Azov Seas for Implementation in Donetska, Zaporizka, Khersonska, Odeska, Mykolaivska Oblasts and AR Crimea" takes into account provisions of this governmental instruction, provides substantiation for directions of developing the multi-sector economic complex of this region, forecasts the number of population and the number of holiday-makers and tourists for the future, as well as introduces the planning structure of the coastal territory in view of protection, rational use and reservation of valuable lands of different destination and future prospects for development of coastal territories and cities within the system of the European Black Sea Region [2, 3].

Separate issues of the ecological and town-planning nature related to development of coastal territories are regulated in Ukraine by over 15 legislative acts, including "On adoption of the National Program of Environmental Protection and Recreation of the Azov and Black Seas", "On the Nature Reserved Fund of Ukraine", "On Resorts", "On the General Territorial Planning Scheme of Ukraine", "On Territorial Planning and Land Development", "On Protection of Cultural Legacy", etc. [7, 8]

The Project "Environmental Collaboration for the Black Sea" financed by the European Union upon the request of the Ministry of Environmental Protection of Ukraine developed the new draft Law of Ukraine "On the Coastal Zone" as an integral object of integrated management and legal regulation of economic activity, zoning planning and development of its territory's elements.

Actuality of the legislative provision for development and protection of natural resources of the coastal zone is grounded on the following aspects [9, 10].

• *Uniqueness and invariance of natural resources of the Azov-Black Sea region.* The potential of resort and recreational, tourist and natural landscape resources of the coastal zone in view with its current status is not sufficiently used − 6 times less that could be taking into account perspective opportunities. The priority role in development of this sphere. both as the means of satisfying cultural needs and growth of the national and regional economy is underestimated at all levels of governmental structures.

• *The high urbanization level of the coastal zone of the region.* The percentage of town-planning development territories within the two kilometer protection coastal zone makes over 70,0%; density of population exceeds the mean indicator for Ukraine by 33 %; the number of population of coastal districts and cities makes up over 6 million persons. All of this requires expansion of spatial scopes of costal settlements for their "ecological and town-planning unloading".

• *Polyfunctional economic structure of coastal settlements.* Natural landscape resources valuable for development of resorts and recreation, land resources limited for town-planning development and inevitability of strengthening of the production constituent in the system of "production-settlement-resort (recreation, tourism)" due to building of strategic industrial objects, ports, communal and warehouse objects generate conflicting problems. In this connection, coastal settlements become an object of differentiating of various functions and spatial transformation on principles of searching for a "balance of interests".

• *Ecological impacts on functioning of coastal settlements.* Coastal settlements are lo-

cated in "epicenters of ecological risks and restrictions". By the level of negative impact on marine basins of the beach area, the housing and communal economy, which inflicts more than a half of all economic damages, and objects of marine transport and industrial enterprises are the greatest" sources of contamination, the percentage of losses inflicted by which makes up to 40.0%. This promotes the role of ecologically-oriented planning facilities of balanced natural and anthropogenic development and creation of specialized functional districts and areas within the coastal zone.

• *Limited regulatory documents on planning of coastal territories with their specific features.* Planning aspects of coastal territories and cities are currently regulated by the State construction norms DBN 360-92** "Town-planning Planning and development of urban and rural settlements"; by the designer's reference' book "Town-planning", as well as by over ten methodical recommendations of the period of 1970 − 90s. However, all the above-mentioned regulatory and methodical documents refer to general principles of planning of all types of settlements without taking into account specifics of natural and geographic conditions of their location; recommendations on planning of coastal territories mainly offer planning suggestions only for resort settlements, their areas and complexes, which are developed based on socio-economic principles contradictory to market ones without studying of the poly functional structure of coastal settlements and taking into account special requirements of nature protection legislation.

The practice of town-planning development of coastal territories proves that today we witness an "active expansion" of valuable resort and recreational, as well as nature protection lands both for development of material production objects and for placement of cottage and summer residences building, housing multistory construction, etc. The issues related to the pattern of authorized town-planning use of territories of coast-protection areas, coastal shelter belt, resorts sanitary protection districts, sanitary and protection- areas of industrial objects are not being resolves, there are no expressly defined "restrictive and authorization" directions of building activity, no regulatory suggestions on balanced poly functional development of coastal cities − centers of administrative, industrial, cultural and tourist destination, as well as settlement systems strong points have been developed.

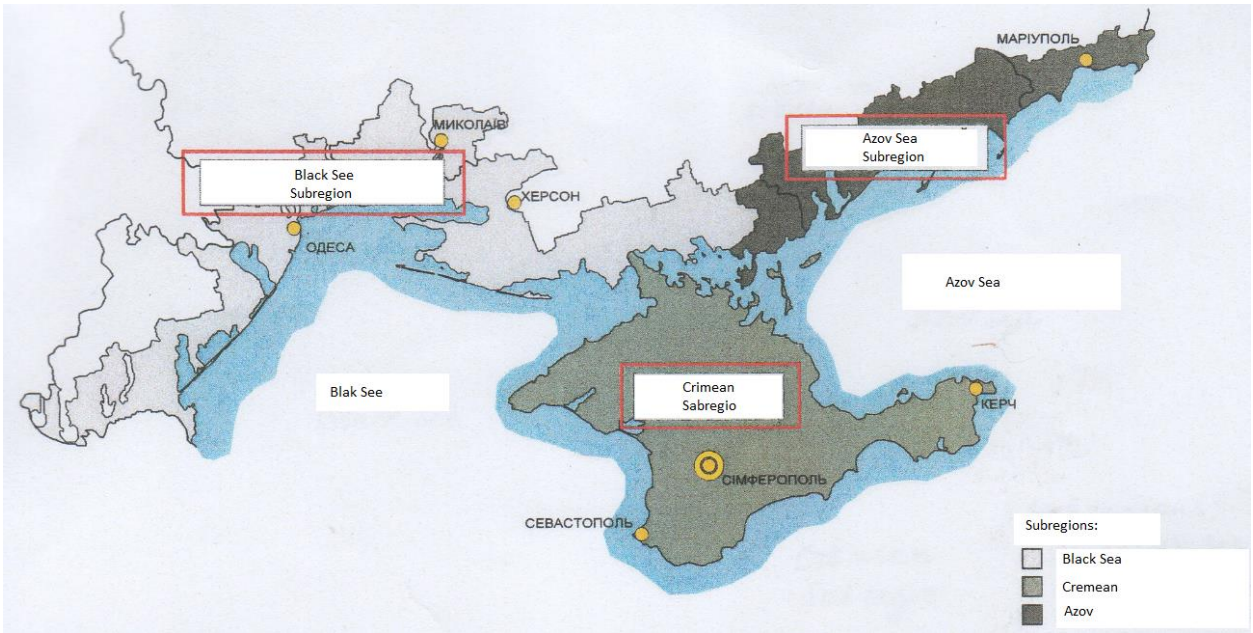
Taking into account the research and practical elaborations developed in this sphere, it is possible to conclude that currently only general principles of forming mainly resort towns as centers of temporary settling of holiday-makers have been worked out, as well as requirements to resort and recreational construction have been regulated. At the same time, project developments and scientific researches do not embrace such urgent issues as:

a) *disproportions* in development of the functions "production-settlement-resort (recreation, tourism)"; b) *ecological violations* in the coastal shelter belt; c) *loss of land and beach resources* for development of resorts, recreation and tourism in connection with their non-targeted development; d) use of *national* natural resources of the Ukrainian part of the coast as an inalienable constituent *of the intergovernmental tourism system* of European Black Sea countries − for recurrent local needs and out of control land redistribution; e) development of coastal settlements as ordinary settlements without taking into account their special *marine economy*, *external economic* and *tourist* functions.

DEFINING THE KEY TERMS

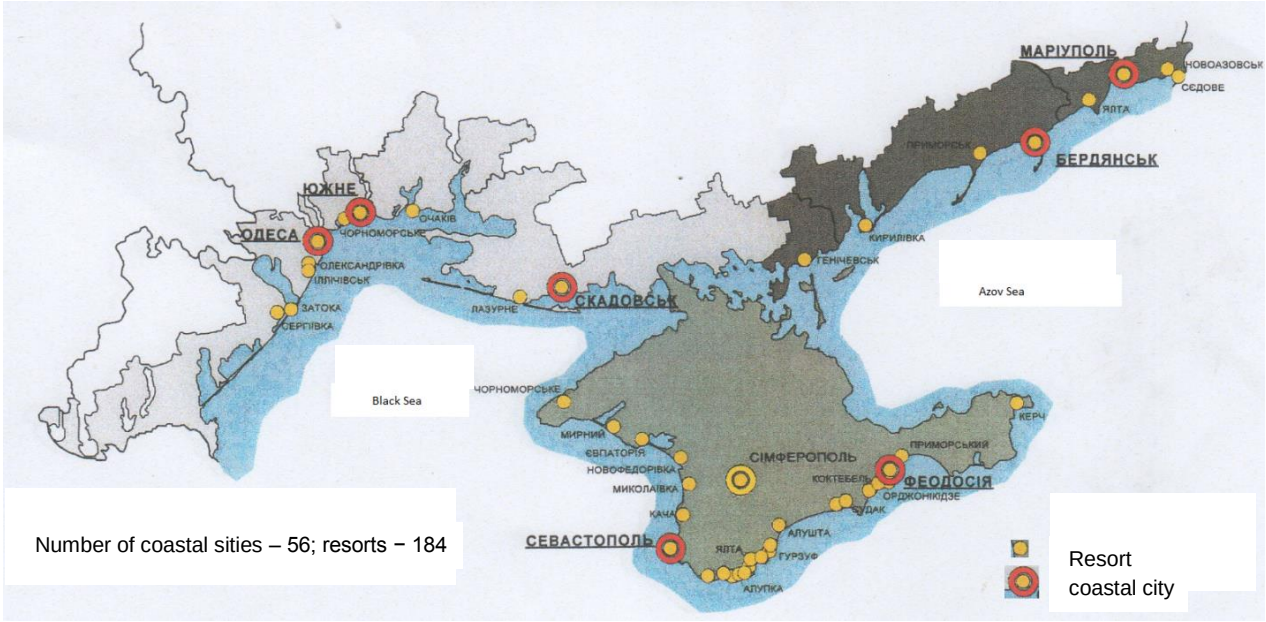
In the Guidelines, the terms are interpreted as follows [1, 4]:

Coastal region − the territory adjoining the Black and Azov seas directly or through basins of estuaries, which has *a* brightly expressed affinity of the climate, orography, hydrographical network, the settlement system, characteristic of it, and presence of prominent natural complexes and objects of historical and cultural legacy; embraces territories of the AR Crimea, the city of Sevastopol, Odeska, Mykolaivska, Khersonska, Zaporizka and Donetska Oblasts and is divided into three *subregions* − the Crimean, the Black Sea and the Azov ones.



Subregions	Index, %			
	Population	Square	Urban rate	Recreation capacity
Black Sea	47,0	39,6	78,6	33,0
Crimean	18,0	36,9	71,4	37,8
Azov	35,0	23,5	80,9	29,2

A. Location of the black sea, Crimean and Azov subregions within Azov-Black sea region



B. Location of the coastal sities and resorts on the Azov-Black sea shore

Fig.1. Schemes of regionalization and urbanization of the Azov-Black Sea coast

Coastal district − an administrative district adjoining the Black or Azov Seas in the composition of a coastal region.

Coastal settlement − a territorially integral compact natural habitat of concentration of population in composition of a coastal district; based on the number of population, functional significance and economic profile, coastal settlements are divided into urban (the largest, major, large, middle, small settlements and urban type villages) and rural ones (major, large, middle, small).

Coastal city − a settlement located in composition of a coastal region with a coastline, developed functional and planning structure that is related to sea economy, transporting administrative cultural, resort recreational and tourist activity; divided into cities of republican (AR Crimea) and Oblast significance.

Coastal agglomeration − a group of the most territorially approximated settlements located along the coastline united by developed inter-settlement connections of the integrative nature.

Coastal territory − the territory of the coastal region, coastal district, coastal settlements, major cities and agglomerations comprising all lands within their territory in accordance with categories of their main target destination set by the current legislation.

Coastal zone − the contact area of dry land and the sea that passes all along the coastline and includes the dry land part with natural and anthropogenic complexes under the impact of the sea, and the adjoining marine basin that is under the impact of the coast; the dry land includes territories of coastal districts, coastal settlements, major cities and agglomerations that directly border on the coastline; the basin part includes basins of inland waters and the territorial sea.

Coast protection zone − the nature protection territory of economic activity regulated by the current legislation set along seas, round sea arms and estuaries, as well as other reservoirs; external limits of coast protection zones are defined within land use organization projects or in composition a town-planning documents.

Coastal shelter belt − the nature protection territory allocated within the coast protection zone and set along the coastline for the purpose of protecting the marine and coastal natural environment against unfavorable anthropogenic impacts, as well as includes the dry land part and the basin part − coastal "shelter" marine basin with the mode of limited economic activity.

Beach area − apart of the coastal shelter belt (both on dry land and in the marine basin), the planning, sizes, borders and usage mode of which are defined in accordance with requirements of the Law of Ukraine "On resorts" and DBN 360-92** "Town-planning Planning and development of urban and rural settlements".

Territorial planning scheme (of coastlines, the coastal territory) − a town-planning document determining key solutions for planning development and other use of the respective territories of administrative and territorial units or their separate parts.

General coastal settlement plan − town-planning documents determining key solutions of development, planning construction and other use of a settlement's territory.

Coastal region, district, coastal agglomeration, major city development concept − a constituent of the territorial planning scheme of the general plan determining strategic directions of a town-planning object's development in view of national, regional and local interests.

Regional settlement system − an intentionally formed in the conditions of a coastal region or its sub-regions and administrative regions aggregate of urban and rural settlements of different sizes and economic profile incorporated with functional, transportation, other mutual connections round the coastal central city of the system with the highest administrative status, economic and socio-cultural potential.

Ecological network of a coastal region − a territorial system of nature protection objects including areas of natural landscapes subject to special protection, and territories and objects of the nature reserve fund, resorts and medically and sanative, water shelter territories, etc. located within and beyond the limits of coastal districts and coastal settlements; a constituent of the national ecological network of Ukraine.

Coastal resort and recreation, tourist system − an aggregate of resorts, recreation areas, tourist formations, nature reserve objects located on the coast and mutually linked, linked with historical and other settlements with tourist and excursion routes, transportation and engineering communications.

Engineering and transporting infrastructure of a coastal region − territorial system of external transport constructions − railway, motor-car, air, marine, public passenger transport; water-supply networks, sewage system, power supply; coast-protecting hydro technical constructions, ports, moorages, navigation safety objects and other objects, construction of which is not restricted by the current legislation.

OBJECTIVE AND TASKS OF TERRITORIAL PLANNING OF THE COASTAL ZONE

The objective of the guidelines is to offer suggestions on the terminology and concept system, principles of planning functional zoning protection and rational use of territories (basins) of coastal zones in compliance with requirements and restrictions of the current legislation, to describe the procedure of development, coordination and adoption of the Territorial Coastal Planning Scheme, * to define its structure and tentative contents [16 − 18].

The key tasks of territorial coastal planning are:

• comprehensive assessment of the territory (basin) of the coastline within the set project frames, state of its economic use, stores of natural resources, their biological and landscape variety, medical resources, available cultural legacy objects, current settlement system, engineering and transporting infrastructure, as well as other specific features:

• substantiation of future needs, priority directions and scales of perspective development of economic activity within the coastal zone;

• conducting scientifically substantiated functional zoning of the territory (basin) of the coastal zone, providing for means of its planning organization of balanced and non-exhaustive nature management;

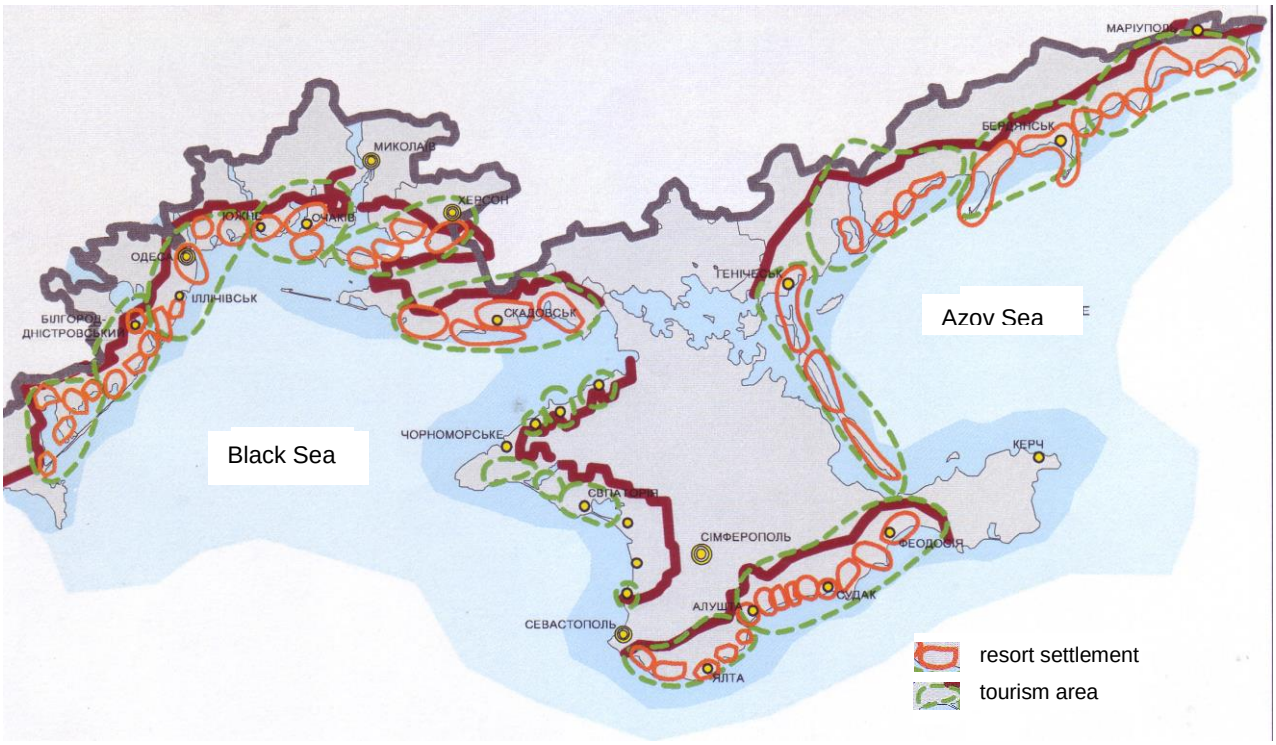
• development of suggestions for distribution of lands based on their target destination, buildings and reconstruction of housing and communal economy and public servicing objects, engineering development and equipping the territory of settlements, development of the transport network, realization of nature protection, anti-erosive, anti-sliding and fire-prevention work, renewal of disturbed natural complexes, coastal protection, prevention of changes of the territory's hydrological mode;

• protection and rational use of natural medical and sanitation, recreational, historical and cultural resources, creative competitive conditions for functioning of resorts, recreation and tourism areas, providing for planning means for people's free access to the sea and guaranteeing ecological safety in the coastal zone;

• defining monitoring activities for the environmental status of the territory (basin) of the coastal zone, forecasting dynamics of possible changes, prevention of impact of unfavorable processes, preservation of natural habitats of animals and plants included into the Red Book of Ukraine, the Green Book of Ukraine, the European Red List of the species of animals and plants under the threat of disappearance at the global scale, the Red Book of the International Union for Conservation of Nature (IUCN);

• assistance of development of efficient economic activity in the coastal zone taking into account national, regional and local needs in the sectors of agriculture and forestry, fishing ports activity, shipbuilding navigation, local trades, etc. in compliance with restrictions of the current legislation;

• organizing the integrated coastal zone management system based on principles of collaboration of state, self-governing, non-government, businesses and other structures, a strategic approach to planning and implementation of all administrative and economic activities related to the coastal zone taking into account the long-term prospect [10 − 15].



A. Planning Scheme of the Black and Azov Sea coast of Ukraine

Region	Length, km	Depth, km	Asia, sq. km	Population, thousand	People/sq.km
Bulgaria	380	30 – 35	12000	500	45
Georgia	300	3 – 20	6000	480	80
Romania	245	30 – 35	7000	400	60
Russia: Anapa-Tuapse	250	10 – 20	4000	360	90
Great Sochi	110	1 – 3	210	200	950
Azov Coast	600	5 – 35	10000	1200	120
Ukraine: Odessa Coast	500	15 – 30	22800	2219	100
West Crimea	390	10 – 20	7600	550	72
South Crimea	60	1 – 5	288	148	530
East Crimea	154	3 – 15	1530	156	107
Azov Coast	760	1 – 20	7600	600	80

B. Comparative characteristic of the Sea Coasts of the Different Countries

Fig.2. Features of urban characteristics of the Azov-Black Sea coast

DESCRIPTION OF THE AZOV-BLACK SEA REGION

The Azov-Black Sea region is located in the southern part of Ukraine within administrative borders of Donetska, Zaporizka, Mykolaivska, Odeska, Khersonska Oblasts and the Autonomous Republic Crimea, the city of Sevastopol, it borders on the territories of Moldova and Romania The territory of the region makes up 167,1 thousand sq.km. and constitutes 27,7% of the total area of the territory of Ukraine.

The population living in the territory of the Azov-Black Sea region − approx 13,5 mln. people (29,0% all the entire population of Ukraine), is extraordinarily varied in the national composition and ethnic features; apart from Ukrainians and Russians, in separate districts there are compact settlements of Tatars,

Germans, Bulgarians, Greeks and representatives of other peoples [1].

The Azov-Black Sea region comprises territories of coastal administrative districts and coastal cities that directly or indirectly (through basin estuaries) adjoin the seacoast and form *the coastline,* the total area of which is 59,2 thousand sq.km. and population − over 6 million people [2].

Based on the complex of physical and geographical, economic and town-planning signs, within the limits of the region three *subregions* are separated: the Black Sea, Azov and Crimean ones.

The total coast length of the Azov-Black Sea region makes up 2759,2 km, within that beach resources occupy approx 1300 km of the coastline. Apart from the marine basin, there are 14 estuaries in the territory of the region with the area of 2,5 thousand sq.km.

The network of nature reserved territories of the state significance within the region comprises: biosphere preserves − 2, natural preserves − 6, national natural parks − 1, nature reserves − 35, regional landscape parks − 14, botanical gardens − 2, parks-sights of gardening and park art − 10.

On the base of medical and sanitation resources (mineral water, medical muds, brine of estuaries and lakes, sea water), the territory of the region comprises 184 urban and rural settlements attributed to resort ones [3], approx 700 resort and sanitation, recreational and tourist facilities with the total capacity of 149,7 thousand beds.

The Azov-Black Sea region has a unique historical and cultural legacy. The state protects over 3000 real immovable sights of archaeology, history, monumental art architecture and town-planning 13 historical and cultural preserves, 66 historical cities and settlements of the urban type are included into the State register.

Socio-economic conditions of this region have their specific features [2]:

• favorable transport and geoeconomic position that attributes international value to this region as a "pan-European transportation area" of the Black sea basin or the "Eurasian transport area" of the Azov-Black Sea basin;

• tracing of routes of international transport corridors (ITCs) − the "Danube Water-Way" (ITC No.7), "Helsinki, Finland – Alexandropulos, Greece" (ITC No.9), "Baltics (Gdansk) − the Black Sea (Odesa)", the uniform transport system of BSEC countries, etc.;

• integration links in international organizations: the European region "Lower Danube", association of European regions, the working group of Danube regions, GUAM association, etc.;

• inclusion into international projects of the pan-European and Eastern European ecological networks with creation of the "Azov-Black Sea natural ecological corridor";

• the strategic significance of the region in formation of the economic complex: serves foreign trade connections, transit of oil and gas, has pre-conditions for creation of the coastal infrastructure for development of oil and gas resources of the Black Sea and Azov Sea shelf and constellates the fishing activity;

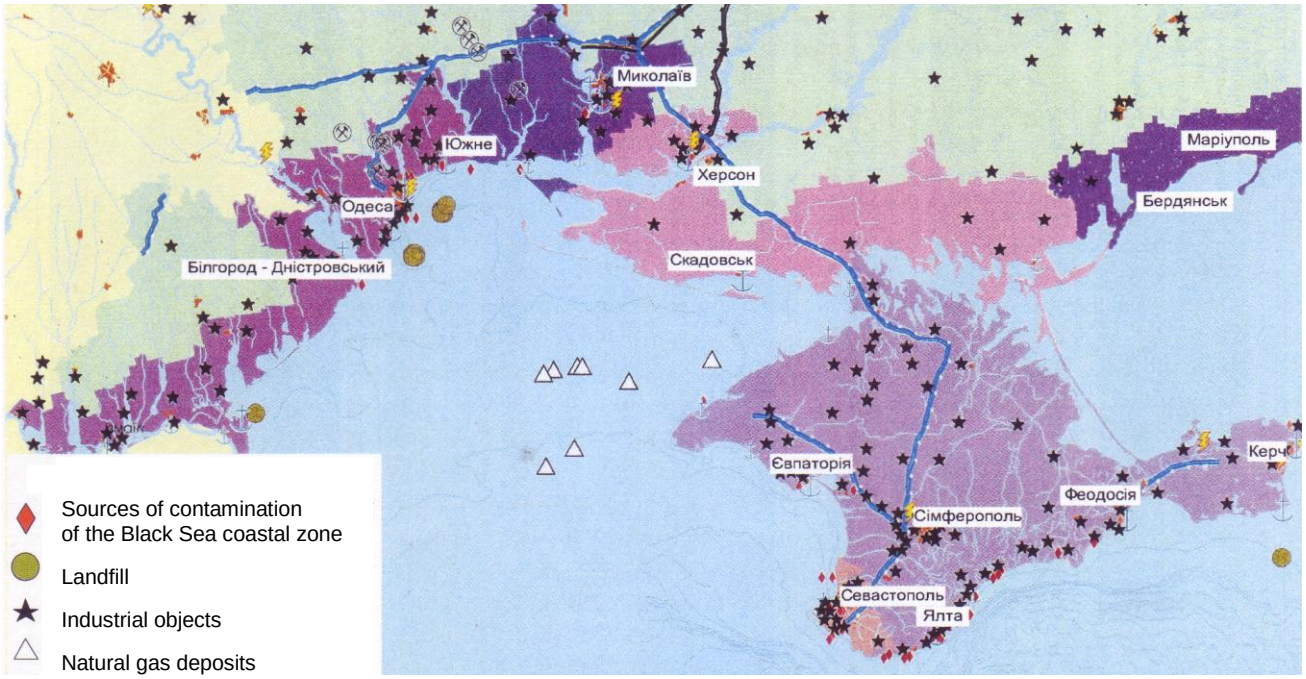
• uniqueness of natural and cultural resources for development of resorts, recreation and tourism areas, as well as objects of the nature reserve fund of the intergovernmental significance (on the borders of Ukraine, Russia and Romania);

• industrial potential, on the base of which 8 large industrial centers, 8 centers for processing of sea food, 6 types of mineral resources mining and processing complexes, 20 marine trade ports and 11 ports points have been formed;

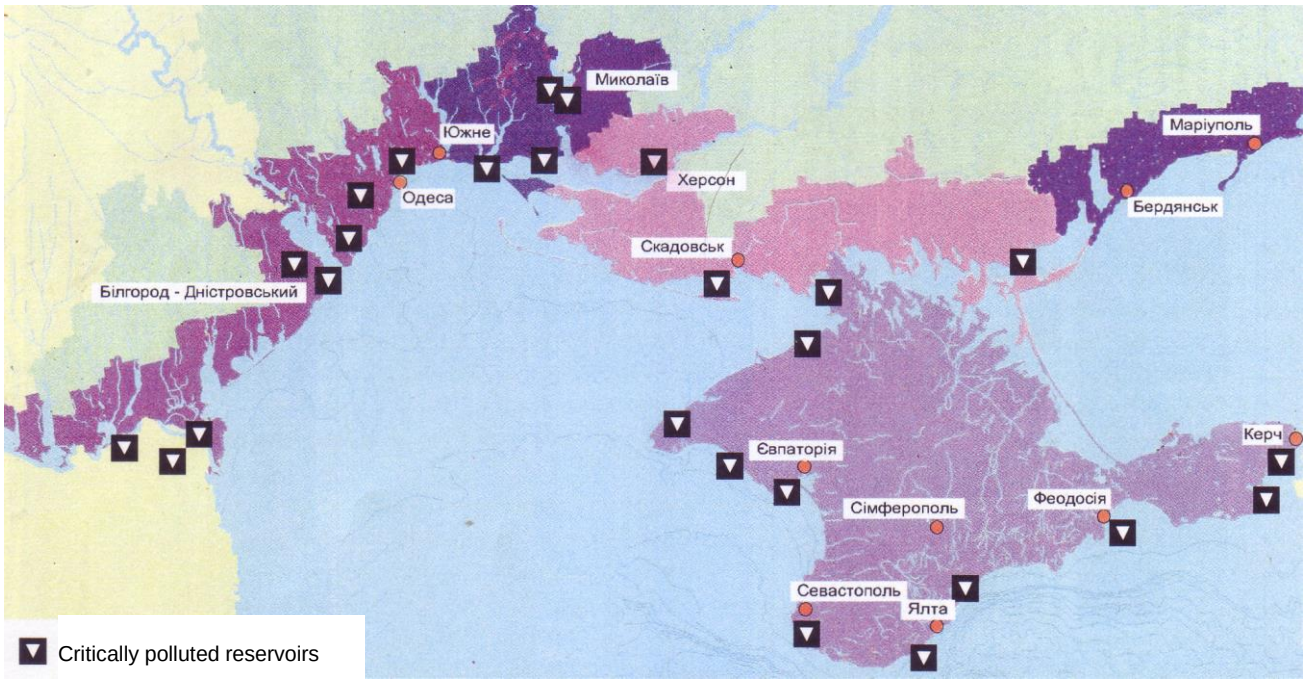
• developed agriculture, which apart from production of grain, gardening vegetable-growing and gourd fields, oil-bearing cultures and meat and dairy products has a key industry - viticulture and production of high-quality wines and brandies.

The network of urban settlements within the coastline of Azov-Black Sea region includes 130 settlements, among them 56 bordering on the coastal basin.

The average density of population in the coastline of the region is 104,57 people/sq.km



A. Location of industrial and production objects on Azov-Sea Coast



Loss of beach resources in connection with their non-targeted development

Territory	Loss,%
Autonomous Republic Crimea	38,3
Mykolaiv region	13,3
Odessa region	40,0
Kherson region	8,4

Ecological impacts on functioning of coastal settlements

Economical activity	Pollution,%
Urbanization	59,0
Transport	32,0
Industry	8,0
Recreation	1,0

B. Location of the points of ecological violations in the coastal shelter belt

Fig.3. Environmental characteristics of the Azov-Black Sea coast

(the average indicator for Ukraine is 77,74 persons/sq.km.); in the Black Sea subregion it is the highest – 124,83 people/sq.km., in Azov one – 78,72 people/sq.km., in the Crimean subregion – 99,28 people/sq.km.

The decree of urbanization of the coastal zone is extraordinarily high − on average, 77,69 %.

In the area of potential danger caused by various sources of the techno genie nature, more than 40% population of the region live.

The planning structure of the coastal zone of the Azov-Black Sea region in accordance with suggestions of "DniproMisto" [2] is based on 59 coastal administrative and territorial units (cities, city councils, districts) of Odeska, Mykolaivska, Khersonska, Zaporizka Oblasts, the Autonomous Republic Crimea and the city of Sevastopol. It is formed in composition of the 3 subregions − the Black Sea, Azov and Crimean one, has a developed system of urban and rural settling, historical settlements formed, functioning resorts, resting areas and tourism centers, objects of the nature reserve fund and historical and cultural legacy, places of compact settlement of ethnic minorities; BSEC International Transporting Corridor (10…20 km from the coastline) is its spatial framework connected with regional routes of all types of transport connection, engineering networks and coastal protection constructions.

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Территориальное планирование и развитие туризма в прибрежной зоне Украины

Тамара Панченко

Аннотация. Черноморский регион Украины протяженностью 2,8 тыс. км может быть идентифицирован как один из наиболее отдаленных регионов в области устойчивого развития туризма. Потенциальные возможности развития туризма и их улучшения могут быть вызваны следующими основными факторами: неполный уровень развития туристических ресурсов; привлекательность для населения таких регионов, как Восточная Европа, Северная и Центральная Азия, которые имеют транспортное сообщение и традиционно используют побережье Черного моря для летнего отдыха без языкового барьера; расширение туристического поля для туристов из стран Центральной и Западной Европы; развитие качества туристического сервиса в результате реализации приватизации туристических комплексов; улучшение уровня экологической безопасности, который уже наблюдается и может быть продолжен в результате осуществления природоохранных мер; развитие транспортной системы, улучшение доступа и визового режима; разница между расходами на туристические услуги.

Закон Украины «О туризме» установил законодательные предпосылки для трансформации туризма. Также предусматривается существенное изменение правительственной схемы в области туризма с целью приблизить ее формирование к одному из приоритетов в отрасли экономики. В то же время существуют реальные проблемы и ограничения, которые ограничивают развитие устойчивого туризма в украинской части прибрежной зоны. Существует необходимость в развитии некоторых частей туристических услуг, которые являются обязательными компонентами системы рыночной экономики и которые ранее не были разработаны или решены без учета экономических мер.

Это: создание маркетинговой системы для туристической деятельности, в том числе создание системы продажи, реклама, организация структуры услуг в соответствии с требованиями, сертификация туристических комплексов относительно мирового уровня обслуживания; развитие туристической инфраструктуры, предоставление необходимой информации о качестве окружающей среды и стоимости возобновляемых ресурсов. Необходимо провести экологическую санацию туристических комплексов на основе их приватизации.

Ключевые слова: территориальное планирование, прибрежная зона, развитие туризма, описание Азово-Черноморского региона.

Application of modular system for innovation buildings architectural design

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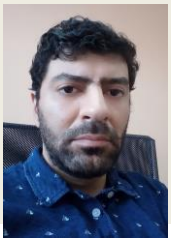
Получено 12.04.2019, принято после просмотра 26.05.2019
https://doi.org/10.31493/uwt1921.0102

Abstract. This article deals with the modular regulation techniques in the design of innovative enterprises in order to improve operational efficiency, as well as creating a more rational method of expansion and transformation. Consequently, the advantages of modular architecture in reducing the cost, labor and costs of building materials are compared with traditional methods. In addition, the contribution of further expansion of buildings by modular architecture is described. Based on scientific research, two classes of a modular system are defined for regulating the architectural structure of existing and new objects of an innovative enterprise: combined and specialized. Such systems are realized in the form of a grid, cellular structure and prefabricated units, which allow combining homogeneous and heterogeneous functional zones. At the same time, more acceptable module dimensions are determined for the main types of spaces in innovative enterprises: office, laboratory and production. The use of one or another type of modular solution, which adapts to the requirements of the terrain and the functional process of innovative buildings for various purposes, is recommended.

Modular unit techniques for the construction of temporary, permanent and mobile buildings of innovative enterprises are also presented in this article. Prefabricated modules, which include flat materials and spatial blocks, are considered. Metal, wood, plastic and reinforced concrete wrapped and blocks for creating modular systems are the subjects of study in this article. Also, some companies that have developed typical modular buildings from similar building materials are named. The methods of connecting and assembling elements from the modules both at the plant and at the construction site are analyzed. It also explains the relationship between the dimensions of modular structures and vehicles. Examples from world experience are given for each of these types.

Keywords: innovative enterprise, Science Park, modular system, universality, flexibility, functional area, functional cell.



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INTRODUCTION

Modular construction as an accelerated construction method is an alternative for temporary and mobile architecture. Buildings designed in this way consist of sections (modules) prepared at the factory and contain internal technical facilities (electrical wire, water and sewer pipes). After the assembling modules on site, additional architectural finishes can be applied and the completed product is almost indistinguishable from the construction created by traditional methods.

However, modular architecture includes a broader concept than the use of prefabricated units to create a building. Modules can consist of separate prefabricated elements (columns, trusses, panels), combined according to the principle of determined repeating steps and spans. Thus, modular architecture is the best solution for some long-term, temporary or

permanent facilities, such as construction camps, laboratories, schools and classrooms, civil and military housing, industrial facilities, churches, medical mobile buildings, sales offices and retail shopping centers, fast food restaurants and ticket offices.

THE ROLE OF MODULAR DESIGN TO IMPROVE INNOVATIVE ENTERPRISES

Based on the "theory of innovative enterprises" the characteristic features of an innovative enterprise (IE) are the accumulation, collectivity and variability of the innovation process in the management of company [4, p. 67]. IEs are dynamic buildings that, in accordance with the frequency of changes in research and production methods, are able to change their characteristics. Some architectural ways such as transformation of form and structure, dynamic lighting, the use of universal three-dimensional elements are useful to achieve this goal [6, p.53]. Scientific achievements and the experience of advanced technologies in various fields promote innovative developments of engineering, technology, labor organization and management [5, p.129].

Science Parks are vivid examples of IE. There are 3 types of processes in a science park, which simultaneously appear with the growth of the enterprise and innovative progress: research and experiment; production; rent of office spaces. The territorial expansion of facilities is necessary for the cyclical development of the innovation process. However, it is not the single duty of innovative enterprises. The architectural design of innovative buildings should be based on the universality and flexibility, in order to promote the transformation of spaces, fluctuations in the number of personnel and the volume of production. A modular system allows implementing these priorities. The advantages of this solution are minimizing the necessary operational areas with maximum efficiency, expanding effective areas, creating universal spaces; observing the rhythm of transport and engineering communications; opportunities for industrialization of construction work; application of unified design solutions; ability of open planning solutions.

Recommended Classes for Modular Structures

There are two classes of modular structures in order to plan an IE: combined and specialized. The combined modular structure is a common structural module that is used to host all clusters of an IE. This technique is used when using the existing infrastructure and in the formation of IE due to the reconstruction of other buildings; in the case when territorial limitation does not allow to form separate organization of functional groups; in the case of the chaotic IE at the level of the block, city and region (Fig. 1).

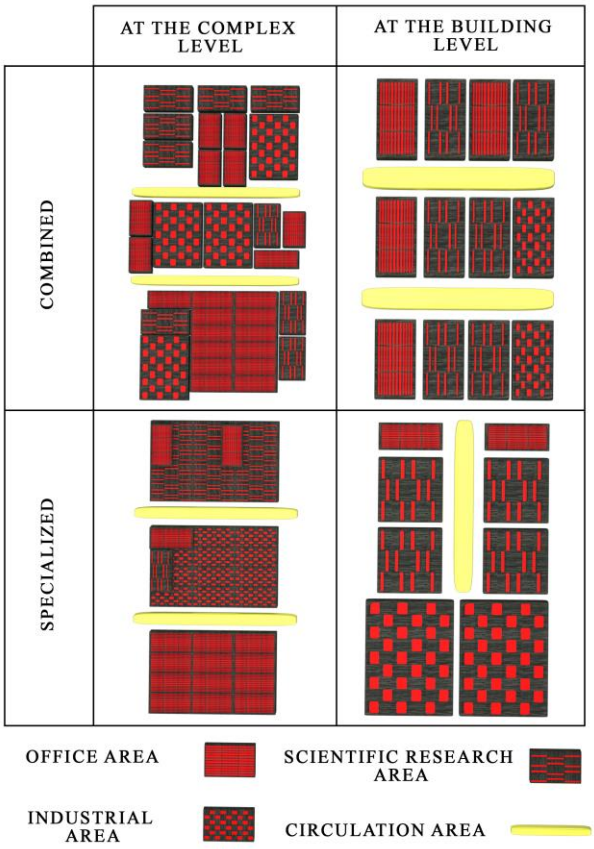

Fig.1. Modular structure's classes

Of course, this technique complicates future expansion and placement of heterogeneous functional areas in one building. In this case, the modular system can be partially or fully

specialized. In the first case, heterogeneous, but functionally connected with each other spaces are organized within the framework of one module. Using this method, office premises are integrated in a laboratory modular system [14, p.29-46] (Fig. 2).

A full modular system allows organizing various functional groups. This method is used for large IEs that are formed in non-constructed areas.

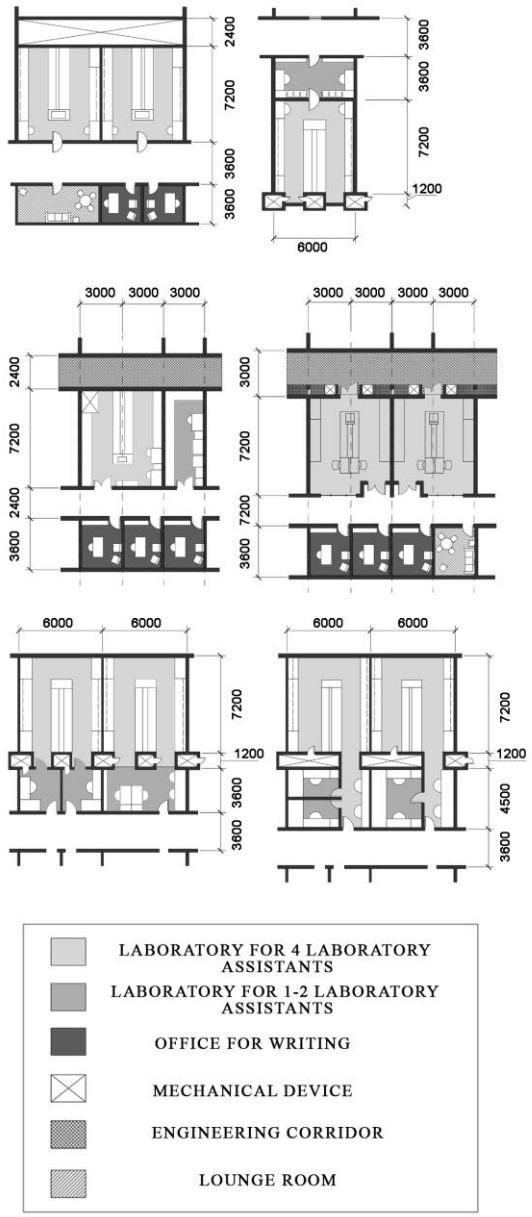

Fig. 2. Samples of a partially specialized modular structure on the example of laboratory facilities (according to [1] in the author's interpretation)

In this method, all vertical elements are integrated into the perimeter of the lab floors. Horizontal ducts run in interstitial floors [14, p.22].

The modules in innovative enterprises are the grid of functional zones in the master plan, cells with specific dimensions, prefabricated units and steps of the supporting structures. These modules can be either flat or spatial (3 dimensional). Modules should include the ratio of service and work areas. According the ergonomics a work post for each person should be at least 1.8 x 1.8 m in plan, which can become a unit for the workplace, work cell, working field, building and urban planning module [9, p. 80]. The other modules are taken as a multiple correspondence of a cell 1.8 x 1.8 m., which can have different configurations, such as 3.6; 10.8; 21.6; 54.0; 72.0; 108.0; 360.0; 1,080.0. If in specific cases a smaller unit is needed, the steps should have a multiple correspondence of 30 cm (i.e. 0.3; 0.6; 1.2). Practically more acceptable grids of columns are 3.6; 6; 9 or 12 m. Spans in accordance with the requirement can be 6; 9; 12; 18; 24; 30; 36m.

For office and laboratory premises, a modular size of the width of is accepted, a multiple correspondence of 3.6 m. Another issue in organization of laboratory-office module is the problem of staff Interior flexibility. It typically takes about three years for a lab to be designed and built. During this time, an organization's research needs may change or the people doing the research may leave and be replaced by others. In either case, there is a good chance that the purpose of the lab will change. If the entire lab is fitted with new casework, the casework may have to be changed before anyone occupies the new laboratory. To minimize this problem, equipment zones should be created in the initial design. An equipment zone is an area that can be fitted with equipment, movable furniture, fixed casework, or a combination of any of these. The fixed casework is usually located on the outside wall, with islands defined as equipment zones. It may also be helpful to locate 90 cm to 180 cm equipment zones on the outside walls to accommodate cylinders near fume hoods and refrigerators at the perimeter [10, p.14].

It is possible to determine the division of common territory in master plan, for example, the distance from IE to transport stops and public facilities should be 360 m, the length of

residential streets 720 m, highways and trunk engineering communications 1080 m [9, p. 82]. As a structure-forming basis for the planning arrangement of industrial facilities in a historical environment, a block-modular structure using a small-sized module – 3 & 6 m can be used. The use of such a module allows taking into account the planning parameters of the existing development during adding new fragments and ensures the best master plan organization of the industrial facility [8, p.92]. To increase the efficiency of a modular system, it is necessary to create horizontally and vertically unified sectors. In this regard, units and block section systems are used. For example, laboratories with uniform spatial parameters are located in one unit, or bathrooms on all floors are in the same place. The height of the premises is determined by a multiple correspondence of 3 m, which reaches more than 9.6 m in industrial premises, and more than 12 m in atrium-type buildings. However, a height above 6 m is not applicable for buildings with more than one floor.

The modular system depends on the type of planning solution. The key point in this regard is the location of workspaces around circulation areas (corridors, stairs, halls and courtyards). There are 3 main layouts of workspace location: linear, central or core and comb-like [14, p.47-50]. In the central design, the rooms are located around a hall or an atrium, and in the rest, around a corridor. The modular structure determined is based on these configurations. In some cases, the central layout is a universal place in which spaces are umbrella-like organized. It means that all the functional areas, which can have their own ceilings, are located under a common cover. An example of this type is the Electronic Products Factory and the Renault Distribution Center in Swindon, England (architect N. Foster). In such buildings, spaces are divided by partitions and furniture. Large-sized unit and pavilion modules are used for organizing spaces of a research and production. For example, the Antarctic Research Station Halley VI (Hugh Broughton and AECOM) and the Schlumberger Research Center in Cambridge (Fig. 3).

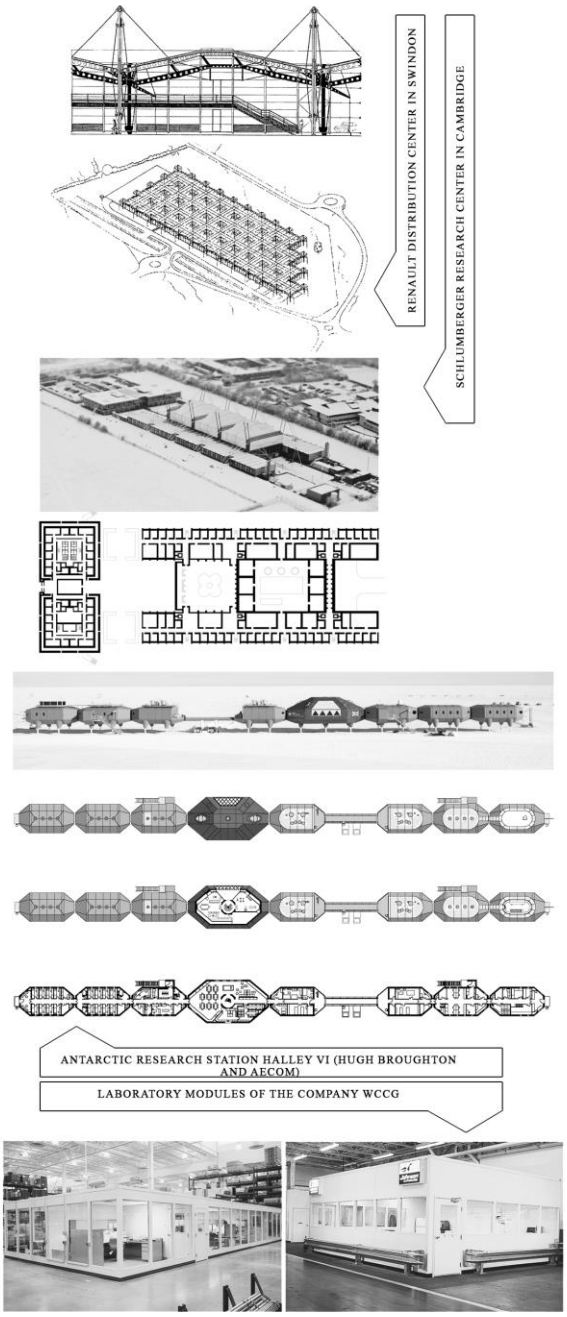

Fig. 3. The modular structural system for scientific and industrial purposes [sources of figures and photos: slideshare.net, tensinet.com, flickr.com, hbarchitects.co.uk, porta-fab.com]

Modular units are usually assembled in large production halls with a conveyor process. Modules are built in the factory within one to three months, and on-site construction can take only 10 days after relocation of building's parts. Even though to install the units a crane sometimes is necessary, but often they

simply slide onto the foundation using fork-lifts. The assembly of modules can usually take several hours or several days, and the final product is indistinguishable from typical buildings built on by traditional methods.

Another way to build a modular system is to use volumetric-unit structures. These units can be separate or combined. Unit modular elements can be used on a large scale to create office-administrative spaces. The conveyor production of modular units can reduce the total cost by 1.8-2 times, the number of assembly elements by five times, and construction duration by three times [1, p.334]. An example of this type of building is the AZM bureau in Holland (architect L. Bisscher), the Plastic office in London (architect H. Stanley Smith) and the office pavilions of the Nardini distillery in Bassano Del Grappa, Vicenza, Italy (architect Massimiliano Fuksas). The press and information center in Tokyo (architect Kenzo Tange) is an example for the combination method (Fig. 4).

The volumetric-unit structures allow to increase or decrease the size of buildings by adding or removing modules without changing the basic structure. The same process can be used for transformation and functional change. Thus, the expansion and transformation of the building does not cause much delay in the exploitation of the enterprise.

The same method can be used to reduction of a company. Modules can be removed and sold as a separate, smaller building. In addition, it is possible to operate them for other purposes by adding or removing modules, or moving the building to another location.

Ultimately, there are some benefits to a modular architecture:

- Reduction of environmental impact;
- Less waste material in landfills;
- Labor and resource efficiency;
- Optimization of the construction process (in many cases, the completion of the construction process occurs 50 percent faster than conventional construction);
- Improving the safety and comfort of the construction process;
- The ability of synchronizing the stages of construction, which in traditional methods go consequently;
- Reducing the cost of building materials and work [17, p.4].

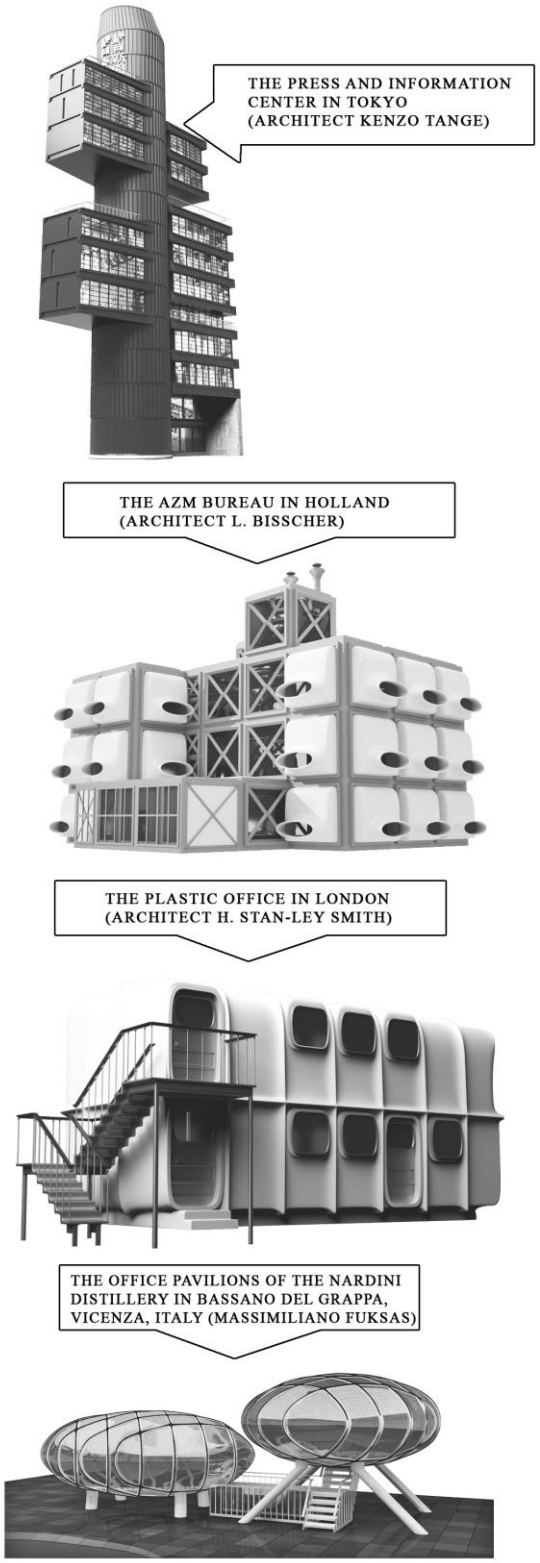

Fig. 4. The unit modules for office buildings

However, the volumetric unit constructions have some disadvantages. Despite the flexibility of this system, the design of non-standard smooth forms is limited. Therefore, specific custom modules are required. In addition, the transportation of blocks depends on the dimensions of vehicles and road regulations. In addition, the number of levels of a modular building is limited. This limit depends on the country's standards. For example, in some Asian countries the construction of modular buildings up to 12 floors is accepted.

The application of large modular units for the design of a production cluster

Since in the frame-panel system not all construction work is completed at the factory (finishing, sanitary, installation remains for the construction site), along with the improvement of progressive frame structures, new systems with a high coefficient of factory readiness are being searched. In this regard, the use of large modular units can be an alternative to increase the speed of construction, as well as simplify the architectural transformation [2, p.334]. Innovative enterprises can include a production cluster or be formed as a part of an industrial district. Modular design is necessary to increase the efficiency of the production process, as well as separate areas with hazardous activities from office buildings. Production workshops, consisting of small unit modules can be combined and create large modular units. These large units govern the configuration of buildings and structures of the production cluster in accordance with existing conditions and requirements. The production process consists of three main stages: storage and supply of raw materials; treatment; the release and storage of the product. Therefore, workshops, buildings and structures, which are associated with each stage, can be considered as an independent unit (except in exceptional cases when technical solutions require combining the elements of two or all stages into one whole). Depending on the topographic features and shape of the site, as well as for the implementation of a more compact planning solution, it is possible to have different configurations of production units: linear; parallel; P- and L-shaped; complex (Fig. 5).

A linear arrangement is preferable for production workshops, as this layout practically and psychologically is more rational. Parallel layout is a kind of linear type and is used when more than one production conveyor line exists.

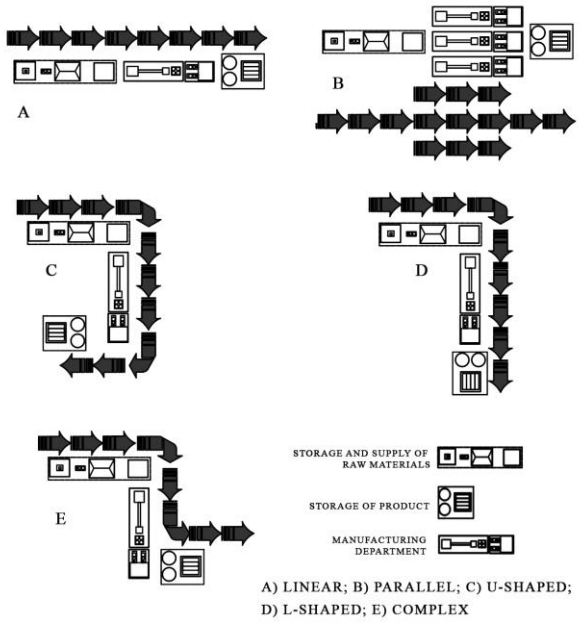

Fig. 5. Layout techniques for the main constituent units of a production cluster

U-shaped layout is appropriate when the raw material and product storages are located near. Sometimes part of the unusable product is returned to the production line, but in this case additional storage facilities for return materials are required. L-shaped layout promotes the separation of entry and exit on the production site. It means that the raw materials are transporting in one direction, products are exported in another perpendicular direction.

Generally, dimensional requirements for modular units are determined by transportation restrictions. The more common dimensions are calculated as follows: the maximum width of the standard module is 3.8 m, and the large – 4.8 m; the maximum length of the standard is 15.8 m, and large: 18.3 m; maximum module height 3.6 m. The maximum height of the finished unit in the form of a building: from one to three floors for wooden blocks, from 5 to 12 for steel, from 12 to 20 for reinforced concrete [18, p.169, 175].

Combination of modular elements

In contemporary architecture, in order to increase efficiency, different materials are used to create modular units. For example, it is possible to make a metal frame, sheathe it with wooden panels with heat-insulating fiberglass layers, and at the end to mount it on a reinforced concrete foundation. Modular units can be created using various combination methods of elements:

- Single element method, where the same fundamental elements with different facade claddings are used;
- By the method of exchange of components, where the same fundamental elements are used, but by changing the parameters of the units after installation, various functions are assigned to each unit (the internal change);
- Cutting in size, where modules with the ability to cut into standard sizes for different purposes are used;
- applying a basic structure in the form of a frame and attach prefabricated elements to it;
- Sectional modularity, in which different elements are used, but are connected by one method to the basic structure and to each other [18, p.182-184].

The classification of modular elements is necessary to improve their application. The principles outlined in the preceding sections, concerned with the various devices which can be used to improve the efficiency of structures, can form the basis of a classification system for structural elements. The primary categorization is between form-active, semiform-active and non-form-active elements because this is the most important factor in determining the level of efficiency, which can be achieved. Elements are further classified according to the degree of 'improvement', which is present in their cross-sections and longitudinal profiles [19, p.45].

Plastic modular units

The first such modules were made in the UK in 1968. Plastic modular units can be used to provide temporary and mobile buildings for areas suffering from cataclysms, as well as for research and expeditionary work in extreme conditions. Other purposes of such a unit are exhibition pavilions, offices, checkpoints, camps, and temporary residential buildings, domestic and medical-operational premises. Plastic units made of compressed PVC sheets are most often produced in pentagonal and hexagonal forms, connected by bolts. Units are combined directly or using prefabricated corridors. In addition, vaulted modules from composite-laminate materials are practiced (such materials include multilayer cellulose, graphite, fiberglass, boron and silicon carbide plates). Such prefabricated units, in turn, are combined from separate prefabricated panels, connected with bolts and other similar reinforcing elements, or sealed with high temperature.

As a disadvantage, the working space in plastic containers is limited. However, they have also some advantages. For example, these units can be environmentally friendly and energy efficient. Existing landscape elements (earth, green cover) can be used as thermal facade insulation. This technology allows adaptation to topography and landscape environment, taking individual approaches and reducing the necessary amount of human resources for installation and dismantling due to the low weight of the constituent elements and the ease of installation process (usually 2-3 people are enough). Unlike other types of modular units (metallic and frame-panel units), technical elements (pipes, ventilation shafts, electrical wires) can be installed anywhere in the unit. On the other hand, plastic materials help to avoid overheating of the internal space of the units.

As examples of plastic modular blocks, two products of French manufacturers will be considered:

1. Wight's Isle, manufactured by Wight Plastics Limited Company, 1971. The basic module consists of six wall panels and 6 roof elements. There are sandwich elements made of two fiberglass layers of reinforced polyester, filled with foamed PVC. The assembly of various elements is carried out using galvanized steel bolts.

2. Floating modules J. (1970). Architects Jacques Boeuf, Jean-Pierre Leverer, B. Gilet and M. Menager have designed these industrial, transformable, combinatorial and expandable units. Architects offered the existing technology of that time to create plastic bottoms and cases under the press. The diameters of the cases reached 3.5 m. The shell elements are assembled using bolts and compression joints. These modules can be grouped to create settlements and coastal cities [20] (Fig. 6).

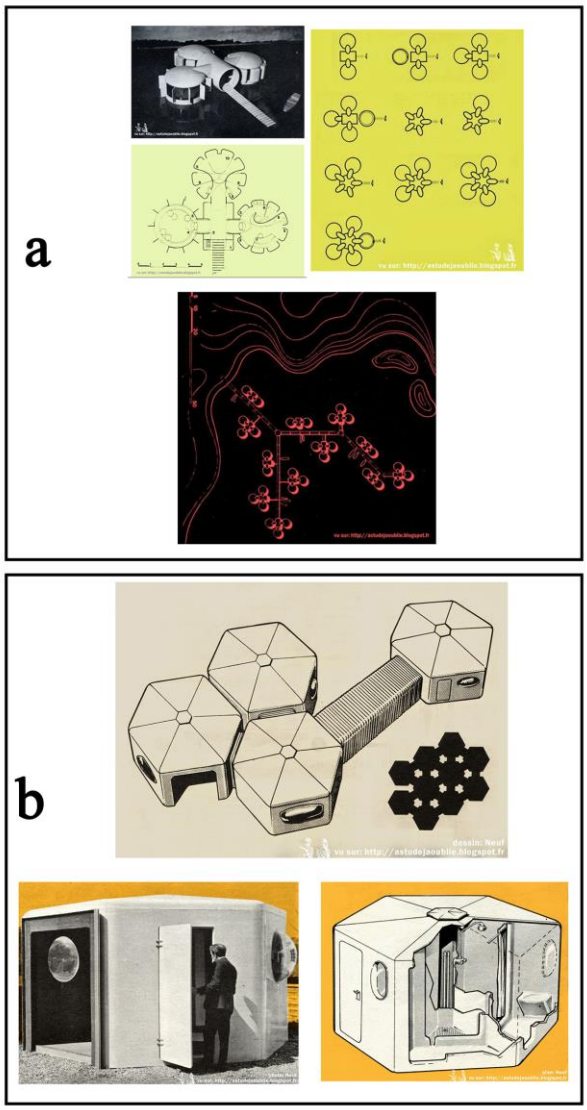

Fig. 6. Samples of plastic modular blocks [20]: *a* – Wight Isle (Isle Wight); *b* – floating modules – J

Container-type units from metal truss and blocks

Even though the containers were first created for industrial purposes (storage, laboratory, household), they were gradually used in the construction of office and residential buildings. There are two directions in the construction of modular container-type buildings:

1 – Reconstruction of metal storage containers by trimming and adding additional elements;

2 – The use of specially prepared elements, facade panels and technical blocks.

As a rule, modules distribute the load at bearing points on the foundation. Thus, a tiled floor with a perimeter system or columnar foundation is the best solution for a modular design. Typically, lightweight construction is not capable to hold a high-rise building, so such buildings cannot have more than three floors. Nevertheless, with additional reinforcing elements (the internal core and the diaphragm), it is possible to increase the number of levels to seven. In this case, it is worth using a strip foundation or piles in areas, where ground is sandy or the level of groundwater is high (Fig. 7).

Adding horizontal trusses, this system offers advantages of compact sizes, minimal welding, high rigidity, and the fewest possible column and connection points, since the corner posts transfer vertical loads to the foundation [11, p.36].

Such a solution, which is used in the American Kullman Frame System (KFS), eliminates the need for a solid foundation and reduces the number of pillars [18, p.169] (Fig. 8). In addition, non-bearing units are used to place sanitary services, technical rooms or other modules that do not contain any load-bearing part of the building. These types of structures are typically constructed from lightweight steel structures.

These dimensions are proposed by KFS:

- Module Width: 13 ft (396 cm) Common Maximum, 16 ft (487 cm) Oversized Maximum Module

- Length: 52 ft (158 cm) Common Maximum 60 ft (183 cm) Oversized Maximum
- Module Height: 12 ft (366 cm) Maximum
- Building Height: 12 Stories Maximum [12, p.35].

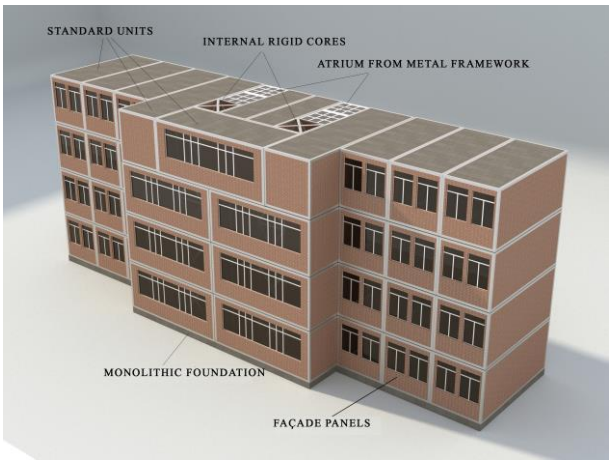

Fig. 7. Combining prefabricated units with an internal core and a monolithic foundation

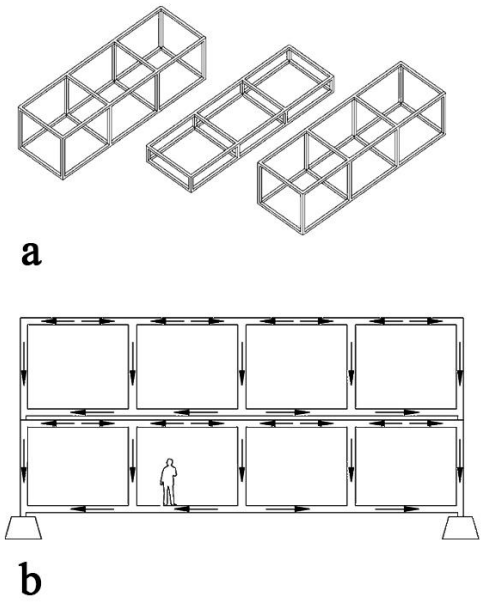

Fig. 8. Kullman Frame System (KFS) [11, p.36/18, p.169]: *a* – modules which host intermediate submodules for the distribution of service rigs; *b* – truss system of the "Virendel" beam box (a horizontal supporting structural element of the floor, working mainly on bending), which distributes the load on the external vertical posts of the module and the foundation

Timber modules

Ease of transportation, aesthetics, environmental friendliness, various construction methods and the ability to use modern and traditional forms are the advantages of wooden structures. However, the construction of wooden buildings over four floors due to increasing the costs, in order to strengthen the support points of the building is not economically justified. Thus, a combination of wood with other types of building materials is inevitable. Nevertheless, there are six, seven-story buildings of wooden modules.

There are some methods to simplify the assembling of timber frame modules:

A) Preparation of individual prefabricated elements: each element (wall and roof panels, floor slabs) is separately made as a two-dimensional object. Modules are wrapped as two-dimensional planes. The floor is built at the factory, covered with a floor lining and positioned horizontally. Then panel walls constructed, sheathed, and tilted onto floor. The result is a three-dimensional assembly. The roof is built and craned on the walls. As a result, a finished unit is created;

B) The following steps can be applied for each of the above assemblies: install windows and doors. To execute wall finishes and roofing (plasterboard panels, plaster, siding, tile, slate, etc.). Transporting to the construction site [18, p.163].

The design of wooden modular buildings based on a method depends on social, economic and geographical conditions. Sometimes several methods can be combined. For example, the Moxy Hotel in Oslo (built in 2017), which consists of units located in the central part of the building and panels on both sides. The multilayer-glued wooden panels (CLT – cross-laminated timber) are divided into two main groups – internal and external. The construction was performed by simultaneously expanding the arrays of modules in different directions (Fig.9). This structural system can be used for hostels, hospitals, offices, laboratories and multicompetent buildings [16, p.3-5].

Reinforced concrete modules

Unlike previous systems of large modules, this type of constructive solution is provided for a long-term period, because the installation and dismantling of units is more complicated. Reinforced concrete modules provide the ability to construct multistory buildings. However, due to the difficulty of transportation and dismantling, this type is not recommended for enterprises with a high pace of development. Such designs are used in the form of:

- Prefabricated panels and columns mounted with bolts and fasteners, welded rods and cables;
- Finished large units (individual or integrated segments);
- Monolithic modular construction [13, p.13-15].

An example based on reinforced concrete modules is Habitat 67 in Montreal (Fig.10, *a* and *b*). Architect Moshe Safdi as the Canadian pavilion designed the building for the 1967 International Exhibition. It was an experimental solution for high-quality housing in dense urban environments [15, p.63-65].

Constructing low rise reinforced concrete buildings to reduce weight (especially in seismic regions), plastic blocks with cement can be combined. Another disadvantage of precast concrete modules is the low flexibility compared to monolithic reinforced concrete buildings. Since the dimensions of the precast elements are predetermined, the variety of exterior forms is limited. Despite this, precast concrete units or the so-called block rooms are built according to the principle of monolithic structures. Thus, with a large amount of production, their manufacture under specific requirements is economically viable.

To install prefabricated reinforced concrete structures, construction methods are based on:
- Open systems (elements which are compatible with other components of the building)
- Closed systems (elements which are compatible only with each other).

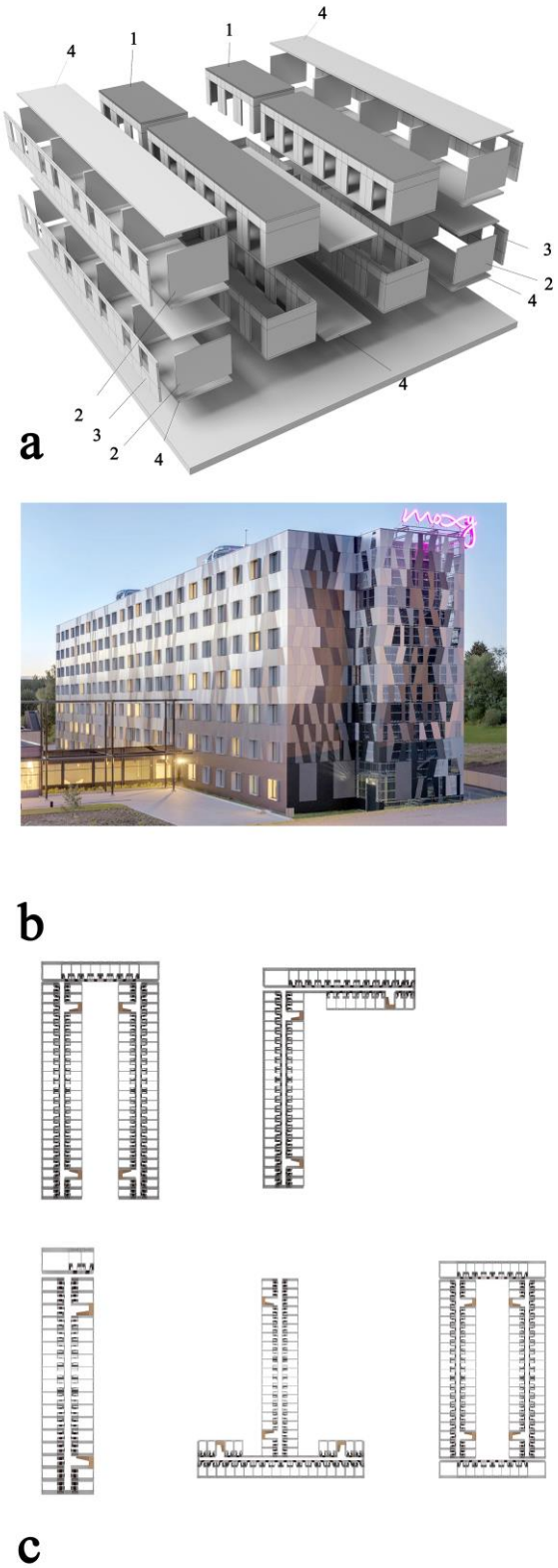

Fig. 9. Wooden modular design of the Moxy Hotel in Oslo [16 c. 4, 5]: *a* – Schematic diagram of the MOXI hotel; *b* –general view; *c* – possible floor plans. 1 – Unit module; 2 – and 3 – facade panels; 4 – Floor slabs (room and corridor)

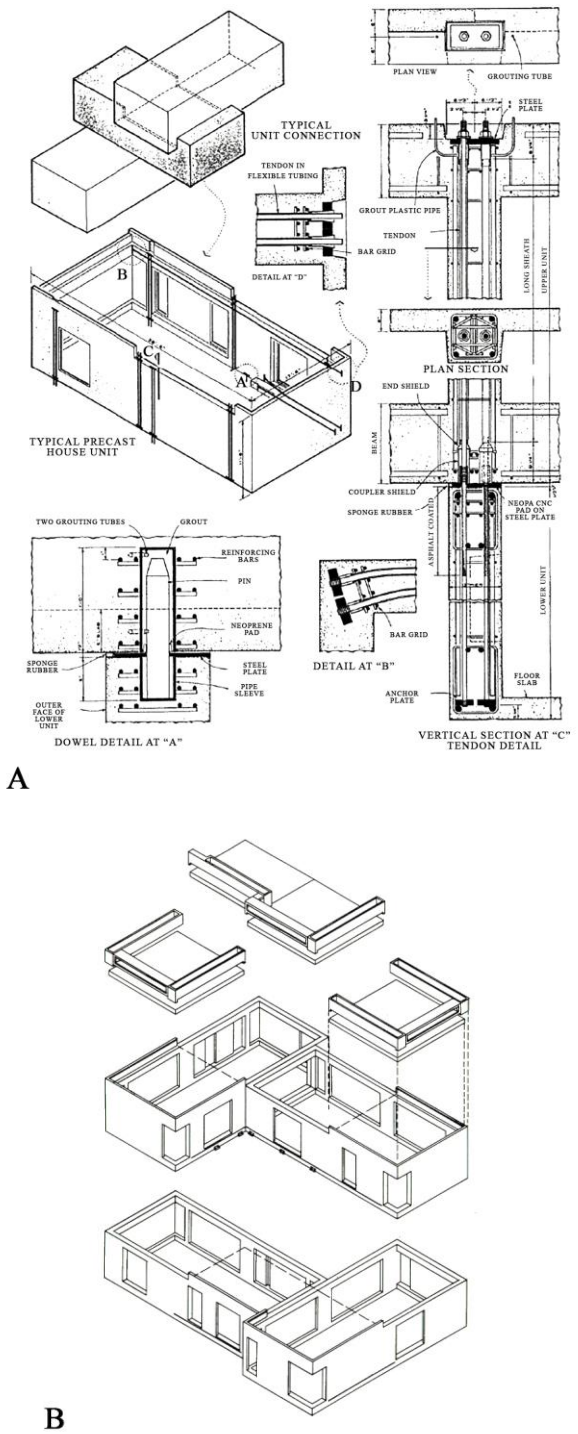

Fig.10. Habitat 67 in Montreal [15, p.63, 64]:
a – details of the strengthening and connection of the units; *b* – units and methods for their combination

The open system includes two-dimensional elements (panels, columns, plates, beams, lintels, stairs), and the closed system includes three-dimensional (units) [13, p.10]. Such items are available in standard sizes and are affordable when purchased in large quantities. Practice shows that mini-systems of components or integrated elements are more widely used. It is also worth mentioning that reinforced concrete elements are more often combined with other construction materials. In this respect, prefabricated concrete foundation elements are used in combination with any other type of modular constructions due to their ease of application in dirty environments and in the presence of fragile ground structure. Bearing wall panels in multi-story buildings can take place as diaphragms and rigid cores, in the space between which service and circulation modules are located. In low-rise buildings, the most common option is a transverse structure with partitions between different zones [16, p.14].

Units are often used to create sites that require intensive maintenance (built-in kitchens, bathrooms and showers, laboratories), where there is a high degree of repeatability and the need for quick assembly on site. Bearing sanitary units are capable of perceiving the load not only from their own weight, but also from floor structures based on them [3, p.108].

Modular reinforced concrete units are ideal for the design of temporary residence buildings (hotels, hostels) in science parks, as well as laboratory and office buildings. Large reinforced concrete units are mainly designated for dealers and manufacturers, including: general offices (construction site trailers, construction trailers); educational portables; commercial, retail, restaurant and convenience stores; military and government; kiosks, guardhouses and communication shelters; health care; industrial and workforce housing [18, p.162].

CONCLUSION

The modular structuring of the architectural and planning solution of the innovative direction buildings accommodates the development and organization of various functional zones in the form of buildings and squares, as well as in the form of premises. If we are talking about territorial modular structuring, the following schemes are recommended: combined and

specialized. When combined, various functional areas are included. This scheme is valid for the reconstruction of existing buildings and the IE design in the grid of densely built-up areas. A specialized scheme that should be used to IE design in undeveloped territories allows rational structuring of functional zones in individual groups. At the building level, modular grids of supporting structures and the use of large-spatial blocks are recommended. Modular container blocks can be used for office and laboratory buildings. Such blocks may be prefabricated or semi-prefabricated. Depending on the purpose of designing modular buildings (temporary, long-term), such blocks can be built from different materials (plastic, reinforced concrete, truss metal structures). Plastic blocks are used for temporary and mobile buildings due to their low weight and simple installation and dismantling process. Steel farm containers are spread over all types of buildings, but in innovative enterprises (industrial parks, innovation centers, factories, research centers) are more suitable for designing workshops, warehouses, offices and laboratories. They can be built in two ways: reconstruction of warehouse containers and the use of specially prepared elements. Metal frames take the main load in such blocks. Wooden modules can be used as separate elements (panels and beams) or as ready-made block units. The disadvantage of such modules is the limited number of floors. Reinforced concrete modules as well as wooden are used in the form of elements and large blocks. They can be used for a wide range of buildings. They are durable and not limited to number of floors. However, due to transportation difficulties and heavy weight, they are limited in size. In addition, the installation and dismantling process for them is more complicated than other types of modular designs. It should be noted that with the transition from two-dimensional elements (beams, columns, panels) to three-dimensional (units), the degree of design flexibility decreases. On the other hand, the dimensions of vehicles determine the maximum dimensions of the modules. Thus, the application of one or another solution is individual for each project.

Sources of illustrations:

Fig.2 – according to [1] in the author's interpretation;
Fig.6 – [20];
Fig.8 – [11];
Fig.9 – [16];
Fig.10 – [15].

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Применение модульной системы в проектировании инновационных зданий

Каземи Лари Голамали

Аннотация. Рассматриваются приёмы модульного регулирования в проектировании инновационных предприятий с целью повышения эффективности эксплуатации, а также создания более рационального метода расширения и трансформации. Следовательно, причислены преимущества модульной архитектуры в снижении стоимости, труда и расходов строительных материалов по сравнению с традиционными методами. Рассказывается о том, как модульная архитектура способствует дальнейшие расширения зданий. На основе научных исследований определены два класса модульной системы для регулирования архитектурной структуры существующих и новых объектов инновационного характера: совмещённая и специализированная. Подобные системы реализуются в виде сетки, ячеистой структуры и сборных блоков, позволяющих комбинирование однородных и неоднородных функциональных зон. При этом определены наиболее приемлемые габариты модулей для основных видов помещений инновационных предприятий: офисных, лабораторных и производственных. Рекомендуется применение того или иного типа модульного решения, адаптирующегося под требования местности и функционального процесса для инновационных зданий различного назначения.

Представлены приёмы блочного модулирования для строительства временных, постоянных и мобильных зданий инновационных предприятий. Рассмотрены сборные модули, в число которых входят плоские материалы и пространственные блоки. Металлические, деревянные, пластмассовые и железобетонные развёртки и блоки для создания модульных систем являются предметами изучения в этой статье. Также названы некоторые компании, которые разработали типичные модульные здания из подобных строительных материалов. Проанализированы способы соединения и сбора данных модулей как на заводе, так и на строительной площадке. Показана связь между габаритами модульных конструкций и транспортных средств. Для каждого из выше упомянутых разделов приведены примеры из мирового опыта.

Ключевые слова: инновационное предприятие, технопарк, модульная система, универсальность, гибкость, функциональная зона, рабочая ячейка.

City Master Plan: Forecasting Methodology Problems (on the example of the Master Plans of Kyiv)

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Received 06.05.2019, accepted after revision 06.06.2019
https://doi.org/10.31493/tit1921.0201

Abstract. The basic document for regulation of the settlement urban development is the Master Plan [1]. The legislative and regulatory framework for regulating the composition, content, approval and approval of this document is very extensive and is based on a broad basis of scientific research and practical experience of domestic and foreign specialists in this field.

The larger the city, the more difficult it is to predict its continued existence. In this article the results of the analysis of historical-geographical, socio-demographic and legislative-normative aspects influencing the regulation of the city development issues (on the example of the historical and current master plans of the city of Kyiv) are covered.

Also are outlined the peculiarities of the formation of the spatial organization of the city territory as a part of the master plans of Kyiv at different historical stages – prior the planning, the period of joining the Russian Empire, the Soviet and the present period. The evolution of models of spatial organization of the city territory is characterized.

The master plans development periodicity is analyzed as well as a conclusion is made about the fallibility of the statutory requirement regarding the indefinite validity of the master plan of the settlement as a basic urban planning document.

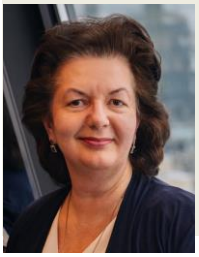
Population size (both actual and predicted) acts as a key indicator of settlement development. The article analyzes the dynamics of the population of Kyiv, identifies patterns of influence of positive and negative factors on this indicator, establishes faults between the actual and predicted population of Kyiv.

The conclusion is made about the extreme complexity of forecasting the prospects for the development of urban systems. The reasons (accuracy of demographic forecasts, counter intuitiveness of development of complex urban planning system, imperfection of legislative and regulatory base) of impossibility of full realization of master plans of settlements, in particular, of the city of Kyiv are considered.

The recommendations on improvement of the legislative and normative base for development of settlements master plans are given. In particular, the return of the fixed term of the Master Plan, that does not exceed 20 years.

The author's vision of promising directions of development and transformation of the spatial organization of the territory at the present evolutionary stage of its existence of the city of Kyiv is formulated. Namely – a cardinal complex reconstruction of the city.

Keywords: Master Plan, spatial development, population density, demographic forecast, legislative and regulatory framework.



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INTRODUCTION

The development of a city from foundation, forming and, sometimes stagnation and death, is extremely hard and difficult to predict. However, people are persistently trying to manage this process and to shape the spatial organization of the city in accordance with ideas about a comfortable urban environment at one time or another in the evolutionary development of society.

The main document that defines the directions and parameters of the spatial development of the settlement is *the Master Plan.*

According to the Law of Ukraine "On Regulation of Urban Planning Activity" (Article 17, Par. 1) "The Master Plan of a settlement is the main type of town planning documentation at the local level intended to reasoning a long-term strategy of planning and development of the territory of a settlement". [1] In this case, the validity of the master plan is not limited, that is, in fact, recognized open-ended. [1, Art. 17, Par. 8].

This applies not only to the new master plans of the settlements, but also to the zoning plans and detailed plans of the territories, which must correspond to the planning decisions of the master plan. It is this position of the Law of Ukraine "On Regulation of Urban Planning Activity" that caused a lot of disputes and problems in the process of developing and agreeing urban planning documentation at the local level, in particular, in the city of Kyiv.

Altogether philosophers and architects, urban planners and simply residents of a certain village are trying to understand the laws of existence and forecasting of the urban systems development. The material presented is based on the analysis of previous studies from several aspects, namely:

- to the issues of spatial organization of the city plan are devoted the works of Bilokon Yu.M., Demin M.M, Ositnyanko A.P., Panchenko T.F., Timokhin V.A., Filvarov H.Y., Fomin I.O.;
- geographical and socio-economic aspects are covered in the works of Bystryakov I.K., Zablotsky G.A., Klyusheichenko E.E., Palekha Yu.M., Stebletska Yu.;
- environmental and socio-demographic issues considered in the works of Libanova E.M., Pribitkova I.M., Solukha B.V., Ustinova I.I.
- legislative and legal aspects of development of master plans are considered by Gleba V.Yu., Dyuzhev S.A., Petrakovska O.S., Smilka V.A.

To what extent does the real spatial organization of the city of Kyiv corresponds to the decisions of the master plan for its development and can the master plan of the settlement be open-ended? Let us try to answer this question by considering the impact of legislative, regulatory, historical, geographical and socio-economic aspects of city development on the example of the city of Kyiv.

AIM AND RESEARCH METHODS

The purpose of this study was to understand the regularities of transformation of the functional and planning organization of the city of Kyiv for the purposes of further forecasting its development.

Using the historical method, political, cultural and socio-demographic factors have been identified that influence the need for urban areas and the transformation of urban space. On the basis of a retrospective analysis of the main drafts of the General plans of the city of Kyiv, using the graphoanalytic method, the evolutionary stages of the formation of the functional planning organization of the territory of the city of Kyiv are established.

Using the comparative method, legitimacy of periodicity of development of master plans of Kyiv and influence of legislative and regulatory base on the development of this type of city-building documentation were determined.

On the basis of the forecasting method, the principal directions of further transformation of the functionally planning organization of the territory of the city of Kyiv are formulated.

RESULTS AND EXPLANATIONS

A) **Historical and geographical aspects**.

Numerous cartographic materials reflecting the status and prospects of the spatial organi-

zation of the territory of Kyiv can be divided into four periods [Yu Stebletska, 2].

1) *Prior to planning* – from the end of the 5th century to the end of the 17th century. There is no cartographic evidence of intentions for future development of Kyiv. This information is found only in chronicle sources.

2) *Kyiv as a part of the Russian Empire* (late 17-19 centuries). During this period were developed:

- the Master Plan of Kyiv in 1695, executed under the leadership of Colonel I. Ushakov – the first document of this type, preserved in more or less full volume;
- the Master Plan of 1787, drafted by General Miller and Real State Advisor Earl Shuvalov;
- the Master plan of Kyiv in 1808 by Architect A. Melensky;
- the Master Plan of 1833 (partially modified in 1837) – the authors: engineer L. Shmegelsky, architects V. Beretti and L. Stanzani;

3) *The Soviet period* (almost all of the twentieth century);

4) *The current planning stage* of Kyiv (21st century).

It is on the last two periods that we dwell in detail. The main drawing of the master plans of Kyiv in the Soviet and modern periods, similar scale shown in Fig. 1 and Fig. 2.

On the eve of the First World War, Kyiv was a very well-developed provincial city. Between the years of 1897 and 1914 the population of the city increased from 248 to 626 thousand people. [3] Accordingly the city was expanded. In 1910, the suburbs of Solomyanka, Protasov Yar, Batyeva Ghora, Shulyavka were added to it. The urban areas of Svyatoshin and Demiyivka also grew out of Kyiv suburbs.

The left-bank settlements of Mykilska Slobidka and Darnitsa, territorially included in the neighboring Chernihiv province, were administratively subordinated to the district authority of the Kyiv region. Urban transport was developing. [3]

The First World War, the Revolution of 1917 and the subsequent Civil War dramatically changed the gradual development of the city. City Powers in the city were constantly changing.

The number of the urban population decreased significantly: some were killed, some left the city. In 1920, there were only 376,000 inhabitants in Kyiv. At the same time, Kyiv lost its status as the capital. The capital of Soviet Ukraine was Kharkiv (from 1917 to 1934).

But already by 1923 the city area expanded almost twice due to the inclusion of 20 nearby settlements within the Kyiv borders: Darnytsia, Mykilska Slobidka, Bilichi, Sovki and other towns. [3]

In 1925 a new topogeodetic survey of the territory of Kyiv in M 1: 2000 was carried out and in 1926 the development of a new city plan began. In 1927, the Bureau of the Kyiv City Administration approved the "Provisional Rules" that governed the urban development of Kyiv.

In 1934, after the decision at the plenum of the Central Committee of the Communist Party (b) of Ukraine to make Kyiv the capital of the Ukrainian SSR again [4], arises the question of the new master plan of the city development, which would respond to the tasks of the then political and economic development direction. The spatial organization of the territory of the capital had to meet the tasks of architectural and urban planning realization of the advantages of the socialist system based on the industrial development of the socio-economic complex of the city.

The first Soviet Master Plan of Kyiv was carried out under the leadership of P. Haustov and approved in 1938. It was also called the Master Plan for Reconstruction, which was to become "the plan of transforming Kyiv into an exemplary socialist city, worthy of the capital of the Ukrainian SSR" [5].

On the one hand, Kyiv's development along the west-east latitudinal direction (along the famous historic Via Regia) with the city's exit on the left bank of the Dnieper was to be a major novelty of the city's spatial planning. More than 20 suburban settlements were planned to be added, with an increase in the total population of Kyiv to 1.5 million people.

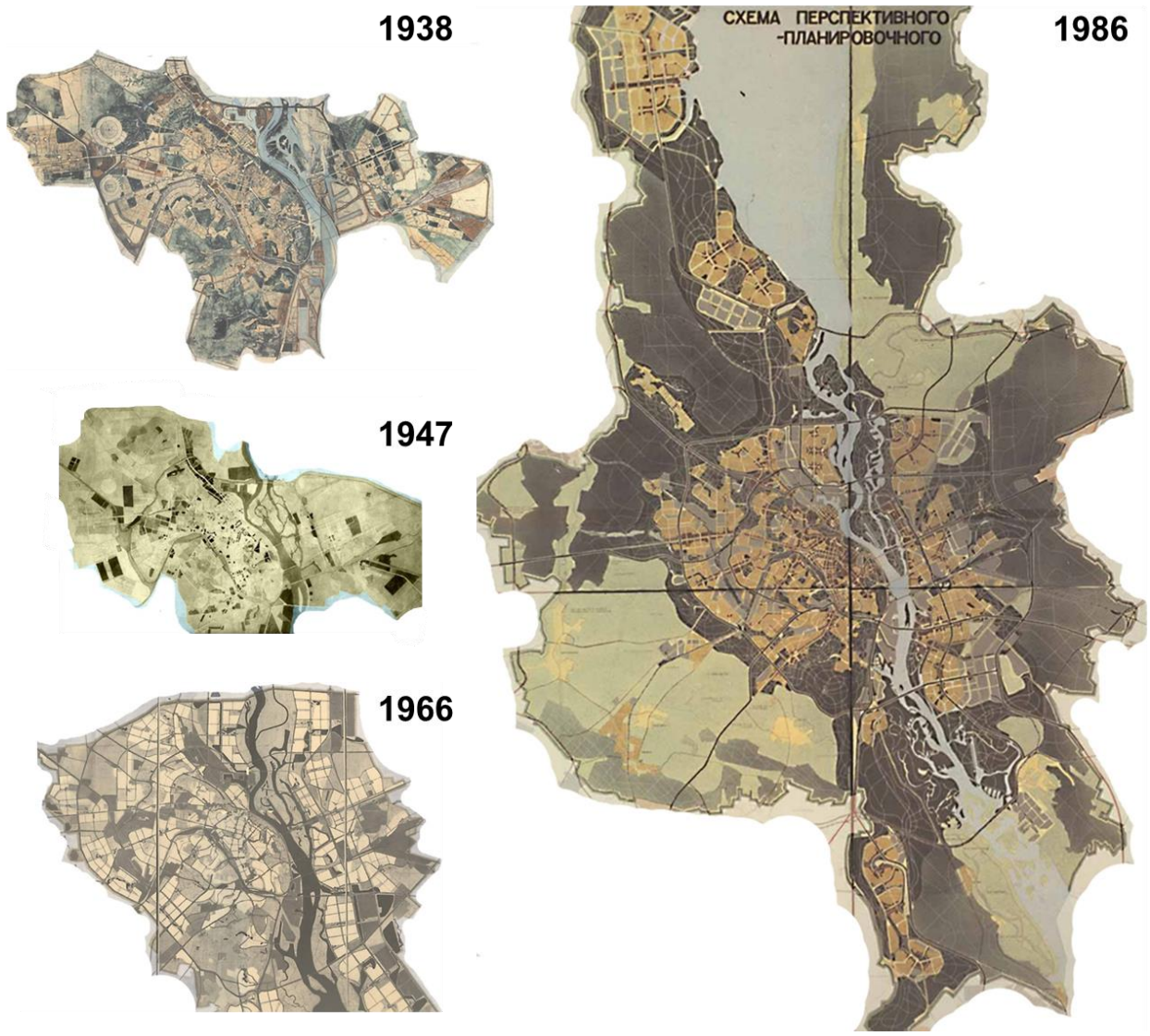

Fig. 1. The city of Kyiv Master Plans of the Soviet period
(Master Plan 1938, 1947, 1966, and 1986)

On the other hand, cardinal transformations should have led to a significant increase in the spatial compactness of the city with the creation of powerful industrial and residential areas, the formation of a large-scale governmental center. [6] Unfortunately, as a result of the so-called "socialist reconstruction", over 100 of the best buildings of the 12-20 centuries were destroyed, though the beginning of the Great Patriotic War of 1941-1945 did not allow completion this ambitious plan.

At the time of Kyiv's liberation on November 6, 1943, there were only about 180,000 people in the city. The overwhelming number of industrial sites, public buildings, the city center were destroyed. The city needed a complete rebuilding. The master plan of Kyiv in 1947, executed under the direction of O. Vlasov and B. Prymak, became the reconstruction plan. The estimated population of the city in 1970 was 1.2 million people.

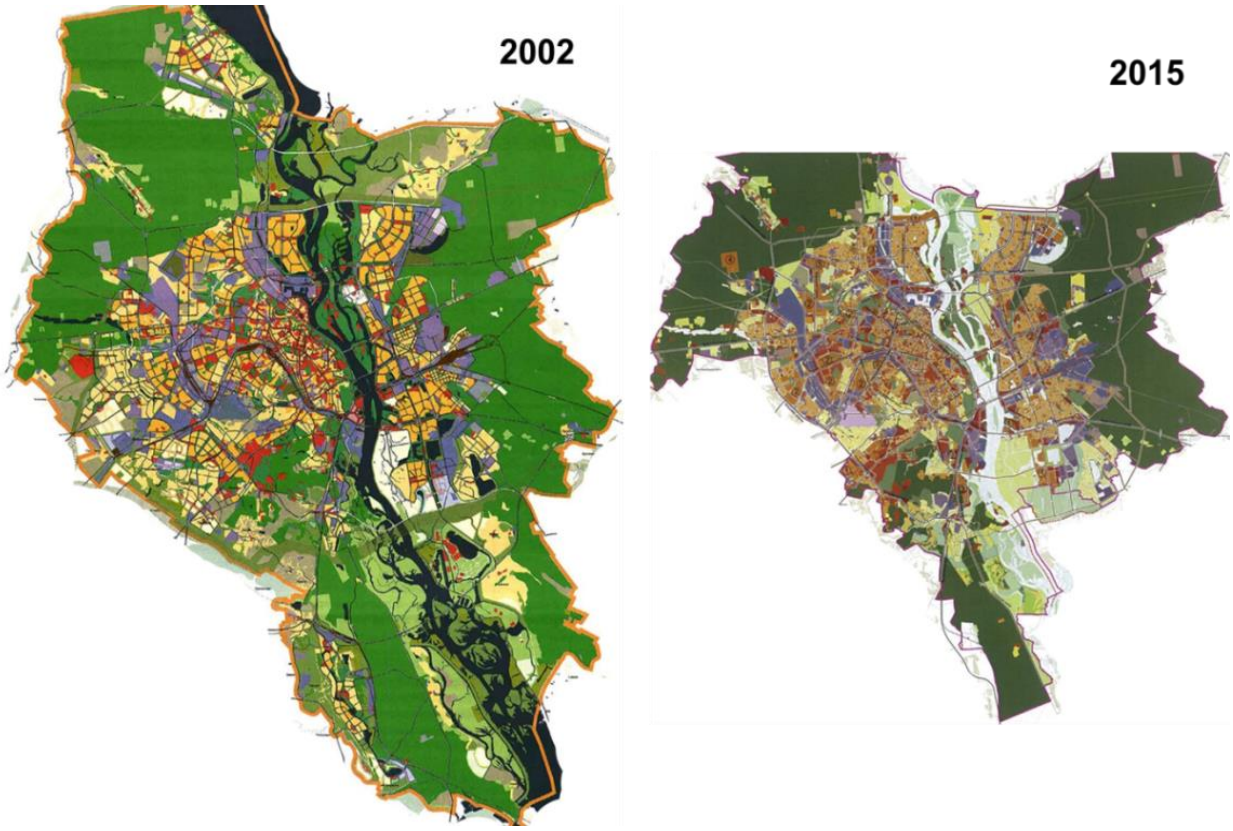

Fig. 2. Master plans of Kyiv of the contemporary period
(Master Plan 2002, Draft Master Plan 2015)

The Master Plan 1947 had to solve the painful question of the reconstruction of the destroyed city. The ideas of spatial development actually formed the modern planning structure of Kyiv – the radial-ring trace of the main transport highways. There was envisaged and implemented construction of the first section of the subway from Vokzalna station to Arsenalna station (1960); Darnytskyi Railway Bridge and Paton Bridge, Khreschatyk reconstruction and extension; the formation of the Boulevards of Lesya Ukrainka and the Friendship of Nations.

Massive housing construction begins with houses of the first industrial series. There is also a girdle of areas of individual private housing that have been allowed to solve the housing problem of the growing population of the capital.

The city's development was at such a rapid pace that the estimated population of 1.2 million in 1970 was already reached in 1961.

The rapid growth rate necessitated the development and approval in 1966 of a new Master Plan of Kyiv with an estimated population of 1.8 million in 1980. This master plan became the basis for the spatial organization of modern Kyiv with a compact planning structure. New areas and residential blocks of Obolon, Troyeshchyna, Kharkivskyi, Lisovyi, Vynogradar and others are emerging. The Ring Road project and many other projects that have not yet been implemented are envisaged.

For the first time, the master plan addresses the problems of Kyiv's development in connection with the suburban area.

The last Kyiv master plan of the Soviet period was the Master Plan of 1986 (the head of the team – M. Demin, architects

P. Kuchmarenko, E. Lishansky and others). Its main idea was to form a linear structure of a simple urban plan along the Dnieper River, creating a so-called "water green" diameter.

It was envisaged around the city of Kyiv the formation of a suburban area with the purpose of accommodation there industrial enterprises connected with the national economic city complex, development of suburban agriculture, organization of suburban mass recreation of the population. [8].

In fact, some of the city functions were outsourced outside the city of Kyiv in the adjacent administrative districts of both Kyiv and Chernihiv regions, with a total area of 1.76 million hectares [9].

The total projected population for 2005 was 3.05 million people.

Development of a linear planning structure of the city along the Dnieper River with the maximum approach of residential formations to recreational coastal territories, an increase of almost twice the length of the city in the north-south direction (from Lutezh to Khodosovka) required powerful engineering and transport communications. In particular, the extension of the subway to Dimer in the north was envisaged.

Unfortunately, the most powerful technogenic disaster of 1986 (the Chernobyl disaster), and then the collapse of the USSR with the subsequent economic crisis completely made impossible the implementation of the last Soviet Master Plan of Kyiv.

The current stage of the development of independent Ukraine is marked by only one, currently in force, the General Plan of Kyiv 2002 (Head – V. Chekmaryov).

Kyiv's acquisition of a new administrative and political status – the capital of an independent state, required the creation of an appropriate urban space. However, unfortunately, the first master plan of the capital of the period of independent Ukraine remained ideologically “Soviet”. It retained the idea of spatial development of the previous master plan – a significant (66%) increase of the city area to 143 403 hectares for the period up to 2020 at the expense of the adjacent territorial boundaries. [10]

At the same time, the predicted population was expected to increase only to 2.65 million people, compared to the current one – 2.61 million.

It also incorrectly determined the estimated level of auto-mobilization of the population, which led to the foundation of the underdeveloped street and road network of the city in the future.

The general plan did not take into account the processes of new socio-economic processes - land splitting, ownership of land, the need to coordinate design decisions with the local authorities of the territorial entities of the Kyiv region, adjacent to the borders of Kyiv.

All this has led to an understanding of the need to develop a new master plan, taking into account the current socio-economic conditions of the city. Already in 2010, by the decision of the Kyiv City Council [11, 12], the Concept of Strategic Development of the City of Kyiv (the first stage of development of the Master Plan for the Development of the City of Kyiv and its Suburban Area by 2025) was approved.

The next step was the drafting of a new Master Plan for the development of Kyiv and its suburban area by 2025. According to the project, the predicted population of Kyiv is expected to grow to 3.14 million people, and the area remains at 83.6 thousand hectares.

The spatial organization is subordinated to the idea of forming a compact city with maximum use of existing territorial resources within the existing limits. The Master Plan is currently being approved and approved.

Summarizing the historical and geographical aspects of the evolution of Kyiv's spatial organization over the past 120 years, it can be stated that none of the six master plans of this period has been fulfilled. The reasons in different years were political (wars, revolutions, changes in the political structure of the country, the administrative status of the city), socio-economic (change in the level of income and social benchmarks, economic crises, change of ownership of land) and technogenic (Chornobyl disaster) cataclysms.

The spatial organization evolved from linear west-east, through compact and radial to linear north-south, and again to compact.

For the period after the end of active hostilities in the early twentieth century, the average duration of the master plans is 18 years.

B) **Socio-demographic aspects.**

In urban planning the population becomes the basic characteristic of any planning formation at all territorial levels - from a separate object (number of residents), block, neighborhood, district (residential, rural, industrial - number of employees, recreational - number of resting people) to the settlement, administrative district, region and country [13, 14]. Having determined the estimated population using the standards the needs defined for all types of resources, primarily territorial ones, for the functioning and development of urban development objects.

One of the key factors that influence the accuracy of city development forecasting is the determination of population estimates. In spite of the presence of numerous methods, demographic forecasting [15, 16], determining the perspective population is a very difficult task. The number of factors affecting this value is very numerous, diverse and labile [17], which makes it difficult to obtain accurate forecasts.

This is confirmed by the analysis of the existing master plans of Kyiv of the 20-21 centuries. Let' consider the actual and predicted dynamics, in accordance with the general plans, population size (see Fig. 3).

According to the census of 1897, the number of Kyiv residents was 247.7 thousand people. According to the most recent 2001 census, there were 2,611.3 thousand people, and according to the official statistics of the Main Department of Statistics in Kyiv as of June 1, 2019, the number of permanent population reached 2,911.9 thousand people, that is, it increased approximately 12 times, adding on average a quarter of one million inhabitants every ten years.

In fact, growth rates have not been the same throughout the period. They reached their maximum values from 1945 to 1980. Also, the transfer of administrative functions to the capital of the Ukrainian SSR in 1934 and the implementation of the plan of industrial development of the country contributed to population growth.

The maximum population decline is related to the period of occupation of Kyiv during the Second World War - 1941-1943 (from 846.7

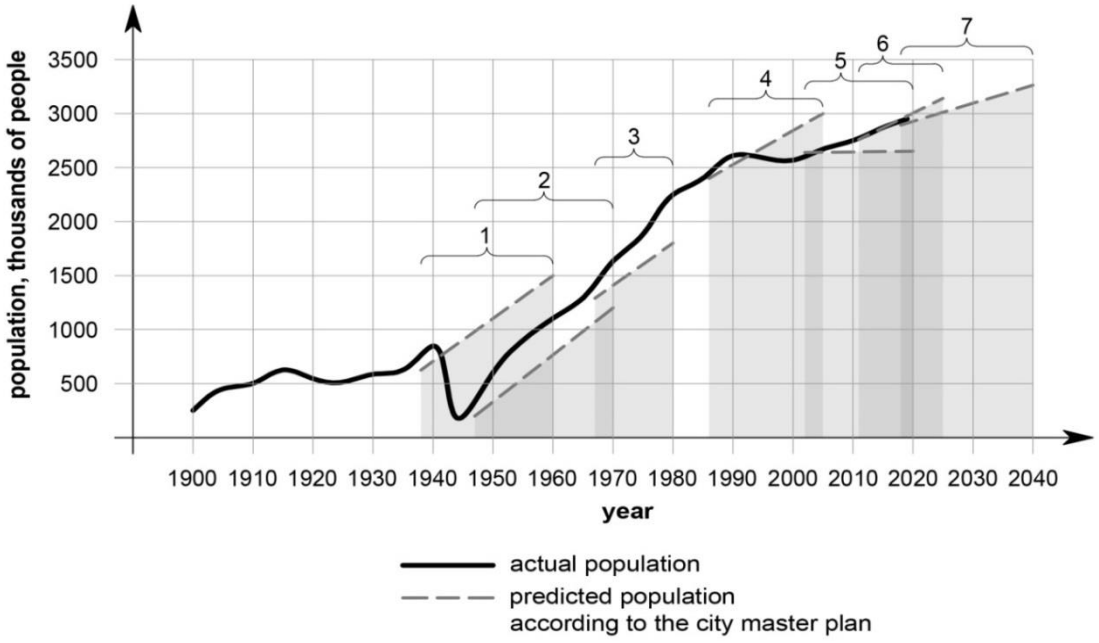

Fig. 3. Dynamics of actual and predicted population of Kyiv.
(1. Master Plan 1938, 2. Master Plan 1947, 3. Master Plan 1966, 4. Master Plan 1986, 5. Plan 2002, 6. Strategic Development Concept 2010, 7 draft Master Plan 2015)

thousand to approximately 180.0 thousand people) [18]. The decline also occurred during the First World War and Civil War.

The last decade of the twentieth century was marked by the stabilization of the population at about 2.6 million, and only at the beginning of the twenty-first century Kyiv's population is gradually increasing.

This is connected, first of all, with the attraction of the population to the largest city in search of work in connection with the negative economic situation in the country and migration of the population from the eastern regions (Donetsk and Lugansk) and the Autonomous Republic of Crimea caused by the "hybrid" war

If we analyze the accuracy of the prognostication for the future population according to the master plans (see Fig. 3) and its actual change, we can draw the following conclusions.

No calculations of the predicted population were justified. According to the master plans of 1938 and 1986, the estimated population was 350,000 people higher from the actual. And, according to the master plans of 1947 and 1966, around 400-430 thousand less than predicted. The master plan of 2002 had an error of about 200 thousand people.

Unfortunately, since the census has not been conducted for eighteen years, we do not know the exact figure. Thus, the predicted value of the population under the project of the new master plan is more likely to be incorrect.

C) **Legislative and regulatory aspects.**

The questions concerning methodology for predicting the spatial development of urban systems are constantly being the subject of research on urban planners [19, 20, 21, 22, etc.].

The huge theoretical and practical achievements found its concentrated expression in the legislative and regulatory framework for the development of draft master plans for settlements.

The key legislative and regulatory documents that regulate these issues include:

1) On Regulation of Urban Planning Activity (Law of Ukraine No. 3038-VI of February 17, 2011);
2) DBN B.1.1-15:2012. Composition and content of the master plan of the settlement;
3) DBN B.2.2-12:2019. Planning and development of territories;
4) DSP 173-96. State sanitary rules for planning and construction of settlements;
5) DBN B.2.2-3:2012. Composition and content of the historical and architectural reference plan of the settlement.

The first Soviet regulatory document governing the planning of settlements was "Temporary rules and regulations for the design and construction of buildings and structures" (PIN 1929). These "Rules ..." were abolished and replaced by "Rules and norms for urban development, design and construction of buildings and structures" (PIN 1930). In 1958, they were replaced by the "Rules and norms of planning and urban development" (SN 41-58). The following regulatory documents on steel design - SNIP II-K.2-62, SNIP II-60-75, SNIP 2.07.01-89, DBN 360-92. And since October 1, 2019, the new DBN B.2.2-12:2019 "Planning and development of territories" comes into force.

In the last decades of the Soviet period, the main document was the instruction of BSN 38-82 "Instruction on the composition, procedure for development, coordination, approval of schemes and projects of district planning, planning and development of cities, towns and rural settlements". According to this instruction, the master plan was to be developed for a design period of 20 years, with the allocation of the first stage of construction.

As mentioned above, according to the Law of Ukraine "On Regulation of Urban Planning Activity" and DBN B.1.1-15:2012, the validity period of the general plan of the settlement is not limited and during the determination of the main technical and economic indicators the stage 1 should be allocated (15–20 years).

This “temporary” unlimitedness has caused numerous problems in the process of approval of the last master plan of Kyiv (project of 2015), since there was a discussion about the

legitimacy of developing a new master plan despite the fact that the validity of the previous master plan is “not limited” and, accordingly, it is valid.

However, as the analysis of the master plans of the Soviet and modern periods practice implementation shows, the necessity of developing a new master plan, first of all, is determined by the peculiarities of the socio-political and socio-economic reality of the city's existence. Even with the pre-determined need to develop a master plan every 20-25 years (VSN 38-82), the actual development period was shorter – 17-18 years, reaching 9-10 years during periods of tumultuous crisis.

The factors (circumstances) that caused fundamental changes in the conditions of existence of both the city of Kyiv (in particular, the dynamics of its population, see Fig. 4), and the country as a whole can be attributed to:

A. *negative (those that slow down the development of the city):*
   - World War I, 1914-1918;
   - the Revolution of 1917;
   - the Civil War, 1918-1922;
   - World War II (Great Patriotic War), 1941-1945;
   - Chornobyl technogenic disaster, 1986;
   - collapse of the USSR with the subsequent economic crisis, 1991;
   - World Economic Crisis, 2008

B. *positive (those that stimulate urban development):*
   - the country industrialization plan implementation with the development of industrial base of the city, beginning – 1929.
   - transfer of capital from Kharkiv to Kyiv, 1934;
   - the program of reconstruction of the destroyed city after the Second World War, 1946;
   - implementation of the program of mass housing construction ("khrushchevka"), 1957
   - short-term economic growth of the period of independent Ukraine, 1998-2006;
   - stimulation of housing construction due to internal migration of the population to the capital as a result of the military conflict in Donbas, 2014

Frequency of occurrence of negative (unpredictable) influencers on the development of the city of Kyiv for the period under consideration is approximately 17 years, which con-

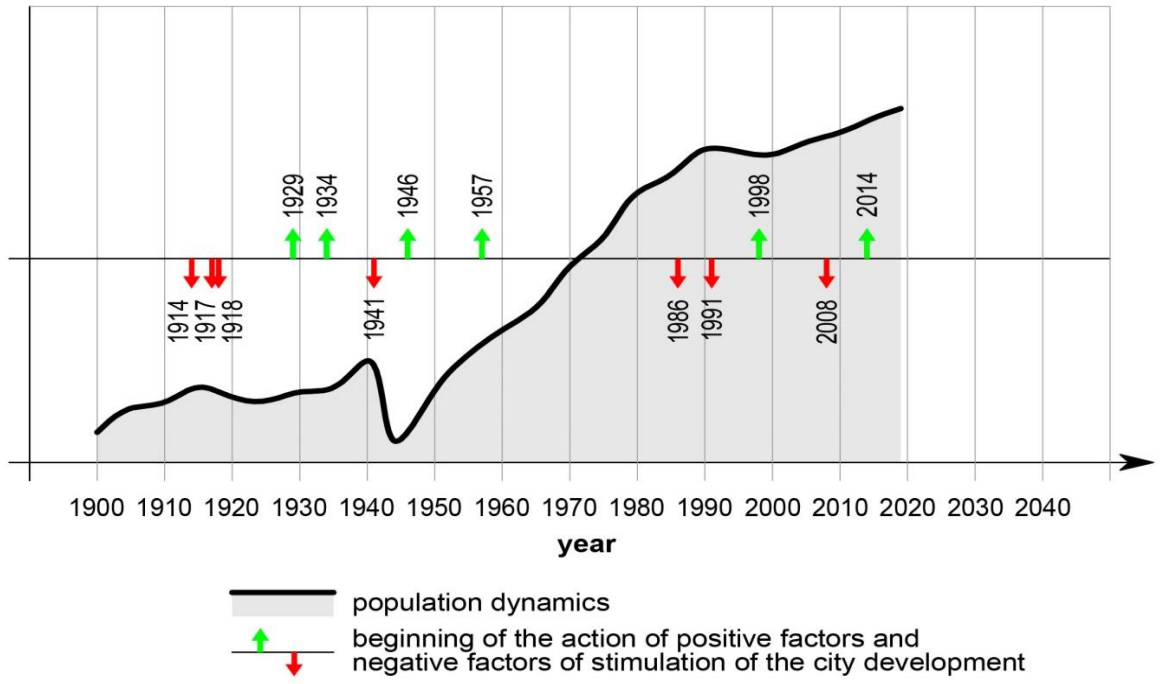

Fig. 4. Impact of positive and negative factors on the dynamics of the actual population of Kyiv

firms the doubt of determining the validity of the city master plan as unlimited. To the same extent, this also applies to other settlements, since negative factors of influence are common to the whole country. Regarding the frequency of changes in the basic normative documents on urban planning, it is also possible to note some correlation with fundamental political and socio-economic changes in the life of the country. For example:

- the introduction of temporary (PIN 1929) and subsequently permanent (PIN 1930) came after the realization of the need to move from agricultural orientation to industrialization of the country. In 1927, the 15th Congress of the CPSU (b) adopted the "Directives for the drafting of the first five-year plan for the development of the economy of the USSR."

- SN 41-58 are adopted after the approval of the programs of mass housing construction (the so-called modern "Khrushchevka") in 1957.

- DBN 360-92 came into force after Ukraine gained independence (1991) and drastically changed political and socio-economic orientations.

Unfortunately, the latest DBN B.2.2-12:2019, which should meet the current global trends and challenges of urban environment formation in the conditions of neo-economy and spread of innovative technologies, remained ideologically "Soviet".

CONCLUSIONS AND RECOMMENDATIONS

The study made it possible to formulate the following results:

A. No Master Plan of the city of Kyiv has ever been implemented. It is connected with the political, ideological, socio-economic conditions of the society's development, as well as the consequences of the biggest technogenic disaster – the Chornobyl accident.

B. The statutory requirement for an unlimited duration of the master plan requires adjustment. The most rational is the term 20-25 years. And, given the speed of change in the world's scientific, technical and socio-economic factors influencing people's awareness of urban comfort environment, it should be no more than 15-20 years.

C. Transformation of the spatial organization model of the territory of the city of Kyiv took place cyclically – from dispersed in the pre-Soviet period, then linear west-east, through compact and radial-circular, to linear north-south, and again to compact.

D. The population dynamics of the city are directly linked to both positive and negative influences and are extremely difficult to predict. Not even once during the study period (120 years) was an accurate demographic prognosis possible. The fallacy ranged from 200,000 to 450,000 people in both directions.

Summarizing the above mentioned, it can be said that, before approving the draft new Master Plan for the City of Kyiv (commencement of 2015), a census should be conducted and the actual indicators of the socio-demographic structure of the city's population should be determined.

Now the main thing. In our opinion, taking into account the current socio-economic factors, the actual state of deterioration of fixed assets, objects and networks of engineering and transport infrastructure of the city, the fundamental idea of the new Master Plan should not be the development of new territories, but a **cardinal complex reconstruction of the city of Kyiv.**

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Генеральный план города: проблемы методологии прогнозирования (на примере генеральных планов г. Киева)

Алла Плешкановская

Аннотация. В статье освещены результаты анализа теории и практики прогнозирования перспектив пространственного развития крупного города (на примере генеральных планов города Киева).

На базе ретроспективного анализа охарактеризованы периоды разработки генеральных планов Киева – допланировочный, период вхождения в состав Российской империи, советский и современный [1].

Исследование выполнено в разрезе трех ключевых групп факторов, входящих в состав методологической базы разработки градостроительной документации местного уровня – генеральных планов населенных пунктов. А именно – историко-географические, социально-демографические и законодательно-нормативные аспекты влияния на прогнозирование пространственного развития города.

Подробно рассмотрены генеральные планы Киева периода XX-XXI века и установлены этапы трансформации пространственной организации территории Киева. Концептуальные идеи эволюционировали от линейной в направлении запад-восток к линейной в направлении север-юг, от рассредоточенной до компактной.

Проанализировано соответствие динамики фактической и прогнозируемой численности населения Киева с учетом политические и социально-экономические особенности того или иного периода развития общества.

Сделан вывод о чрезвычайной сложности прогнозирования перспектив развития крупнейшего города. Рассмотрены причины (неточность демографических прогнозов, контринтуитивность развития сложной градостроительной системы, несовершенство законодательно-нормативной базы) невозможности полной реализации генеральных планов населенных пунктов, в частности, города Киева.

Приведены рекомендации по совершенствованию нормативно-правовой базы разработки генеральных планов населенных пунктов. Сформулировано авторское видение перспективных направлений пространственной организации территории города Киева, в составе проекта генерального плана, который сейчас разрабатывается.

Ключевые слова. Генеральный план, пространственное развитие, численность населения, демографический прогноз.

Urban Planning Aspects of Ecological and Urban Planning Regulation Fundamentals for Main Street and Road Network Functioning and Forward Development

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Received on 20.05.2019, accepted after revision on 10.06.2019
https://doi.org/10.31493/uwt1921.0202

Abstract. The greatest influence of motor vehicles is manifested in the urbanized environment. The city is an indicator of sustainable development or an unfavourable relationship between motor vehicles and the urban environment. The study is based on an assessment of the impact of the vehicles current state on the street and road network and trunk road adjacent areas to substantiate the adopted planning protective measures and to determine the functional purpose of the trunk road adjacent areas proceeding from environmental impact on street and road networks. Anthropogenic air pollution sources are primarily represented by industrial enterprises and vehicles emissions.

The main task in determining the assessment of the effectiveness of the protective solutions of trunk road adjacent areas is the correct choice of assessment criteria, according to which the efficiency of solutions will differ. Since the street and road network with all its traffic flows is an integral structural element of the city, its impact on the environmental performance of the urban environment can undoubtedly be called the prevailing one.

It is necessary to highlight noise, airborne emissions and air (atmosphere) pollution among the main environmental impacts, the source of which is the functioning of the street and road network. Since the street and road system is the main tool in wastewater collection and disposal, it also has a direct impact on the ecological condition of hydrosphere objects, i.e. groundwater, springs, water bodies. Its environmental impacts on the urban setting's lithosphere are also evident: road surface contamination, lubricant residues and gasoline pollute the soil during the removal of rain and melt wastewater. It is impossible to rule out the harmful effects of electromagnetic loads from rail vehicle operation. According to the State Statistics Service of Ukraine, the quality of atmospheric air in a modern developed city is primarily dependent on the volume of pollutant emissions, the two main sources of pollution being stationary 15…30% and mobile 70…85% (using Kyiv's example).

Key words: ecological state of urban environment, trunk road adjacent area, environmental impact.

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PROBLEM STATEMENT

The purpose of this work is to explore the issues relating to the coordination of area development regulation and management processes that require research and unity of urban planning and ecological systems based on fundamental laws that are invariable and the violation of which leads to negative effects.

The development of methodological bases for regulating the functioning and development processes of the main street and road network in environmental and urban planning should be based on a comprehensive, problem-

oriented approach and interdisciplinary approaches used in research to solve many of our time's problems. The basics of the formation of the ecological and urban planning regulation need to be searched through the development of the metropolitan setting for the scientific substantiation of the functioning and development of regulatory urban planning codes and standards.

The following research tasks are identified in accordance with the objective:

- to analyse the existing ecological and city planning models of the urban environment;
- to develop a modern model of the ecological and urban planning setting;
- to investigate the main factors of impacts and potential of pollution of the urban setting ecological system;
- to explore the impact of vehicles on the ecological state of the urban setting;
- to identify methods for reducing environmental impacts on a trunk road adjacent area;
- a model of the effectiveness of the ecological and urban planning regulation of the functioning and development of trunk road adjacent areas has been proposed to assess and predict the environmental impacts on a trunk road adjacent area.

To achieve this goal, appropriate methods were used: a systematic approach, modelling methods, analytical methods, field studies, experimental design methods, mathematical methods, graphical-analytical methods of material systematization and presentation, as well as the principles and provisions of the general system theory, system and comparative analysis.

RECENT RESEARCH AND PUBLICATIONS ANALYSIS

The relevance of this research topic is indicated by the analysis of scientific works and urban development codes and standards in effect. This research topic is the subject of research by renowned scientists such as:

- V.I. Nudelman, M.M. Domin, Ye.Ye. Kliushnichenko, H.I. Lavryk, M.M. Habrel, Yu.M. Bilokon, I.O. Fomin, M.M. Kushnirenko, A.P. Ositnianko, O.I. Synhaivska, A.M. Pleshkanovska, H.Y. Filvarov in urban and territorial planning issues;
- B.V. Solukha, M.M. Osietrin, Ye.O. Rejtsin, D.S. Samoilova, V.I. Huk, T.O. Shilova, M.S. Fishelson, M.S. Murza, A.Ya. Tulaieva, H.L. Karaban, Z.I. Aleksandrovska, Yu.L. Shevchenko, V.S. Weinberg, I.B. Solukha, O.S. Furmanenko, I.I. Ustinova etc. in theoretical and scientific-methodical system studies in the aspect of transport and ecological problems.

STATEMENT OF BASIC MATERIAL

Environmental pollution is a complex process with different structural features and action parameters to generate different environmental impacts. The information model has been plotted with the classification of the pollution structure in the urban setting for the study of ecological and urban planning processes (Fig.1). According to this model, pollution impacts in the urban environment are classified by the following features:

- pollution sources;
- impact assessment;
- occurrence rate;
- exposure duration;
- pollution components;
- the parameters of effect on the urban environment;
- labour-intensive measures taken to eliminate pollution effects;
- complexity of such events' organization;
- external factors’ effects.

In turn, two types of origin were proposed to distinguish pollution sources in the urban environment: communication and area-specific (Fig.2).

Communication pollution sources which are the facilities of the city’s street and road network, should include all traffic flows, vehicles and mechanisms. Area-specific pollution sources are separate functional areas of the city (industrial, municipal, commercial). According to the impact assessment, pollution is divided into ultimately hazardous, highly hazardous, moderately hazardous, acceptable and safe.

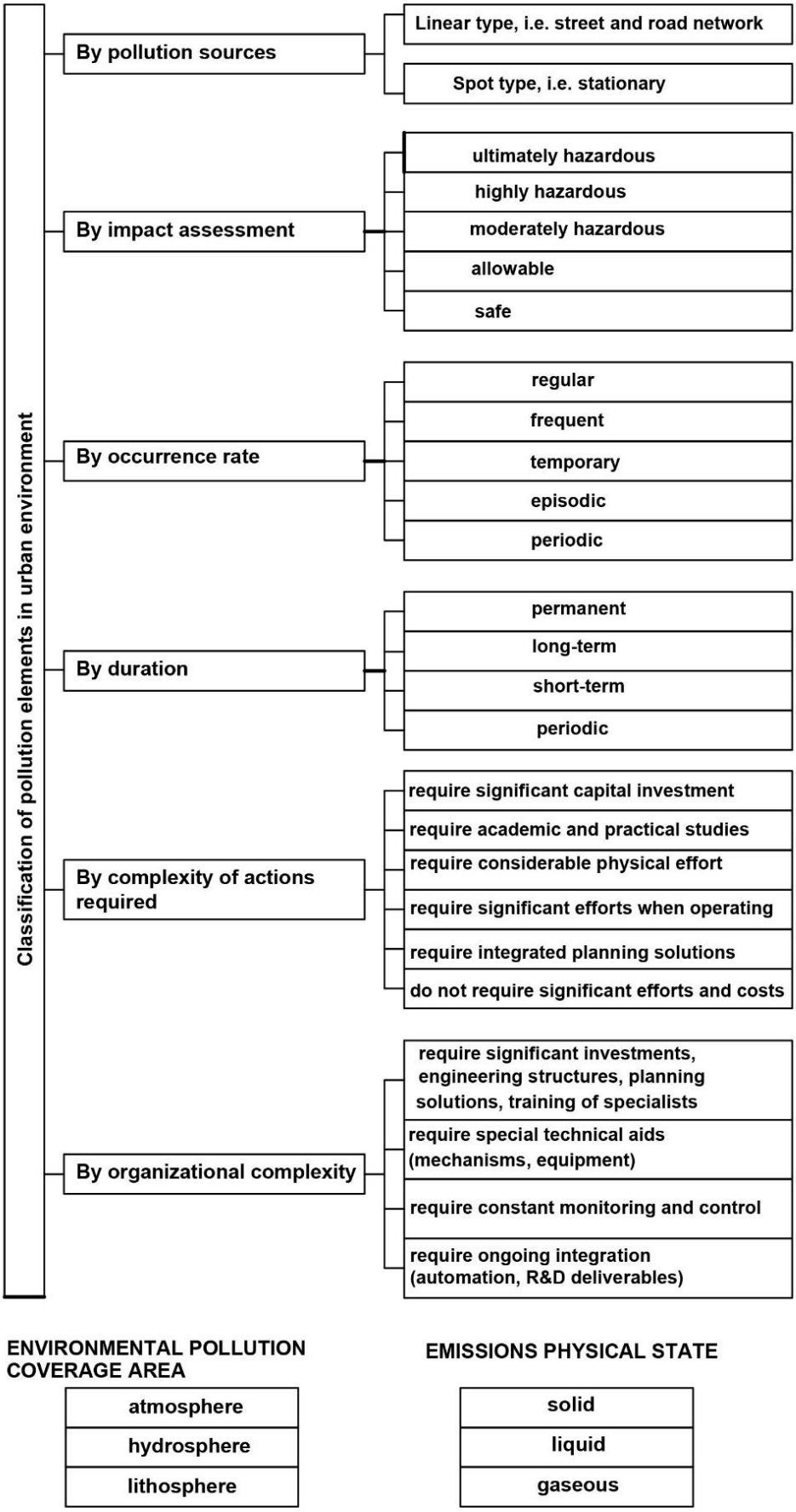

Fig. 1. Classification of pollution elements in the urban environment

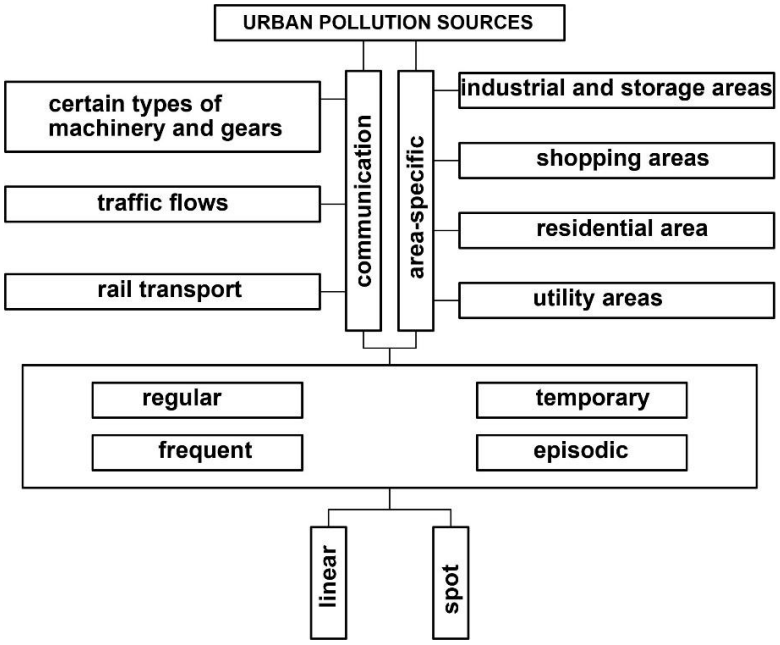

Fig. 2. Block diagram of the classification of urban pollution sources

The results of the completed study allow us to formulate the consequences of pollution impacts on the urban environment:

- environmental pollution is a process of undesirable material costs, energy, labour, means and funds that people invest in the construction and planning of the area, which in turn become the irrecoverable waste that pollutes the urban environment;
- pollution results in irreversible damage to both individual ecological systems and the biosphere as a whole, including the impact on global physical and chemical parameters of the environment;
- fertile land is lost, ecological system the entire biosphere productivity are decreased as a result of pollution;
- pollution directly or indirectly leads to deterioration of physical and moral state of a person as the main production link of a society.

The developed information models indicate the complexity of the processes occurring in the planning structure of the city.

Formalized multistage representation of the object of study of the main street and road network allows to understand clearly the process of formation of certain environmental loads, their physical and chemical condition, and indicates the management methods to reduce environmental impacts on an area in question.

In general, it is possible to work out a matrix of factors influencing the environmental impact on the street and road network based on the completed studies and the system-structural analysis (Fig.3).

It is necessary to distinguish noise and gas air pollution in the atmosphere among the main

the functioning of a street and road network. Since the street and road system is the main tool in wastewater collection and disposal, it also directly affects the ecological state of hydrosphere objects, i.e. groundwater, water sources, and water bodies. Its environmental impact on the urban lithosphere is also evident: contaminated road surface, remains of lubricants and gasoline pollute the soil during the removal of rain and melt wastewater.

The need to develop a set of methods for managing and developing the ecological condition of urban environment is proven by analysing modern data on emissions from motor vehicles. It is also evident that as a result of the city's main concentration of traffic flows, the main street and road network areas are under the major influence. The degree of at-

mospheric

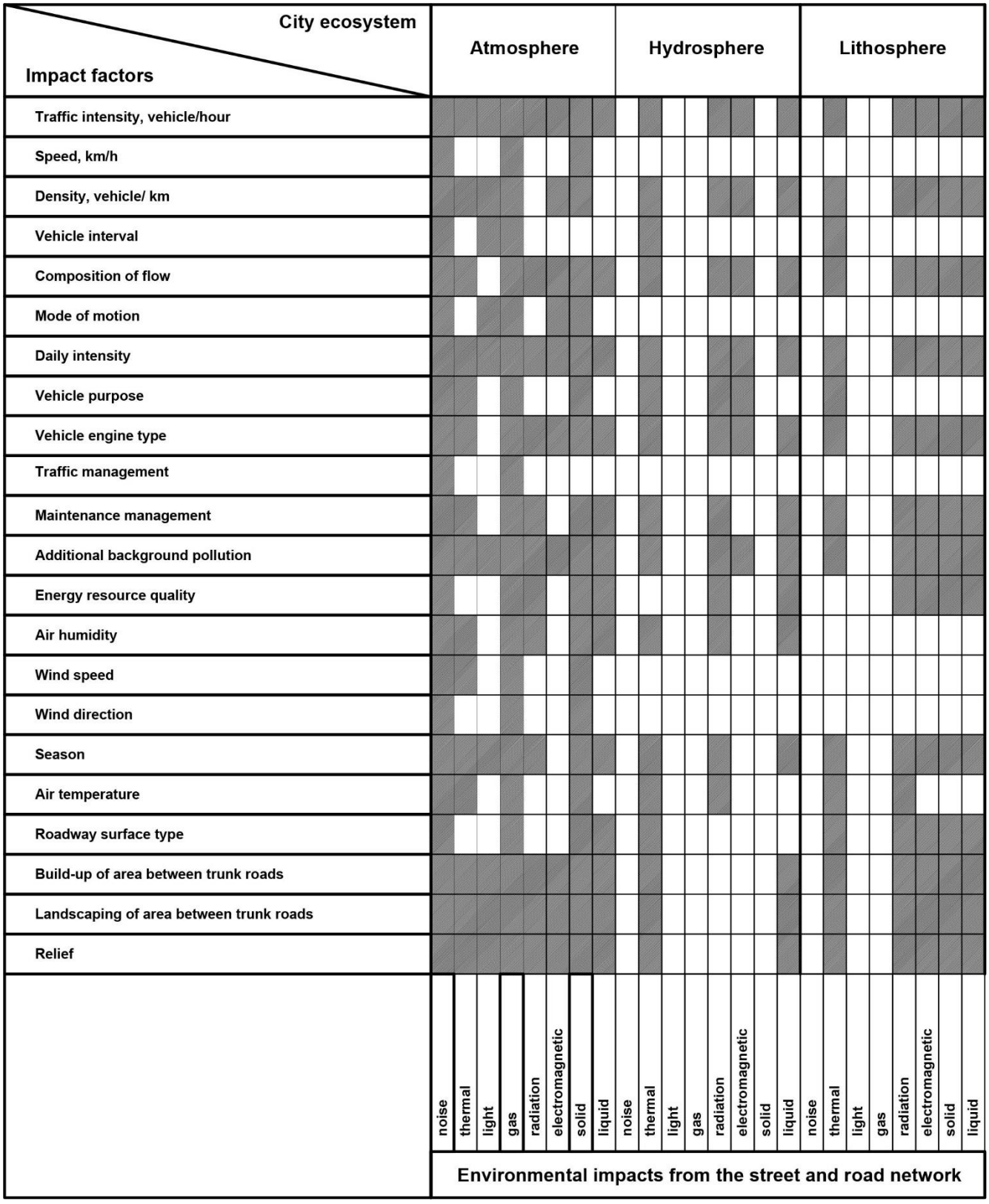

Fig. 3. The matrix of factors influencing the environmental impacts on a street and road network

air pollution caused by vehicle emissions in local areas depends on the possibility of transferring pollutants, their level of chemical activity, meteorological distribution conditions in the area, and underlying surface characteristics. Numerous chemical reactions with different reaction rates, time of existence of all the substances involved, different dependencies of turbulent diffusion coefficients on the properties of the underlying surfaces, and certain hydrometeorological processes may occur in a limited space. The complexity of reliable modelling of automotive emission processes spread in the atmosphere therefore arises.

The approach that has been researched and proposed before for determining the EPI (ecological planning indicator) with its multifactorial content (value), on the determination of the elements and factors of influence on its action potential, will lead to the possible use of this EPI indicator by experts as an indicator of compliance of existing planning and design solutions with the regulatory planning support of the area, identifying environmental damage cases due to their direct effect, the investment volume to reduce the extent of environmental impacts, which in turn will affect the value of land and its functional efficient use. To evaluate the planning solutions enacted and the measures to reduce the EPI indicator, a model was proposed to streamline the use of trunk road adjacent areas, streamline the engineering solutions enacted, appropriately take into account a deterrent factor in countering the potential environmental impact, and determine the optimum protective measures for the area in the form of an optimum efficiency indicator formula:

$$Eopt = EPI\,(Rm;\ Nn) \qquad (1)$$

provided that $Rm \rightarrow \max$; $N \rightarrow \min Nn$,

where *Eopt* is the optimum quality of protective measures; *EPI* is the ecological planning indicator; *Rm* is the coverage of civil construction protective measures; *Nn* is the set of types of civil construction protective measures.

The calculation of the minimum impact on the area, which allows the use of *Nn*-type protective measures, is given by the method of inverse action potential of the selected optimum protective measure to counteract the spread of environmental impact.

The studies that have been completed for the spatial arrangement of trunk road adjacent areas allow us to highlight a number of features:

- a differential approach to urban areas protection methods;
- area spatial planning optimization;
- functional and applying the trunk road adjacent areas;
- optimization of site preparation during planning and construction;
- a differential approach in the city's street and road network routing.

As a result of the research conducted and the developed scientifically based models, a system of interrelated criteria and factors influencing the formation of the urban area has been created as a set of methods for plotting the Ecological and Urban Planning Regulation Fundamentals for the functioning and forward development processes of the main street and road network (Fig.4).

The creation of the city's ecological framework should therefore take into consideration all the components of planning solutions, reflecting an effective scientific and technical justification for implementing and resolving the relevant challenges within the urban planning sector, one of which is creating a population-friendly (proper quality) environment and maintaining its continued effective upgrades.

CONCLUSIONS

Using the experience of theoretical and practical advances in urban and spatial planning the models have been developed in the study to ensure the effectiveness of regulating the ecological and urban planning status of adjacent areas of trunk road adjacent areas. A model of providing the Ecological and Urban Planning Regulation Fundamentals for the functioning and forward development processes of the main street and road network, taking into consideration the environmental impacts and forecasts, has been de-

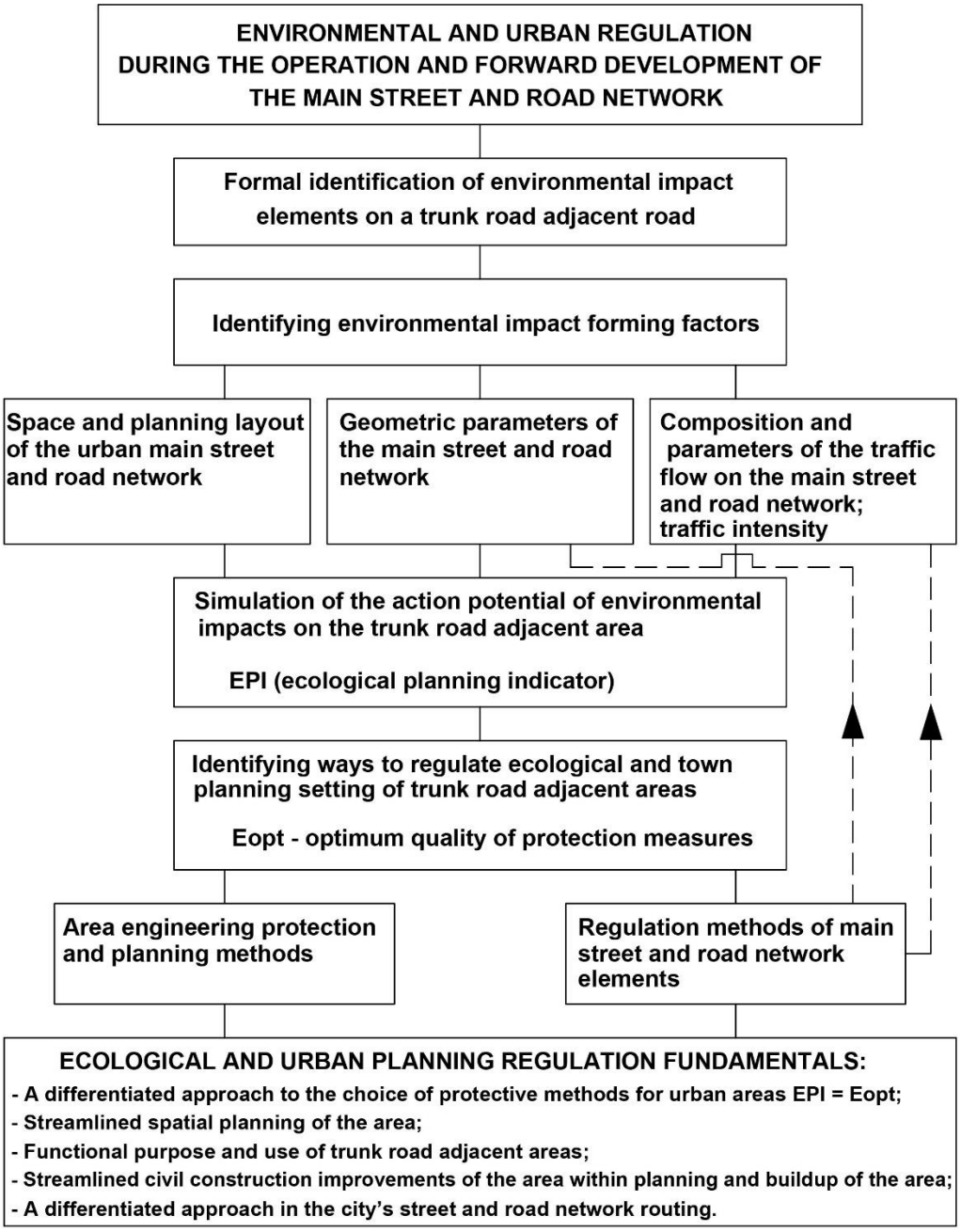

Fig.4. A model of providing the Ecological and Urban Planning Regulation Fundamentals for the functioning and forward development processes of the main street and road network

veloped based on the planning solutions enacted, with the functional purpose of the area and the choice of civil construction protective measures for the area pointed out.

Studies of the trunk road adjacent areas, taking into account the ecological and urban planning aspect, will ensure the viability of their further functional use, the formation of the city's main motor transport corridors in the context of the development of new infrastructure and the reconstruction of the city's main road and road network, and identifying the economic efficiency of urban planning design solutions.

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Градостроительные аспекты обеспечения оснований эколого-градостроительного регулирования процессов функционирования и развития магистральной улично-дорожной сети

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Аннотация. Рассмотрены основные проблемы, связанные с исследованием и разработкой методологических основ эколого-градостроительного регулирования процессов функционирования и развития магистральной улично-дорожной сети под влиянием экологических нагрузок.

В наибольшей степени влияние автотранспорта имеет проявление в урбанизированной среде. Город является индикатором устойчивого развития или неблагоприятной взаимосвязи автотранспорта и урбанизированной среды. В основу исследования положена оценка влияния современного состояния автотранспорта на улично-дорожную сеть и на примагистральную территорию для обоснования принятых планировочных мер защиты, определения функционального назначения примагистральных территорий в соответствии с экологическими нагрузками, которые возникают на улично-дорожной сети. Техногенные источники загрязнения атмосферного воздуха представлены, главным образом, выбросами промышленных предприятий и автотранспорта.

Главной задачей в определении оценки эффективности планировочных решений защиты примагистральных территорий является правильный выбор критериев оценки, согласно которым эффективность решений будет отличаться. Поскольку улично-дорожная сеть со всеми ее транспортными потоками является неотъемлемым структурным элементом города, ее влияние на экологические показатели городской среды бесспорно можно считать доминирующим.

Ключевые слова: экологическое состояние городской среды, магистральные территории, экологические нагрузки.

Transformation concept "Information technologies" in modern scientific discourse

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Received 27.04.2019, accepted after revision 10.06.2019
https://doi.org/10.31493/tit1921.0301

Abstract. The purpose of the study is to reveal the objective transformations that have occurred in information technology. Conceptualization of these transformations is also important. System, information, network and cognitive approaches allow to reveal the main aspects of the development of information technologies - technical and technological, software and hardware, network, communication, cognitive. The article considers the evolution of information technology. The relationship of information technology with its increasing role and importance of information in the life of man and society is analyzed. Information technologies are disclosed as technologies to create, store, record and process information. Technical and technological direction of information technology development is analyzed. The connection of the information technology concept transformation and development of the information society theory, in particular, the theory of post-industrial society, information society, network society, knowledge society and the digital world is revealed. The connection of the information technology concept transformation and the emergence of the media civilization and global information space is also revealed.

The article shows that the development of information technology is an important factor in the development of the information society. Technology transition (the electronic computer as a machine) to the modern stage of development of digital technologies is characterized by the formation of a single technical and technological basis for the formation of the information society.

The classification of information technology according to its application scope is proposed. Information and communication technologies characterize subject-to-subject interactions, among which pedagogical and political technologies are primarily distinguished. Information space is separate area of information technology application. Information processing technologies in the information space are the basis of modern democratic discourse. An important area of information technology is the information sphere. Information sphere is the sphere of information activity, information exchange and information relations, the regulator of which is the information law. Information security technologies ensure the protection of human rights, society and the state in obtaining objective information. Cybersecurity technologies protect critical infrastructure. The technologies of reality – virtual, cognitive, and augmented – provide the ability of a person's consciousness and thinking to process and create new information.

Identifying the social significance of the technical and technological development of information technologies becomes the basis of recommendations for the implementation of a strategies for the formation of the information society in Ukraine.

Keywords: information technologies, information and communication technologies, network technologies, digital technologies.

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The study of the information technology concept transformation is urgent due to the growing role of information processing for public institutions and the state. Despite the fact that information technology is widely spread as a term, there are no studies on the evolution of the content of its concept. Identification of the information technology genesis characterizes modern scientific and technological progress. Changes in information technology produce significant changes in the development of man and society. The development of the theories of the information society cannot be considered as a complete reflection of the changes occurring in the information technology itself, as well as the changes that are caused by the emergence of new information technologies. That is why the development of information technology is a separate object that has self-sufficient significance.

The purpose of the study is to reveal the objective transformations that have occurred in information technology. Conceptualization of these transformations is also important. Achieving the goal involves the implementation of the following tasks:

- identify the main stages of information technology development;
- study the diversity of information technology;
- find out the impact of the main theories and concepts of the information society on the formation of conceptual differences in the definition of information technology.

The novelty of the research lies in the study of the information technology concept with its initial manifestations and the disclosure of computer technology to the conceptualization of modern network technologies, cybersecurity, and digital technologies.

The concept of information is an important prerequisite for the emergence of the concept of information technology. Today, a retrospective view of information revolutions as the development of information technologies, beginning with the advent of writing [8], is based on the fact that information exists and has been used for a very long time. However, the conceptualization of the concept of information occurs in the context of the historical background of electronic computing equipment emergence. According to K.Shannon, the concept of information is characterized by “overcoming uncertainty” [13, p.162] in the process of choosing and making decisions in the case of some priori knowledge. K. Shannon introduces an idealization that characterizes an equal probability to choose between two possible options. Information functions as a special non-material resource that decision-making efficiency depends on.

A.Turing introduces a combinatorial approach and the calculation of combinations [11, p.320]. Turing machine was created as a combination of mechanisms. But for the first time the connection of mechanisms was intended for information processing. All previous machines turned various forms of energy into mechanical motion. The theory of mechanisms and machines arises as a consequence of the theorization of transformations that occur in mechanical systems. A.Turing creates a mathematical model of data processing [30]. The mechanical design of Turing machine becomes the embodiment of a combinatorial computational approach. The most sophisticated combinations that it creates become the embodiment of pure information.

First, the concept of "electronic computer" arises. The electronic computer considered to be a machine. And only today it is becoming increasingly clear that information technologies are opening up new worlds – virtual reality, the information sphere, the information space and cyberspace. Arpanet was the first to interlink computers. Network technologies appear as communication, messaging and communication development technologies.

The origin of communication is associated with the advent of TV-technologies. Television appears as a global data transmission system. M.McLuhan [16] considers the television to be some probe that covers the whole earth. The media civilization is born. The concept of hyper reality contributes to the birth of a media civilization as well. The emergence of hyper reality [3, p.80; 9, p.34] characterizes the doubling of society: alongside with real social processes, the world of simulacra emerges, which substitute real objects, events and inter-

actions between them. Simulacra's are capable of causing feelings. Hyper reality is transformed into a special arena, where the real world appears in a special, sometimes bizarre and illusory form.

The emergence of post-industrialism contributes to the emergence of the theory of the information society. The information society acts as a society where preference is given to the service sector and knowledge production [1, p. 198]. Industrial technologies are being replaced by intelligent technologies. The concept of intellectual technology is introduced by D. Bell [2, pp. X-XI, XIV, XV-XVII]. Intellectual technology combines both scientific activity (mathematical modeling) and computer's operation. This is a combination of scientific knowledge, scientific methods and electronic computing equipment.

The study of the framework of the information society is trying to overcome technological determinism – the idea that machinery as a technology generates a new type of society. The Information Society acts as a society of the Third Wave (A. Toffler) [29] and electronic-digital society (D. Tapscott) [28, p.33-34]. This is the society in which the processing of symbolic information, rather than the processing of the substance of nature, comes first. This brings to the fore a special type of labor – the processing of signs and symbols (A. Toffler) [29]. Later post-industrialism gives preference to intangible factors of the development.

The concept of information technology are associated with the theory of information society (Y. Hayashi, Y. Masuda) [15]. The study of information technology evolution enables to reveal the transition from abstract consideration of information technology as technology of processing, fixing and storing information to the disclosure of specific information technologies in various spheres of social activity. The development of information technology contributes to the introduction of the concept of the information society. The information society appears as an e-society, which doubles the information and transforms it into an electronic version (A. Shevchuk, A. Golobutsky) [26, p.93]. However, the information society appears as a society that relies on information processing. At the same time, the different nature of information – media and information related to the development of computer technology – is not taken into account. This makes it possible for a long time ignore the importance of the technical and technological direction of development of information technology.

Since the early nineties of the twentieth century, internet technologies have begun to actively develop. Information technologies are starting to be revealed not only as communication technologies. Increasingly, they are emerging as technologies of cyberspace and information system development. Virtual space technologies are arising. The institutionalization of the social manifestations of the virtual space technologies is coming around. Virtual universities, e-business, e-banking, e-commerce are appearing. Sophisticated software and hardware systems are being created, databases and knowledge bases are emerging. Information technology is increasingly associated with the development of computer engineering, design and programming. The Okinawan Charter emphasizes the importance of bridging the digital divide [18, p.53-54]. The emergence of various models of the information society indicates the various forms and rates of development of countries to a higher state of technical and technological development.

The emergence of the theory of the network society (M. Castells, P. Drucker) contributes to the removal to the forefront of network technologies. Network technologies appear as communication technologies. In American research communication acts as a message transmission. There are various models of communication. The theory of network society, network technology covers all types of communications. A network of communication is appearing. The disclosure of network technology as information reveals the social significance of information technology [7, p.83-84]. Informationalism (M. Castells) [6, p.13] is a concept that characterizes a new social form of the information society. This society is a network society. The network so-

ciety took over the hierarchical society at the beginning of the 21st century [10]. But now we are talking about the technology of global and local networks. Social networks, Twitter, Facebook, as well as related social processes have come to the fore recently. Now the influence of these new network technologies on social processes, elections, the development of democracy, the emergence of Twitter is increasing.

Communication interactions are coming to the forefront and contribute to the introduction of the concept of information and communication technologies. For some time, IT (information technology) and ICT (information communication technology) have been regarded considered similarly . The digitization of information contributes to the emergence of the digital technology concept. The digital world [18, p.53-57] is becoming a worldview. Today, digital technologies characterize the modern development of information and communication technologies. In recent years, international conferences on digital technologies have been actively held. The emergence of digital technology expands the technical and technological basis of the information society. There doesn't exist any other base except a digital one. Telecommunication systems exist on a digital basis. The concept of information and communication technology is increasingly used in intersubjective and subject-to-subject interactions. Information and communication technologies emerge pedagogical and educational technologies, as well as political technologies. There is a need to understand the special social content of information that is broadcast, transmitted, created and reproduced in these technologies. There appears the concept of social information technology.

The study of the interaction of human consciousness and thinking and information processes expands the range of information technologies. Technologies of various types of realities appear – virtual, cognitive, augmented. The technology of virtual reality is revealed as a technology of generating reality in which training can be carried out. Virtual reality is also revealed as a new technology that combines the consciousness and actions of many people into a single whole. Virtualistics discovers new dimensions of virtual reality. This is primarily the process of visual information transmission through computer screens. This is also the emergence of a new virtual being of information, through which social connections are realized in the global network.

Introduced by A. Turing, combinatorial approach and calculation of combinations [30] can be considered as a prerequisite for the introduction of a computational approach and computer metaphor in cognitivism. Computer metaphor (Newell, Simon) [17] reproduces the unity of the operations of human thinking and the computer. The treatment of signs and symbols is displayed in the foreground. The “Chinese Room” [22, p.115-116] experiment shows that not only the person, but also the computer, which has no consciousness and understanding, performs actions on signs and symbols. Communication of the processing of signs and symbols with the execution of certain operations becomes important for programming. Symbolic information processing is brought to the fore. The hypothesis of the physical existence of symbols [14, p.804] becomes an important component of the substantiation of the objectivity of the existence of information processing processes. The application of these ideas contributed to the development of artificial intelligence.

The development of programming contributed to the emergence of complex software and hardware systems. Symbolic processing of information received its continuation in the development of programming languages. The introduction of complex software and hardware systems creates prerequisites for the development of information processing at multiple levels. Programs leap from the level of machine control to the levels of the architecture of software systems.

The development of information processing technology in the early nineties leads to the emergence of complex discrete technical systems, for which the struggle with complexity becomes important. Prerequisites to shift the sphere of software system designing to a qualitatively new level are arising. This is the level

of the research domain (G. Booch) [4, p.162]. It also creates the prerequisites to create software systems where the subject area is associated with social functionality [21, p. 84]. Multilevel information processing here is complemented by the introduction of software systems in various spheres of public life, as well as in business [21, p.85].

Technical and technological development of information technologies as technologies for creating, storing and processing information becomes decisive in the development of the information society and the main objective criterion and indicator of this development.

The development of cybernetic approach introduces the idea of control in systems of varying degrees of complexity. The cybernetic approach considers a feedback system.

The functionality revolution that took place in the second half of the nineties in the countries where the technical and technological development of information technology was brought to the fore, has contributed to the spread of information technology in all the spheres of public life.

The emergence of virtual and cognitive reality is one of the hallmarks of the nineties. The concept of cognitive reality technology was proposed by A. Zenkin [31, p.72-75]. Cognitive reality technology creates a new integrity, including the actions of man, his mind and human interaction with the computer. Technologies of augmented reality, which arise later, characterize the possibilities of including expert knowledge and various types of information (including graphic) directly into the process of human perceptual information processing. In conditions of extreme activity (military actions, rescue operations, etc.) such augmented information processing becomes crucial.

The emergence of manipulative and other technologies influencing human consciousness in the information space actualizes the issue of information security. Information technologies provide the possibility of obtaining objective information at all levels – from an individual to the society and state. The distribution of bots, fakes and bogus information stimulates the development of information technology to identify false and incomplete information.

Recent spread of cyberattacks and unauthorized interference in the process of information exchange necessitates the development of cyber security technologies. Cyber security technologies are aimed at protecting critical cyber structures. Critical cyber structure characterizes the growing importance of technologies that regulate and determine the quality of the information component of financial institutions, banks, law enforcement and government agencies and other systems.

The development of democracy in the modern global network world involves the use of Facebook, Twitter and other social networks as democratic institutions. The exchange of information in the process of communication acquires the value of the development of social emotions. This becomes the mechanism of communication of power and society. At the same time, this determines the independence of information processes from the government, which characterizes the ability of society to form its viewpoint. The development of e-government is becoming important.

The development of information technologies as communication technologies contributes to the emergence of new social institutional entities. These include the information sphere and information space. The information sphere becomes the sphere of information activity, which requires new information technologies, the institutionalization of information exchange, contributes to the development of information law. The information space brings the level of information processing to a qualitatively new level. This is the space where information products are created and function. Information product targeting to social processes is due to the impact on people's minds. There exists a complex multilevel influence on a person at verbal, emotional, psychological, conscious and unconscious levels.

The information space becomes a platform to form a democratic discourse. By drawing people of different convictions into its circle, the information space becomes a representative of public opinion and a tool for its for-

mation. Now digital technologies create a single basis for the development of modern society. The difference in technological basis, which has been stored for many years thanks to the preservation of analogue technologies in the field of television, has disappeared. However, even a single technological base of development does not yet create a basis for overcoming the difference between the technical and technological direction in the development of the information society and the direction that is associated with the development of civilization.

The attempt of the theory of post-industrial society to establish technological determinism as the basis of social development has not been realized. Technology itself does not produce social phenomena. But one cannot deny the influence of information technology and the development of information technology on the information society development. The society would never have experienced the structural and qualitative changes that we have witnessed for the past 30 years without the development of technical and technological direction of information technology. It is impossible to consider the state of the society and the functioning processes of all its social institutions disregarding the development of information technologies.

The emergence and approval of the information sphere, information space, critical cyber structure, national information infrastructure, e-government are also impossible without taking into account information technologies. Therefore, the desire to reduce the information society in hyper reality or media space today, in the context of globalization development, reasonably pulls the country back. This is a return to outdated technical and technological forms. It is also a substitution of the progressive development in all spheres of public life on the basis of advanced technologies for creating false reality and developing manipulative technologies that assert the political discourse.

Objectively, this contradicts the public strategy to develop the information society and knowledge society as the basis for the country's progressive development and democracy. However, overriding the digital divide and spreading digital technologies result in a country's growing competitiveness. Often digital technologies are restricted by things, personal communication, network communication. An objective indicator of competitiveness is then the development of information technologies in the field of economics and education, social and public administration, defense and health.

The study of information technology concept transformation allows to track the development of information technologies as intellectual technologies, technologies related to the development of computer engineering, communication technologies, network technologies, information technologies and information communication technologies, digital technologies, etc. The emergence of new technologies results in the new social infrastructures of the information society. There exists a transformation of the social ontology of the information society as a result of the information technology development.

At the beginning of the XX century the case touched on changing the basis of the information society, i.e. from certain information technologies to collect, log, accumulate and process information to the qualitatively new basis of the information society – software systems of the organization level. These systems are capable to perform all production as well as social function. Today we need to talk about the transformation of the social ontology in the information society, strengthening its technical and technological basis in all spheres of public life.

To emphasize the importance of the technical and technological direction of information technology development is extremely important for the future of Ukraine. In present-day concepts of the digital world and digital philosophy, only the fact of digital technology spread is emphasized. In this case, the focus shifts to processing and storage of personal information shared in social contexts. In the context of modern globalization, such concept contributes to the development of trade. However, it can not be the basis for the development of the country.

Objective transformations of information technologies reveal changes in their content and expansion of their sphere of influence. The improvement of information technologies shows their growing influence on the development of the information society. Information technologies are included in social dimensions, transforming the essence of labor, ways of implementing intellectual activity, performing production and social functions. The study of the influence of information technologies on social processes and phenomena opens up the horizons of the future world order.

Information technology can be classified according to the sphere of its application. Information and communication technologies characterize subject-to-subject interactions, among which pedagogical and political technologies are primarily distinguished. A separate area of information application technology is the information space. Information processing technologies in the information space are the basis of modern democratic discourse. An important constituent of information technology is the information sphere. This is the information sphere of information activity, information exchange and information relations, the regulator of which is the information law. Information security technologies ensure the protection of human rights, society and the state in obtaining objective information. Cybersecurity technologies protect critical infrastructure. The technologies of reality – virtual, cognitive, and augmented – provide the ability of a person's consciousness

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Трансформация концепта "информационные технологии" в современном научном дискурсе

Александра Рубанец

Аннотация. Целью исследования является раскрытие объективных трансформаций, произошедших в информационных технологиях. Важна также концептуализация этих трансформаций. Системный, информационный, сетевой и когнитивный подходы позволяют раскрыть основные аспекты развития информационных технологий – технико-технологический, сетевой, коммуникационный, когнитивный. В статье выявлены основные этапы эволюции информационных технологий. Проанализирована связь информационных технологий с возрастанием роли и значения информации в жизни человека и общества. Информационные технологии раскрываются как технологии создания, хранения, фиксации и обработки информации.

Проанализировано технико-технологическое направление развития информационных технологий. Выявлена связь трансформации концепта информационная технология с развитием теории информационного общества, в частности теории постиндустриального общества, информационного общества, сетевого общества, общества знания и цифрового мира. Выявлена связь трансформации концепта информационная технология со становлением медиацивилизации и глобального информационного пространства. В статье показано, что развитие информационных технологий является важным фактором развития информационного общества. Переход от технологии в виде техники (электронно-вычислительная машина как машина) к современному этапу развития цифровых технологий характеризует формирование единой технико-технологической основы формирования информационного общества.

Информационные технологии делятся по сфере действия. Информационно-коммуникационные технологии характеризуют субъект-субъектные взаимодействия, среди которых прежде всего выделяются педагогические и политические технологии. Отдельной сферой действия информационных технологий является информационное пространство. Технологии обработки информации в информационном пространстве являются основой современного демократического дискурса. Важной сферой действия информационных технологий является информационная сфера. Это информационная сфера информационной деятельности, информационного обмена и информационных отношений, регулятором которых является информационное право.

Технологии информационной безопасности обеспечивают защиту прав человека, общества и государства в получении объективной информации. Технологии кибербезопасности обеспечивают защиту критической инфраструктуры. Технологии реальности – виртуальной, когнитивной, расширенной и дополненной – обеспечивают возможность сознания и мышления человека обрабатывать и создавать новую информацию. Выявление общественного значения технико-технологического направления развития информационных технологий становится основой рекомендаций для реализации общественной стратегии построения информационного общества в Украине.

Ключевые слова. Информационные технологии, информационно-коммуникационные технологии, сетевые технологии, цифровые технологии.

On calculation of the pseudo-inverse econometric models matrix with a rank deficient observation matrix

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Received on 20.04.2019, accepted after revision on 20.06.2019
https://doi.org/10.31493/tit1921.0302

Abstract. The approach to estimating the parameters of linear econometric dependencies for the case of combining a number of special conditions arising in the modeling process is considered. These conditions concern the most important problems that arise in practice when implementing a number of classes of mathematical models, for the construction of which a matrix of explanatory variables is used. In most cases, the vectors that make up the matrix have a close correlation relationship. That leads to the need to perform calculations using a rank deficient matrix. There are also violations of the conditions of the Gauss-Markov theorem. For any non-degenerate square matrix X, an inverse matrix X^{-1} is uniquely defined such that, for random right-hand side B, the solution of the system $X\beta = B$ is vector $\beta = X^{-1}b$. If X is a degenerate or rectangular matrix, then there is no inverse to it. Moreover, in these cases, the system $X\beta = B$ may be incompatible. Here it is natural to use a generalization of the concept of the inverse transformation, which is formulated in terms of the corresponding problem of minimizing the sum of squared residuals. In the same case, having a QR decomposition, one can use the formula $X^{+} = R^{-1}Q_1'$. In addition, it is recommended for specific calculations. With an incomplete rank, the most convenient form of representation X^{-1} follows from the expansion in characteristic numbers. If $X = U\sum V$ with non-zero characteristic numbers, then $X^{+} = V\sum^{+}U'$. We propose an alternative X^{+} calculation method, which relies on the decomposition of a rank deficient matrix into the product of two matrices of full rank.

Keywords: econometric model, matrix of incomplete rank, Gauss-Markov conditions, pseudoinverse matrix.

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INTRODUCTION

There are several mathematically equivalent expressions for a matrix pseudo-inverse of X. If X is not degenerate, then $X^+ = X'$. When X has a full columnar rank, its pseudo-inverse matrix can be represented as $X^+ = (X'X)^{-1}X'$.

In the same case, having a QR schedule, one can use the formula $X^+ = R^{-1}Q_1'$, besides, it is strongly recommended for specific calculations. With incomplete rank X, the most convenient form of representation X^{-1} follows from the schedule by characteristic numbers. If $X = U\sum V$ with V non-zero characteristic numbers, then $X^+ = V\sum^+ U'$. This article proposes an alternative calculation method based on the decomposition of a rank deficient matrix for the product of two full rank matrices.

METHODOLOGY

Let there be a linear relationship between the variable Y and m explaining variables $X_1, X_2, ..., X_m$ and the perturbation ε, ε is a random variable, emphasizing that only the existence of second-order finite moments is necessary.

If we have a sample of n observations over variables X_j, $j = 1, 2, ...m,$, then we can write

$$y_i = \sum_{j=1}^{m} x_{ij}\beta_j + \varepsilon_i,\ i = 1, 2, ..., n. \qquad (1)$$

Equations (1) can be written in matrix form: $Y = X\beta + \varepsilon$, where (2)

$$Y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix},\ X = \begin{pmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{pmatrix},\ \beta = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_m \end{pmatrix},\ \varepsilon = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix}$$

Let's denote through X' and ε' the matrices transposed to X and ε, respectively.

Let the following conditions be met:

1) $M\varepsilon = 0$ (3)

2) $M(\varepsilon\varepsilon') = \sigma^2 \cdot E,$

where E is the unit matrix; (4)

3) X is a matrix whose elements are deterministic numbers; (5)

4) rank X <m(matrix X -incomplete rank) (6)

In many econometric studies, the assumptions $[10-14]$ of dispersion constancy and the absence of perturbation correlation (4) seem to be unrealistic. Thus, when examining consumer budgets, one can see that the variance of residuals relative to the regression line increases with increasing profits. Similarly, in the analysis of firms activities, the variance of residuals should probably increase with the size of firms.

Therefore, condition (4) should be replaced

$$M(\varepsilon\varepsilon') = D = \sigma^2 W, \qquad (4')$$

where D is the covariance $n \times n$ – matrix$[19]$.

The estimates according parameter β least squares in (1) are defined as the $\hat{\beta}_1, \hat{\beta}_2, \dots \hat{\beta}_m$ minimizing values

$$L = \sum_{i=1}^{n}\sum_{k=1}^{n}(y_i - \sum_j x_{ij}\hat{\beta}_j)\cdot (y_k - \sum_j x_{kj}\hat{\beta}_j)\alpha_{ik} \to \min_{(\beta)}, \qquad (7)$$

where the matrix $A = \|\alpha_{ik}\|$ is symmetric, decidedly defined $n \times n$ is the matrix. The solution (7) $\hat{\beta}_1, \hat{\beta}_2, \dots \hat{\beta}_m$ will be called the task pseudo-solution (1-2). The solution will be linear towards y. In addition, provided (3) $P_1\hat{\beta}$ will be an unbiased value $P_1\beta$ in (1).

That is,

$$M(P_1\hat{\beta}) = P_1\beta \qquad (8)$$

P_1 is orthoprojector.

The solution, generally speaking, will not be the only one. We will try to minimize the amount

$$(\sum_{j=1}^{m}\beta_j^2 \to \min). \qquad (9)$$

Then the solution (7) is unique and is called the normal pseudo-solution of the problem (1–3, 4', 5, 6). When $A\cdot D = E$ – solution (7) is optimal. The Gauss-Markov theorems take place here.

For case (6), unbiased estimates β are impossible, but some unbiased linear combinations of unknown parameters can be estimated.

Let be X a non-degenerate matrix, then the solution (1, 2) can be written in the form

$$\hat{\beta} = X^{-1}Y + X^{-1}\varepsilon\ ,$$

where X^{-1} – the matrix is inverted to X. An inverse matrix is a very useful mathematical concept and often needs to be calculated X^{-1}. In the case of a problem (MLS), the question arises whether there is a $m\times n$ matrix Z, which uniquely defined by the matrix X and it is such that a solution for single minimum length $(\sum\beta_i^2 \to \min)$ (MLS) is expressed by the formula $\hat{\beta} = ZY$.

Such a matrix Z does exist [20], it is called a pseudo-inverse of the matrix X and is denoted X^+. For the sake of simplicity, we put it $W = E$.

The matrix X^+ is uniquely determined by the matrix X and does not depend on the specific orthogonal decomposition X [20]. For each $j,\ 1\le j\le n$ j is the column of the matrix X_j can be written in the form $X_j = X^+e_j$ where e_j j - the column of a single matrix E

So $\hat{\beta} = X^+Y$. The purpose of the article is to constructively define and calculate X^+.

Definition 1.

For random $n\times m$ matrix X, the pseudo-inverse matrix, denoted X^+, is the $m\times n$ matrix j - the column of which is the only minimum length (MLS) solution. $X\hat{\beta} = e_j$.

Definition 2.

Matrix X^+ of a $m\times n$ size is called a Moore-Penrose pseudo-inverse matrix for matrix X, if it satisfies the following four conditions

1) $X^+XX^+ = X^+$
2) $XX^+X = X$
3) $(X^+X)' = X^+X$ – symmetrical
4) $(XX^+)' = XX^+$ – symmetrical.

From the condition $X^+XX^+ = X^+$ it follows $X^+XX^+X = X^+X$.

Denote $X^+X = P_1$, then $P_1^2 = P_1$, that is P_1 – idempotent.

Similarly $XX^+ = P_2$.

From conditions (3, 4) we obtain P_1, P_2 orthoprojectors [21]. It can be proved that the general solution of problem (1) is expressed by the formula

$$\hat{\beta} = X^+Y + (E - P_1)\bar{C}\ ,$$

where $\bar{C}$ is a random vector.

One can prove that a matrix defined X^+ always exists and is a unique one. If X is a non-degenerate square matrix, then $X^+ = X^{-1}$ obviously satisfies the conditions (1–4).

Theorem 1.

If the $X - n\times m$ matrix $n > m$ and rank $X = m$, that is, has a full rank, then $X^+ = (X'X)^{-1}X'$. If the $X - n\times m$ matrix $m > n$, then $X^+ = X'(XX')^{-1}$.

Proof.

Let X be a full rank matrix. $z = (X'X)^{-1}X'$.

Let's check the Moore-Penrose conditions. Let it $n > m$.

Proof.

Let X be a full rank matrix. $z = (X'X)^{-1}X'$.

Let's check the Moore-Penrose conditions. Let it $n > m$.

1) $ZXZ = (X'X)^{-1}X'X(X'X)^{-1}X' =$

$= (X'X)^{-1}X' = Z$

2) $XZX = X(X'X)^{-1}X'X = X$

3) $ZX = (X'X)^{-1}X'X = P_1 -$ orthoprojektor $\Rightarrow$

$\Rightarrow P_1 -$ symmetrical $[21]$

4) $XZ = X(X'X)^{-1}X' -$ symmetrical .

Let it $m > n$, $Z = X'(XX')^{-1}$

1) $ZXZ = X'(XX')^{-1}XX'(XX')^{-1} = X'(XX')^{-1} = Z$

2) $XZX = XX'(XX')^{-1}X = X$

3) $XZ = XX'(XX')^{-1} = P_2 -$ orthoprojektor $\Rightarrow$

$P_2 -$ symmetrical $[21]$

4) $ZX = X'(XX')^{-1}X -$ symmetrical .

Moore-Penrose conditions are necessary and sufficient for the matrix Z to be equal X^+ [2].

The theorem is proved.

Lemma 1.

Let it be the $X - n \times m$ matrix rang X=r $(r < m < n)$.

Then $X = AB$, $A - n \times r$ – is a full rank matrix, – $B - r \times m$ is a full rank matrix.

Proof.

Let it $X = \{X_1, X_2, \ldots, X_m\}$, X_j is a column X $(j = \overline{1,m})$. Let $A = \{X_1, X_2, \ldots, X_r\}$, where $X_1, X_2, \ldots, X_r$ are the basic columns. Then any X_j is a linear combination of basis columns

$X_j = \sum_{k=1}^{r} b_{kj} X_k \Rightarrow x_{ij} = \sum_{k=1}^{r} x_{ik} b_{kj}$. so

$(X = AB)$.

$A = \|x_{ik}\|_{\substack{i=\overline{(1,n)} \\ k=\overline{(1,r)}}}$; $B = \|b_{kj}\|_{\substack{j=\overline{(1,m)} \\ k=\overline{(1,r)}}}$; $\|x_{ij}\|_{\substack{i=\overline{(1,n)} \\ j=\overline{(1,m)}}}$.

A contains r base columns, therefore rangA=r. B contains all columns of a single matrix E. So rang$B = r$. Lemma proved. $X = AB$ and by theorem 1 $A^+ = (A'A)^{-1}A'$, $B^+ = B'(BB')^{-1}$.

Theorem 2.

$X^+ = B'(BB')^{-1}(A'A)^{-1}A'$

Proof.

It is known that $(AB)^{-1} = B^{-1}A^{-1}$. Pseudo-inverse equality $(AB)^+ = B^+A^+$ is not always fulfilled.

Let us prove that

$X^+ = (AB)^+ = B^+A^+ = B'(BB')^{-1}(A'A)^{-1}A'$.

Let's check Moore-Penrose's conditions for

$Z = B'(BB')^{-1}(A'A)^{-1}A'$

1) $ABZAB = ABB'(BB')^{-1}(A'A)A'AB = AB$

2) $ZABZ =$

$= B'(BB')^{-1}(A'A)^{-1}A'ABB'(BB')^{-1}(A'A)^{-1}A' =$

$= B'(BB')^{-1}(A'A)^{-1}A' = Z$

3) $ZAB = B'(BB')^{-1}(A'A)^{-1}A'AB =$

$= B'(BB')^{-1}B = P_1 -$ symmetrical

4) $ABZ = ABB'(BB')^{-1}(A'A)^{-1}A' =$

$= A(A'A)^{-1}A' = P_2 -$ symmetrical .

So Moore's conditions are fulfilled, and therefore $Z = (AB)^+ = B^+A^+ = X^+$. The theorem is proved.

The solution (1, 2) $\hat{\beta}$ is determined simultaneously: $\hat{\beta} = X^+Y + (E - P_1)C$. Vector C is random.

Therefore, if the matrix X is incomplete, then it is impossible to find an unbiased value $\hat{\beta}$. Consider $\hat{\beta}$ the normal solution to problem (1, 2). Indeed,

$$\hat{\beta} = X^{+}Y = (AB)^{+}Y =$$
$$= B'(BB')^{-1}(A'A)^{-1}A'(AB\beta + \varepsilon) =$$
$$= B'(BB')^{-1}(A'A)^{-1}A'AB\beta +$$
$$+B'(BB')^{-1}(A'A)^{-1}A'\varepsilon =$$
$$= B'(BB')^{-1}B\beta + B'(BB')^{-1}(A'A)^{-1}A'\varepsilon =$$
$$= P_1\beta + X^{+}\varepsilon, \quad M\hat{\beta} = P_1\beta \neq \beta.$$

Definition 2.

The $\hat{\beta}$ parameter value is called X – unbiased if $MX\hat{\beta} = X\beta$.

Lemma 2.

The value $\hat{\beta} = X^{+}Y$ is an unbiased value β

Proof.

We use (2), then

$$\hat{\beta} = X^{+}Y = X^{+}(X\beta + \varepsilon) = X^{+}X\beta + X^{+}\varepsilon \ ,$$

hence from (3) and (9)

$$M(X\hat{\beta}) = M(XX^{+}X\beta + XX^{+}\varepsilon) =$$
$$XX^{+}X\beta = X\beta \ .$$

Otherwise

$$\hat{\beta} = B'(BB')^{-1}(A'A)^{-1}A'(AB\beta + \varepsilon)$$
$$X\hat{\beta} = AB\hat{\beta} = ABB'(BB')^{-1}(A'A)^{-1}A'AB\beta +$$
$$ABB'(BB')^{-1}(A'A)^{-1}A'\varepsilon =$$
$$= AB\beta + A(A'A)^{-1}A'\varepsilon = X\beta + A(A'A)^{-1}A'\varepsilon.$$
$$MX\hat{\beta} = X\beta.$$

Lemma is proved.

$$M\hat{\beta} = B'(BB')^{-1}B\beta = P_1\beta \ .$$

So, in general, $\hat{\beta}$ is a biased value of β. Let us estimate the variation $\hat{\beta}$ – disperse $\hat{\beta}$ towards with $M\hat{\beta}$:

$$\operatorname{var}\hat{\beta} =$$
$$= MB'(BB')^{-1}(A'A)^{-1}A'\varepsilon\varepsilon'A(A'A)^{-1}(BB')^{-1}B =$$
$$= \sigma^2 B'(BB')^{-1}(A'A)^{-1}(A'A)(A'A)^{-1}(BB')B =$$
$$= \sigma^2 B'(BB')^{-1}(A'A)^{-1}(BB')^{-1}B =$$
$$= \sigma^2 B'(BB'A'ABB')^{-1}B =$$
$$= \sigma^2 B'(B(AB)'ABB')^{-1}B =$$
$$= \sigma^2 B'(BX'XB')^{-1}B$$

Consequence 1.

$$M(B'(BB')^{-1}B\hat{\beta}) = B'(BB')^{-1}BM(\hat{\beta}) =$$
$$= P_1 M\hat{\beta} = P_1^2\beta = P_1\beta \ ,$$

$\hat{\beta}$ is P_1 – an unbiased value β.

In general $\hat{\beta}$ is defined ambiguously

$$\hat{\beta} = X^{+}Y + (E - P_1)C \ . \qquad (10)$$

Theorem 3.

The covariance matrix $D(X\hat{\beta})$ of the $X\hat{\beta}$ parameter estimates $X\beta$ in model (2) is equal [20]

$$D(X\hat{\beta}) = \sigma^2 X(X'X)^{+}X' \ ,$$

where $(X'X)^{+}$ – pseudo-inverse to $(X'X)$.

Proof.

We use lemma (2):

$$X^{+} = (X'X)^{+}X', X^{+}Y = X^{+}X\beta + X^{+}\varepsilon \ . \quad (11)$$

Then

$$X\hat{\beta} = XX^{+}Y = XX^{+}X\beta + XX^{+}\varepsilon == X\beta + XX^{+}\varepsilon.$$

So using (3), (4), (9) we obtain

$$D(X\hat{\beta}) = M(X\hat{\beta} - X\beta)(X\hat{\beta} - X\beta)' =$$
$$M(XX^{+}\varepsilon, \varepsilon'(XX^{+})') =$$

$$= M(X(X'X)^{+}X'\varepsilon\varepsilon'X(X'X)^{+}X') =$$
$$= \sigma^2 X(X'X)^{+}(X'X)(X'X)^{+}X' =$$
$$\sigma^2 X(X'X)^{+}X'.$$

Otherwise

$$D(X\hat{\beta}) = M(X\hat{\beta} - X\beta)(X\hat{\beta} - X\beta)' =$$
$$= M(ABB'(BB')^{-1}(A'A)^{-1}A'\varepsilon\varepsilon'A(A'A)^{-1} \cdot$$
$$(BB')^{-1}BB'A = \sigma^2 A(A'A)^{-1}A' = \sigma^2 P_2.$$

The theorem is proved.

Consequence 2.

$D(X\hat{\beta})$ does not depend on non-basic vector-columns of the matrix X.

Suppose that $c = \begin{pmatrix} c_1 \\ c_2 \\ \vdots \\ c_m \end{pmatrix}'$ belongs to the linear shell of the rows $x_1, x_2, \cdots, x_n$ of the matrix X.

Then $c = \gamma X$ where

$$\gamma = \{\gamma_1, \quad \gamma_2, \quad \cdots \quad, \gamma_n\}.$$

Then according to (11)

$$\gamma X\hat{\beta} - M(\gamma X\hat{\beta}) = \gamma XX^{+}\varepsilon.$$

Besides, $c = \gamma X$, $M(c\hat{\beta}) = c\beta$.

Therefore, we get

$$D(c\hat{\beta}) = M(c\hat{\beta} - c\beta)(c\hat{\beta} - c\beta)' =$$
$$M(\gamma X\hat{\beta} - \gamma X\beta)(\gamma X\hat{\beta} - \gamma X\beta)' =$$
$$= M(\gamma XX^{+}\varepsilon\varepsilon'X^{+'}X'\gamma') =$$
$$M(\gamma X(X'X)^{+}X'\varepsilon\varepsilon'X(X'X)^{+}X'\gamma') =$$
$$= \sigma^2\gamma X(X'X)^{+}X'X(X'X)^{+}X'\gamma' =$$
$$\sigma^2\gamma X(X'X)^{+}X'\gamma' = c(X'X)^{+}c'.$$

CONCLUSIONS

Thus, if the matrix of an accurate system is incomplete, then minor values of the perturbations of the input data and rounding errors will not necessarily lead to the appearance in the process of transformation of the system any rows or columns consisting entirely of the same small elements. This is the main, but not the only, difficulty in constructing numerical methods for decomposing systems with rank deficient matrices, which is built on equivalent transformations of the original system.

Another difficulty is connected with the reasoning for further transformations of those systems whose matrices have rows and columns with minor elements.

If the input data of a system with a rank deficient matrix is given with errors, no increase in the accuracy of the calculations and no transformations will provide the guaranteed accuracy of a normal pseudo-solution. This requires additional information about the exact task involved. But suppose that after the unitary transformations, a system with small rows or columns is obtained. Replacing these rows and columns with zero values is equivalent to a small perturbation of the initial system matrix. If we can accurately find the normal pseudo-solution of the resulting system, it will mean that the projection of the normal pseudo-solution of the exact system on one of the subspaces drawn on singular vectors will be calculated sufficiently accurately. There is no reason to expect a better result without additional information.

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О вычислении псевдообратной матрицы эконометрических моделей с матрицей наблюдений неполного ранга

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Аннотация. Рассмотрен подход оценивания параметров линейных эконометрических зависимостей для случая сочетания ряда особых условий, возникающих в процессе моделирования. Эти условия касаются наиболее важных проблем, возникающих на практике при реализации ряда классов математических моделей, для построения которых используется матрица объясняющих переменных. В большинстве случаев векторы, из которых составляется матрица, имеют тесную корреляционную связь. Что приводит к необходимости выполнять вычисления с использованием матрицы неполного ранга. Также имеют место нарушения условия теоремы Гаусса-Маркова. Для любой невырожденной квадратной матрицы X однозначно определена обратная матрица X^{-1} такая, что при произвольной правой части B решением системы $X\beta = B$ будет вектор $\beta = X^{-1}b$. Если X – вырожденная или прямоугольная матрица, то обратной к ней не существует. Более того, в этих случаях система $X\beta = B$ может оказаться несовместимой. Здесь естественно пользоваться обобщением понятия обратного преобразования, которое формулируется в терминах соответствующей задачи минимизации суммы квадратов невязок. В этом же случае, имея QR-разложение, можно использовать формулу $X^{+} = R^{-1}Q_1'$. Кроме того, именно она рекомендуется для конкретных вычислений. При неполном ранге наиболее удобная форма представления X^{-1} вытекает из разложения по характеристическим числам. Если $X = U\sum V$ с V ненулевыми характеристичными числами, то $X^{+} = V\sum^{+}U'$. Нами предлагается альтернативный способ вычисления X^{+}, который опирается на разложении матрицы X неполного ранга на произведение двух матриц полного ранга.

Ключевые слова: эконометрическая модель, матрица неполного ранга, условия Гаусса-Маркова, псевдообратная матрица.

Influence of urbanization on economic social scope: negative consequences

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Received 27.04.2019, accepted after revision 30.05.2019
https://doi.org/10.31493/tit1921.0303

Abstract. The architectural and construction environment has a very strong influence on the psyche of people living in it. It was noticed that the accumulation of multistory houses with evenly spaced windows of the windows helps to reduce the intelligence and increase the aggressiveness of those people who watch them daily. Similarly, the accumulation of a large number of cars that fill yards and streets is also perceived. For people that living in the city, frequent cases appearance depression. Largely it is connected with their way of life, lack of time, workload at work andhome, all sorts of trouble, and you have a gradient rate accelerated rhythm life. Theoretical concepts and concepts of A. Marshall, A. Weber, E. Hoover, W. Aizard and updated by Nobel laureate in economics P. Krugman and his are key to understanding the nature and causes of population concentration and economic activity in major cities. From the point of view of these researchers, the attractive force of cities, including the largest ones, is associated in its most general form with the emergence and development of the phenomenon of agglomeration effects (agglomerative economy). In the modern theory of agglomeration effects caused by the spatial manifestation of the action of market forces and affecting the growth of cities, researchers identify two of their main types: localization effects and urbanization effects More than 50 percent of people around the world live in cities, and the World Health Organization predicts that this share will continue to grow. People migrate to cities, in particular, in Ukraine, for many reasons, including family ties and employment opportunities, political situation in a country or region and has several serious negative consequences. In order to improve the conditions of their lives, people strive to make them more comfortable, comfortable and favorable for themselves. However, this leads to the separation of man from the natural environment of his habitation and to the violation of natural ecosystems. It creates a kind of urban system, consisting of architectural and construction objects and much disturbed natural ecosystems. Thus, the levels of urbanization in Ukraine's regions will over time be aligned. The development of existing agglomerations and the formation of new ones, in particular in the coastal part of Ukraine, will continue.

Keywords: urbanization, biosphere, urban environment, depopulation, urban population.

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THE IMPACT OF URBANIZATION ON UNEMPLOYMENT JOBS

Urbanization leads to a shortage of jobs. Companies and governments cannot create enough jobs to meet the demand of a rapidly growing population. As a result, the unemployment rate is rising dramatically, resulting in people turning to state programs and benefits. The government loses money by reducing energy, health, education, public transport, waste management and physical security. Poverty is spreading and hampering economic

growth, and depopulation is taking place [14-19].

The strategic goals of the development of regions for the long term can be considered theoretically sound and practically feasible only when they are developed in the aspect of municipal districts and urban districts. It is on the territory of the latter that new production facilities are being opened, old ones are being modernized, residential complexes, social and engineering infrastructure facilities are being built. At the same time, the anomalously dispersed nature of the manifestations of economic activity in municipalities and urban districts hinders the formation of a single economic space and the achievement of the strategic development goal – improving the welfare and quality of life of the population in the region [2, 10]. In order to better understand and explain the characteristics of the economy and demography of the region, you need to carefully look at the specifics of the settlement population, the network of settlements, their functions and importance in the life of the region, as well as the prospects of settlements. Each region has its own settlement system, which must be taken into account in the process of regional strategic management. The main feature of the current stage of the settlement process is urbanization, which is a historical process of increasing the role of cities in the development of society, causing changes in the socio-occupational and demographic structure of the population, influencing its culture, lifestyle, psychology, etc. [7]. Urbanization – This is a complex process, hence the indicator characterizing this phenomenon should be difficult.

The idea that urbanization should be measured not only by the share of citizens in the whole population, but also by the share of citizens living in big cities (from all or only from the urban population), in scientific literature on the geography of the population is generally accepted (Fig.1). F.M. Listengurt calls the share of citizens "the first indicator" of the level achieved during urbanization, and the share of their own living in large cities (with 100 thousand inhabitants or more) is "the second indicator".

At the same time, the nature of urbanization in developed and developing countries is different. In developed countries, the process of urbanization, in its former sense, is actually completed and smoothly goes into the processes of suburbanization (the process of growth and development of the suburban area of large cities), counter-urbanization (the process of erosion, reduction of the number of cities) and rururbanization (the process of the spread of urban forms and living conditions on countryside) [3]. The realities of life in the modern global economy of the XXI century. Such that economic power is increasingly geographically concentrated in the largest forms of settlement, among which the leading positions are occupied by the largest cities with a population of one million and above [1]. Megacities, which are the cores of the concentration of gigantic production capacities, the concentration of information, innovation and cultural potential, providing the bulk of the increase in national wealth, dominate within the territorial structure of the economy of developed countries [4].

Fig.1. Overpopulation

The classic theoretical concepts and concepts of A. Marshall, A. Weber, E. Hoover, W. Aizard and updated by Nobel laureate in economics P. Krugman and his are key to understanding the nature and causes of population concentration and economic activity in major cities. by colleagues. From the point of view of these researchers, the attractive force of cities, including the largest ones, is associated in its most general form with the emergence and

development of the phenomenon of agglomeration effects (agglomerative economy). In the modern theory of agglomeration effects caused by the spatial manifestation of the action of market forces and affecting the growth of cities, researchers identify two of their main types: localization effects and urbanization effects [1]. Agglomeration effects, acting in unity, give rise to a synergistic effect, increase the increasing returns, and ultimately give the economy of large cities the objective benefits of growth.

The uneven distribution of settlements is a brake on the social and economic development of the country, predetermines the presence of regressive regions, i.e., the unevenness of the socio-economic status of the regions and the different (often very substantial) quality of the "living environment" in these regions [3]. Undeveloped transport and logistics infrastructure reduces the price competitive advantages of domestic producers, not only in external but also in domestic markets, reduces the radius of movement of goods and discourages the strengthening of the unity of the economic space of the country [8].

THE IMPACT OF URBANIZATION ON DEMOGRAPHIC PROCESSES

To a large extent, it manifests itself, depending on the differences between cities in terms of size and economic profile (functional type). With the development of the urbanization process, the birth rate of the urban population in comparison with rural populations is falling, and in the future, the birth rate is decreasing in rural areas.

In almost all countries, the birth rate of urban dwellers who have recently moved from rural areas is higher than long-lived in urban areas (if the adaptation of rural residents in cities is not tangible). The mortality rate in the early stages of urbanization in the poorly developed countries was higher in urban areas than in rural areas, which is explained by unsanitary living conditions of the concentrated population. Particularly high infant mortality. The villagers who move to cities are usually poorly adapted to the conditions of city life! However, over time, differences in mortality rates of urban and rural populations are decreasing. With the development of urbanization, the role of migration in the growth of cities is gradually decreasing. The intensity of the territorial mobility of the population as a whole is increasing, especially the intensity of pendulum migration [1].

URBANIZATION AND ITS IMPACT ON THE BIOSPHERE

Urbanization has a negative impact on all components of the biosphere. Such influence increases year after year. Large cities pollute the atmospheric air as a result of the movement of various types of transport, as well as emissions of industrial enterprises, heat and power stations, which meet the needs of the citizens [23-25].

Construction of high-rise buildings has negative consequences for soils. There is a drainage of the areas of such buildings with compensating surface elevations in the suburbs. Fully changing natural landscape. Cities are artificially created ecosystems in which they lost species diversity of plants and animals that inhabited the area before [20, 21, 22].

Urban areas are characterized by extensive use of water resources for various household and industrial needs (Fig.2). As a result, a huge amount of sewage is formed, which, even after cleaning in special facilities, presents a danger to those water objects where their dis-

Fig.2. Negative impact on biosphere

charge is carried out. In view of the fact that all the waters inevitably fall into the oceans, the cities contribute to its pollution with toxic substances, suspended particles, sulfates, chlorides, petroleum products, organochlorine compounds, heavy metal salts [2].

THE IMPACT OF URBANIZATION ON THE HEALTH

It has long been noticed that the urban environment has a negative impact on human health. This topic is devoted to numerous studies that reveal the peculiarities and main trends of this influence, their qualitative and quantitative characteristics. However, the urgency of this problem increases in connection with the development and strengthening of the process of urbanization, the peculiarities of its impact on the environment. Urbanization is a process that involves the growth and development of cities, increasing the proportion of urban population at the expense of rural areas. In the process of urbanization, the role of cities in the development of human society is being enhanced. Urbanization is associated with the formation and development of civilization, the overcoming of certain restrictions, characteristic of the natural life of man, the creation of an artificial environment of its habitation [26].

Fig. 3. Negative impact on health

In order to improve the conditions of their lives, people strive to make them more comfortable, comfortable and favorable for themselves. However, this leads to the separation of man from the natural environment of his habitation and to the violation of natural ecosystems. It creates a kind of urban system, consisting of architectural and construction objects and much disturbed natural ecosystems. The architectural and construction environment has a very strong influence on the psyche of people living in it. It was noticed that the accumulation of multistory houses with evenly spaced windows of the windows helps to reduce the intelligence and increase the aggressiveness of those people who watch them daily. There is a certain relationship between urbanization, the environment and the health status of the urban population. Studies show that, in general, many factors are affected by the health of the urban population. Among them, one can identify those that are typical of the urban lifestyle. These include increased nervous loads, transport fatigue, etc., but most of all – pollution of the environment with various harmful substances (Fig.3). Therefore, appropriate measures are needed to improve the urban lifestyle, reduce harmful emissions to the atmosphere by industrial enterprises and vehicles. It is also necessary to remove the location of children's institutions from the main trunk roads and industrial enterprises as in sources of pollution of air and water rmful substances [13].

breakdown of socio-economic for- s of the early 90's of the XX century celerated the manifestation of those in- processes that were laid down in eco- and social policies during the entire XX [27].

anization in modern Ukraine takes place the backdrop of depopulation of the tion in conjunction with the economic Both circumstances affected both the nd the countryside. Therefore, the abso- mber of urban population in Ukraine is sing, although there are still cities that e to grow. The demographic crisis in the countryside leads to the fact that, in difficult economic conditions, young able-bodied

population of reproductive age flows to cities. This contributes to the further growth of the proportion of urban residents and the absolute number of residents of some cities, especially the largest and those located in agrarian weakly urbanized regions.

Thus, for 2001 – 2008, the largest growth rates of the population were Kyiv as the capital of Ukraine, as well as Vinnytsia and Khmelnytsky as the centers of the regions where the share of urban population is still one of the lowest. However, if the high natural growth in the countryside compensated for the migration outflow, nowadays the demographic situation is better in cities than in the countryside, and modern urbanization through migration poses a threat to the existence of rural settlements.

Another economic crisis, however, leads to the manifestation of reverse, desurbanization processes, which are manifested in the outflow of the population to the countryside. Deurbanization processes are also manifested in: increasing the employment of urban residents in agricultural activities, some easing the impact of cities on the natural environment due to reduced capacity or stopping of many enterprises, the termination of territorial growth of cities. [28]

Today, the largest urban settlements have the best conditions for further growth. It is in them that the greatest socio-economic changes take place. Gradually saturated with industrial and social (including market) infrastructure, these settlements become favorable for the placement of complex productions, the development of services and management. In the conditions of the socio-economic crisis, such cities become centers of progressive changes in the restructuring of the economy, and their inhabitants - carriers of new social relations. The absolute majority of middle and small cities were unable to maintain an existing population. Exception is purely agrarian regions, where rural population actively migrates to cities.

In the regional context, the following trends are emerging: urban population growth is greatest in the west and in the center of the country, as well as in the south and, especially, in the Crimea. The reasons are the continuation of industrialization and development of services and migration from rural areas (in the west of Ukraine and Podillya), the development of a resort economy and favorable climatic conditions (in the south). Thus, from 2001 to 2009, the highest rates of population growth were observed in Kyiv, Lviv, Vinnytsia, Khmelnytsky, Rivne, Cherkasy, Chernivtsi, Ivano-Frankivsk, Bila Tserkva, and Evpatoria. Industrial cities of the east, especially Donbass, on the contrary, are losing population intensively, as industrial enterprises are closed and the population loses the opportunity to work in such cities.

The situation is also aggravated by the difficult ecological situation in such cities, even economically attractive. The population of Makiyivka, Gorlovka, Kramatorsk, Nikopol, Sivorododonetsk, Pavlograd, Lisichansk is the most losing. Except in the case of large cities, there is only Kryviy Rih, whose population is increasing, because his well-being is ensured by the operation of ferrous metallurgy enterprises [29].

Despite the quantitative losses of the urban population, the process of formation of agglomerations is continuing, which is reflected in the strengthening of the links between the largest cities and the territory adjacent to them, based on labor migration, common labor markets, land, financial resources, etc. Thus, the age of the old, industrial agglomeration goes back into the past, changing with a new, post-industrial agglomeration. The most striking examples of such agglomerations are Kyiv, Kharkiv, to some extent Odesa, Lviv. Suburbanization outflow of the wealthy population in the suburban area, the construction of cottage townships and the reorganization of the villages adjacent to the city contribute to the emergence of agglomerative forms, even in the case of much smaller cities in the traditional rural regions (Vinnytsia, Ternopil, and Zhytomyr), although full-fledged urban agglomerations do not, in the classical sense of the term, is. In the industrial regions of the east, the rudiments of the new post-industrial agglomeration are combined with traditional industrial agglomeration.[30].

In industrial regions, in areas of sintering influence, there is a penetration of urban lifestyles and urban forms of development in rural areas. The proximity of urban settlements leads to the proliferation of non-agricultural activities in rural areas, and a significant part of the rural population takes part in labor trips, while taking advantage of social services in cities. The level of improvement of the countryside is much higher than the average in the country. However, as noted above, during the crisis of industrial production, these regions were more vulnerable and now undergo a process of reducing the urban population.

In agroindustrial regions, a network of urban settlements is represented mainly by one (regional center), a large city and a dense network of small towns, which are more or less evenly distributed throughout the territory. All of them have close economic, transport, managerial, social connections with the regional center and poorly developed connections with other cities. They look "autonomous" because they have close links with the countryside adjoining them, they are the centers of local settlement systems. Consequently, urban settlements in agro-industrial regions play a significant system-forming role, focusing on connections (production, social, managerial, information, etc.) with adjoining rural areas.

In the functional structure of cities, a rural (sometimes forestry) economy occupies a significant place, which is not typical for regions with an industrial type of development. This is reflected in the appearance of small cities: in them significant areas are occupied by cities, gardens, mostly or in most of them there are comfortable natural conditions for people's lives. The close link between urban and rural residents has somewhat reduced the social consequences of the economic crisis than in industrial regions. Therefore, the lower the urbanization rate of the region, the smaller the manifestations of the process of desurbanization.

With the acquisition of a country of independence, the domestic settlement system was able to self-formation within the state territory. The main framework of this system is urban formations. Therefore, in modern conditions there are additional changes and clarification of the spheres of functional influence of the largest cities and the formation of regional resettlement systems. According to the General Scheme of Planning of the Territory of Ukraine, the centers of such systems are the largest cities and their agglomerations – Kyiv, Kharkiv, Dnipropetrovsk, Donetsk, Odessa, and Lviv. The features of modern urban growth, the differentiation of the territory from the standpoint of static characteristics, demography and economic zoning lead to the allocation of two more planning centers – Vinnytsia in Podillya and Lutsk in Volhynia.

CONCLUSION

In the future, renewal of the growth of cities is projected, especially in the western and central parts of the state, as with the inevitable growth of labor productivity in agriculture to the indicators of developed countries, free labor will flow to cities. Thus, the levels of urbanization in Ukraine's regions will over time be aligned. The development of existing agglomerations and the formation of new ones, in particular in the coastal part of Ukraine, will continue.

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Влияние урбанизации на экономическую, социальную сферы: негативные последствия

Елена Борзенко

Аннотация. Архитектурно-строительная среда оказывает очень сильное влияние на психику проживающих в ней людей. Замечено, что скопление многоэтажных домов с равномерно расположенными рядами окон способствует снижению интеллекта и повышение агрессивности тех людей, которые их ежедневно наблюдают. Аналогичным образом воспринимается и скопления большого количества автомобилей, которые заполняют дворы и улицы. Для людей, живущих в городе, нередки случаи появления депрессии. Во многом это связано с их образом жизни, недостатком времени, загруженностью на работе и дома, разного рода неприятностями, высоким темпом и ускоренным ритмом жизни. Более 50 процентов людей во всем мире живут в городах, и Всемирная

организация здравоохранения прогнозирует, что эта доля будет продолжать расти. Люди мигрируют в города, в частности в Украине, по многим причинам, включая семейные связи и возможности трудоустройства. Урбанизация меняет экономическую, социальную и политическую обстановку в стране или регионе и имеет несколько серьезных негативных последствий.

Ключевые слова: урбанизация, биосфера, городская среда, депопуляция, городское население.

GUIDELINES FOR AUTHORS

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Scientific Edition

TRANSFER OF INNOVATIVE TECHNOLOGIES

2019 Vol.2, No.1

The journal is indexed in world databases:

Google Academy http://scholar.google.com.ua
Web ИРБИС http://irbis-nbuv.gov.ua
CrossRef https://www.crossref.org

The original layout is made in the editorial office of the journal
Transfer of Innovative Technologies

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Linguistic consultant	*Valery Gastinshchikov*
Computer layout	*Lev Sukach*
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+38 044 2454217, +38 095 6297417
www.tit.knuba.edu.ua, tit.edit@ukr.net

Publisher and manufacturer

Lira-K Publishing House
Certificate No.3981, ДК series
st. V.Stusa 22/1, Kyiv, 03115
phone/fax +38 044 2479337, +38 044 2288112
www.lira-k.com.ua, www.zv_lira@ukr.net

Signed for printing on June 30, 2019. Format 60×84 1/8
Paper offset. Printing offset. Times New Roman
Cond. print. sheets 10,23. Circulation 100 copies