The article deals with the basic theories of social development from the perspective of philosophy of science. The three main scientific paradigms (classic, nonclassical, postnonclassical) are analized, their basic patterns are displaied.

From the perspective of non-linear thinking the essence of contradictions resulting from the existence of two models of the evolution of the world: physical (thermodynamics) and biological (darwinism) is revealed, as well as its impact on the community development model. It is proved that the methodological solution of this contradiction perhaps in postnonclassic science, namely the theory of self-organization. From this point of view as the end state is negated by chaos and èshatologičnosti understanding of social development.

Key words: *social systems, thermodynamics, darvinism, self-organization.*

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THE PROBLEM OF SAFE ECOLOGICAL INTERACTIONS BETWEEN HUMAN-DIMENSIONAL ENVIRONMENTS AND TECHNICAL SYSTEMS BY EXAMPLE OF COMPLEX SYSTEM «DRIVER/PERSON–CAR–ENVIRONMENT» IN THE ASPECT OF THINKING IN COMPLEXITY

"Complex systems - CHALLENGE
the art of the researcher"
H. Haken

Abstract. Purpose. *The aim of the work is to investigate the possibility of a non-traumatic connection of different classes' systems "driver/person"[D], "car" [C], "environment"[E] into a single macrosystem "driver/person–car–environment"[D–C–E] for road safety.* ***Research Methodology.*** *The study of the key provisions of the road-safety problem of the complex system "driver–car–environment" [D–C–E] is considered in the context of the basic principles of post-non-classics and "thinking in complexity".* ***Results of the study.*** *For the first time, the concept of a* ***complex macrosystem of a new type*** *is introduced, connecting systems of different classes as independent "whole" on the basis of the conceptual model of post-non-classical "whole in a whole". It is hypothesized that the main cause of the accident is a certain* ***incompatibility*** *within the macrosystem" [D–C–E] of the systems [D], [C], [E] connected in it in terms of membership in different classes (1), which causes the emergence of a critical difference / critical threshold for the interaction of complex systems of different classes (2).* ***The practical importance of the study.*** *The growth of road traffic accidents is formed by the joint interaction of "different-quality" systems [D], [C], [E] into a single macrosystem. The new quality of the macrosystem*

[D–C–E] is determined by the nature of the bonds and the emergence of consistency/or mismatch between different integrity in a single macrosystem. ***Conclusions and prospects for further scientific research.*** *It was established the need to accept a* ***safety paradigm*** *as a scientific branch on the basis of the methodology of non-traumatic/ecological connection without combining the multiclass subsystems into a single macrosystem with a mega-control.*

Keywords: *driver, car, environment, "whole in a whole", safety paradigm, thinking in complexity, openness, non-linearity, self-organization, human-dimensionality, order parameters, critical difference/critical threshold*

Introduction

Despite the different levels of motorization and operating conditions, the number of accidents per 100 cars is not significantly different from country to country. The authorities and experts from all countries are trying to solve the problem of road safety adopting narrow professional, subjective methods (improving the intelligent systems of driving and road network, driver training, etc.) These attempts do not affect the number of accidents, but only reduce the severity of accidents by improving passive safety. Irrespective of variety approaches to the investigation of a complex [D–C–E]-type macrosystem, this road safety problem has not been solved and remains relevant for all countries. The proclamation by the UN General Assembly of 2011-2020 as a decade of action to ensure road safety shows that this is a serious problem of international development, requiring to be dealt **with urgency**.

Ukraine has extremely low road-safety ratios, which leads to significant human and economic losses due to road fatalities and injuries. On June 22-23, 2017, the 1st International Congress on Reforming the Management System of Road Safety in Ukraine was held in Kyiv under the motto: "Safe roads for life." As had been noted at the Congress, fundamental shifts in the security philosophy are required to increase road-safety ratios in Ukraine and the world. This will contribute to the formulation and use of the systems road-safety guidelines in decision-making process of Government and public.

We still don't have methodological framework on which the effective theory and expert opinion of road-safety issues will be based. In existing approaches and principles developed to ensure road safety, we cannot see unanimity of views and methods applied by specialists working in this field. This is primarily due to the fact that the **road-safety paradigm** has not yet been adopted in the academic world. Often, road-safety researchers and developers use such poorly defined terms as "risk" (probability theory), "catastrophe" (catastrophe theory), "reliability" (reliability theory), "damage" and "vulnerability", which often leads to confusion in their practical application. It is not clear what from this list (risk, catastrophe, reliability, vulnerability or damage) is the very definition of core item of ensuring security. All these using terms were taken from different areas of science without an

integrating principle. At present, the scientific methods of inquiry based on such terminology are self-contained and methodologically poorly integrated. Mismatch of methodologies, in our opinion, is the major obstacle to the development of general principles of the theoretical basis and the elucidation of a holistic picture of road-safety.

It seems that the post-non-classic science and modern complexity theory ("thinking-in-complexity" concept) should articulate an authoritative position in this matter, since it allows us to see the problem in a complex manner and interconnection of many systems and processes. The problem of the security of a complex macrosystem [D–C–E] has not yet been the subject of a separate, in-depth and systematic study in context of the basic "thinking-in-complexity" concept. The relevance of the problem and inadequacy of existing development necessitated our research.

This article is first focused on the methodological aspects of the improvement the security of a complex [D–C–E]-type macrosystem from the perspective of "thinking-in-complexity".

Literature review

There are two leading trends in modern automobile industry to improve the design of vehicles and the entire [D–C–E]-type macrosystem including to ensure its safety. Both tendencies are toward to reduce the influence of the human factor. In this, the former is reflected in a decreased driver role in the system, in the hope that human factor, as the main cause of the accident, would thereby be eliminated by transforming the [D–C–E]-type macrosystem in [C–E]-type, which excludes attention to a driver, but preserves, and sometimes exacerbates, the safety problem. However, now it takes place at the level of another macrosystem [P – a person, not a driver] – [C–E]. On March 13, 2017, the popular American magazine "Wired" published an article under the paradoxical heading " TO MAKE US ALL SAFER, ROBOCARS WILL SOMETIMES HAVE TO KILL”. The essence of the article is that even the autopilot could not fully ensure the safety of a person, although it is expected, that it will significantly increase the level of security. No matter how often we talk, for example, within the BMW «Alive Geometry» concept, about self-driving car and no matter how convincingly slogan "the car and the driver are companions" sounds; we have to admit that "car will be **digital** driver", and therefore in general algorithmic. And in that capacity it would be more appropriately classified as "program-driving" than the "self-driving" vehicle.

Program-driving cars will become safe once program-controlled pedestrians appear on a road. The number of ways to violate traffic rules is so great that it is hardly possible to train a computer to react to them all. On the other hand, under pressure of vehicle-to-population ratio a significant part of drivers operates worse than the autopilot.

The **second** tendency does not exclude a person from the system, but involves monitoring of driver's psychophysiological state. Leading manufacturers offer a number of monitoring systems for control the pulse, blood pressure, emotional state, degree of fatigue and driver's concentration on the road traffic.

There is no the unequivocal correlation between the "grade" of vehicle automation and the number of accidents. More than 30,000 people die every year in road accidents only in the United States in conditions of well-organized traffic and the quality of the vehicles involved. Worldwide, it's more than a million. Mechatronic systems significantly reduces the severity of accidents by prevention the driving errors (active safety) and weakening the traumatic effect (passive safety), but does not affect their number as such. This increases the "rigidity" of the environment and adds to the burdens on man and nature.

Another trend is the change in the traditional transport system as a whole. English explorers Kingsley Dennis and John Urry in 2009 predicted a rapid transformation of the traditional transport system, which, in their opinion, now is in the position of "self-organized criticality," into a "post-car system" that has several scenarios of implementation [5]. William Clay "Bill" Ford Jr., President, CEO and Chairman of Ford Motor Company in 1999–2006, stand in solidarity with this idea. In an interview given to "Wired", Ford noted the urgency and importance of an early solution to the problem of road safety. "If we do not develop a transport model that is very different from the current one, the problem will not be solved," he said.

Recently, entirely different post-vehicle systems, such as HYPERLOOP by Elon Musk and SkyWay String Transport project by Anatoly Yunitskiy, have been actively developed and, according to experts, road safety could grow 100 times.

The evolution of [D–C–E]-type macrosystem’s complexity has passed through the following stages. At the initial stage, the car was designed as a **product** or as engineering implementation of self-propelled apparatus idea. With the development of mechanics, electronics and information technologies, car is perceived as **mechatronic system** ("mechatronics" term introduced by Tetsuro Mori, "Yaskawa Electric", 1969), the designing of which requires careful coordination of heterogeneous components that will work in aggregate. Mechatronics describes the patterns of mechanical systems operations controlled by microprocessor facilities.

Further the complicated **man-machine system** (V.S. Stepin, 1989) [17], which was later expanded to a complex **socio-technical systems** (V.G. Gorokhov, 2016) [3], becomes study and design subject in post-non-classic science. In the research and design such a system, should take into account external to the technical system factors of social and natural environment. At the present stage, explorers consider cyber-physical systems (K. Mainzer, 2016) [11], through which complex socio-technical (largely self-controlled) systems could be modeled. The basis for understanding of self-organization and emergence in such systems is the mathematical theory of complex systems and non-linear dynamics.

Methodology

Prof. Dr. Klaus Mainzer, commonly referred as a researcher of complexity with a focus on complex systems, algorithms and artificial intelligence in science and society, emphasizes that the methodology of complexity is applicable to systems of different matter, since this is "an interdisciplinary methodology to explain the increasing complexity and differentiation of forms by phase transitions." Understanding the principles of assembling of parts into a sustainable evolutionary whole, the principles of non-linear synthesis, one can choose and design a system with desired properties as an integral unity and foresee unforeseeable, at least in engineering practice. "In engineering science, we should aim at self-organizing systems with controlled emergence of new appropriate features. By detecting global trends and order parameters of complex dynamics, we have the chance of implementing favorite tendencies. By cooperation in complex systems we can make much more progress in choosing our next steps. Cooperation in complex systems supports deciding and acting for the sustainable future of a complex world"[22].

Article seeks to describe the methodology of studying a complex [D-V-E]-type macrosystem in the context of the basic principles of the post-non-classical science and "thinking in complexity" concept. The purpose of the study is to establish that [D–C–E]-type macrosystem is a ***complex*** structure, connecting systems of different classes as distinctive "whole", to show its *openness*, *self-organization*, *human-* and *psycho-dimensionality*, *non-linearity of development* and *instability* [2]. We believe that the principle cause of the road-accidents is not a "human factor" (as accepted by most researchers), but a certain incompatibility between such units, connected within the [D–C–E]-type macrosystem and belonging to different classes, as open non-linear system (ONLS) "Driver", closed linear system (CLS) "Car" and ONLS "Environment" (1). We note the critical difference of dissimilar complex systems in course of their interactions (2).

We introduce the concept of a **new type of macrosystem**, which includes systems described below. These components of the macrosystem are characterized by structure and organization. Systems are classified as "simple/complex", "opened/closed", "self-organizing/ non-self-organizing", "linear/non-linear", "accomplished/becoming". The macrosystem itself is characterized by connections between systems/parts/elements, it has macro- and micro-levels and the controlling parameter.

There are two levels in the structure of the [D–C–E]-type macrosystem:

- **a macro-level**, at which, firstly, systems of different classes [D], [C], [E] are connected to a single [D–C–E]-type macrosystem, and, secondly, these systems of different classes are considering not within a "part-whole"-concept (or as part of one whole) but as distinctive "whole", included in a single [D–C–E]-type macrosystem (according to the conceptual model of psychosynergetics " whole in a whole");

- **a micro-level**, at which separate systems / "whole" [D–C–E]-type macrosystem are existing. There is a synergy of micro- and macro-levels of the [D–C–E]-type macrosystem, where the very designation of the "micro" and "macro" becomes uncertain and conditional.

We believe that the **macro-level** can be regarded as a distinctive whole system formed by interaction of different combined systems depending on their activity rate and leading to the mobility of the control parameter's manifestation, which has not been described by anyone. The components of the macro-level in synergetics are called "order-parameters". The "whole", in which the characteristics of the controlling parameter are manifested, controls the other integral parts that constitute it. The behavior of the [D–C–E]-type macrosystem depends on the behavior of the connected systems, and the behavior of the connected systems depends on the class of theirs. The system class dictates the specific of system behavior.

When connecting systems to the [D–C–E]-type macrosystem, a **mega-level** appears –the "control parameter" of connecting product of the three systems [D], [C], [E] manifests itself in the floating mode (can be any of the 4 systems).

The "order-parameter" (OP) in the H. Haken's "synergetics" means the very slow changing "eternal" variables of the mega-level that function as order-parameters of underlying macro-level. By smoothly varying the OP, it is possible to change the system of the lower levels. The "whole in a whole"-concept takes account of the existing degree of their inadequacy and the possible degree of adequacy that could be obtained in the design of the car.

The degree of adequacy / inadequacy or matching / mismatching of the class of systems entering into the [D–C–E]-type macrosystem becomes the criterion for estimating the critical difference / critical threshold of adequacy, and therefore for safety / injury rate and resource-saving.

The concept of the critical threshold (I. Prigogine) / critical difference (H. Haken) is a certain criticality as some state, the "phase-transition" point reached by the system in its states, typified by the selected indicators. The achievement of this point by the system leads to a quantum leap of the system status or behavior, both positive and negative. In our case, this is the degree of adequacy / inadequacy of the systems [D], [C], [E].

This gave an impulse to the development of methodology for investigating the interaction of systems of different classes: firstly, a "Driver" – an open non-linear self-organizing human-dimensional system; secondly, a "Car" – a closed linear system; and, thirdly, the "Environment" – an open non-linear self-organizing nature-dimensional system (2009–2016). None of the general scientific methodological approaches (structural, functional, holistic, elemental, systematical, cybernetic, ecological, synergistic) reflecting multiclass nature of assembling systems and consider them in terms of "whole in a whole"-concept. This is the same problem of instrumentality formalization the [D–V–E]-type macrosystem inquiry and design.

Besides the foregoing, human- and psycho-dimensionality suggests that this environment differs from the natural one, i.e. ONLS (human-dimensional) ≠ ONLS (nature-dimensional). At the same time, the car (C) as an automated system, by definition, belongs to closed linear systems (CLS). As a result, we obtain a macromodel: ONLS (human-dimensional) – CLS – ONLS (nature-dimensional) or [D–C–E]. The range of system differences determines the emergence of the critical threshold 1 for ONLS and CLS and critical threshold 2 for ONLS (human-dimensional) and ONLS (nature-dimensional). This is demonstrated by a comparison of their models and principles of behavior.

Applying the psycho-synergic conceptual model "whole in a whole", including the "non-linear whole in the non-linear whole" (variant: "environment in environment"), for a case of analysis the behavior of the [D–C–E]-type macrosystem is based on the premise that the conceptual model "whole in a whole" admits the possibility of the existence of one "whole" in the composition of another "whole" in different modes, including a non-linear "macro-whole". The difference between this formulation of the problem of the newest holistic (alpha-holistic) (2005) [6,7] from the "new holistic" by S.P. Kurdyumov and co-authors (1994) [8] is that the Kurdyumov's model retains the "part-whole"-relativity, introducing a new understanding that the whole "it is neither more nor less than the sum of parts, it is qualitatively different" [8]. The "whole in a whole"-concept will allow to include relations in the "non-linear whole in non-linear whole"-mode both without influence and interaction, and with different degrees of latter. Such a model allows us to go beyond the "part-whole" dichotomy or reduction to elements (reductionism), and also partly beyond the boundaries of the "new holistic" [8], which preserve the "part-whole" worldview, since considering "the dependence of methods topologically correct united structures and acceleration of "whole" evolution"[8].

Results

The fundamental provisions for solving the complex [D–C–E]-type macrosystem safety problem have been developed within the context the post-non-classic science principles and "thinking-in-complexity" concept.

For the first time, the concept of a complex macrosystem of a new type is introduced. It is shown that this type of macrosystems connecting systems of different classes as distinctive "whole" on the basis of the conceptual model of post-non-classical "whole in a whole". The post-non-classical stage of the science development and "thinking in complexity" allowed to take into account the multidimensionality and multiclass nature of the systems entering into the [D–C–E]-type macrosystem. An initial incompatibility of systems founded: a "vehicle" as a "linear" system, which is characterized by the "part–whole"-dichotomy; "man" and "environment" as open, non-linear, self-organizing systems, which is characterized by the "whole in a whole" concept. For open, non-linear, self-organizing systems

(ONLS) in post-non-classic and "thinking in complexity" fundamentally different principles and behavioral features are shown in comparison with linear and closed ones.

It is shown that the [D–C–E]-type macrosystem is ***complex***, it is characterized by *openness*, *self-organization*, *human-* and *psycho-dimensionality*, *non-linearity* of development and *instability*. It was hypothesized that the main cause of the road-accidents is not a "human factor" (as accepted by most researchers), but a certain incompatibility between such units, connected within the [D–C–E]-type macrosystem and belonging to different classes, as open non-linear system (ONLS) "Driver", closed linear system (CLS) "Vehicle" and ONLS "Environment" (1) and the emergence of a "***critical difference***" in the interaction of such complex systems of different classes (2).

It was shown that none of the general scientific methodological approaches (structural, functional, holistic, elemental, systematical, cybernetic, ecological, synergistic) reflecting multiclass nature of systems, assembling [D–C–E]-type macrosystem, and consider them in terms of "whole in a whole"-concept.

It was established the need to accept a security paradigm as a scientific branch on the basis of the methodology of creating a model of a non-traumatic/ecological connection without combining the multiclass subsystems into a single macrosystem with a "mega-control". The basic idea is to take into account the "critical difference" between a human-dimensional and/or psycho-dimensional system [D] and a system of movement, in this case a "car", accounting for the fundamental difference in the systems entering into the [D–C–E]-type macrosystem.

Discussion

The main idea of this work is the study of the [D–C–E]-type macrosystem, considering the fact that it includes systems of different classes. In terms of post-non-classic science, there are: closed linear systems (vehicle); open non-linear human-dimensional (V.S. Stepin) [16, 17] and psycho-dimensional self-organizing systems/environments (I.V. Ershova-Babenko); open non-linear self-organizing systems (nature). The paper suggests a hypothesis about the impact of the system class on safety and the need to take into account the degree of matching / mismatching of the class of systems entering into the [D–C–E]-type macrosystem and proposed the conceptual model of psychosynergetics "whole in a whole" (I.V. Ershova-Babenko) [6, 7] as the most adequate in the methodological aspect. The "whole in a whole" or "environment in an environment" concept allows us to consider human- and psycho-dimensionality as a factor affecting safety, not through automation (since it adds to the burdens on man and nature (N. Taleb) [18]), but through the methodological matching of the "openness/closure" parameters of the assembling systems. This concept will also allow to take into account the existing degree of inadequacy of systems [D] and [C] and the possible degree of adequacy

that can be obtained in the design of the car. In the paper, it is proposed to investigate the [D–C–E]-type macrosystem from the standpoint of the conceptual model "whole in a whole", since it deals with the interaction of "heterogeneous" integrities (driver, vehicle, environment). Defining the type of integrities relationship ("whole in a whole", "complex in a complex"), the new quality of the "whole" [D–C–E]-type macrosystem is determined by the ***nature of the communications and the emergence of matching/mismatching between different integrities***.

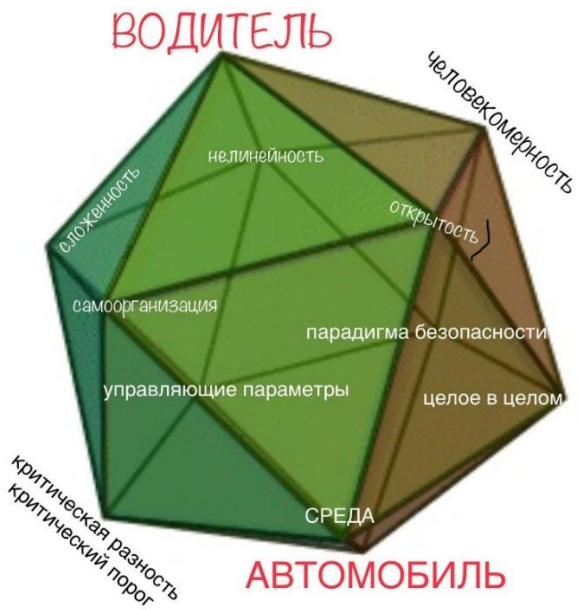
For open, nonlinear, self-organizing systems (ONLS) in post-non-classic, fundamentally different principles and behavioral features are shown in comparison with linear and closed ones.

In accordance with this idea, a new post-non-classical interpretation of a complex [D–C–E]-type macrosystem is proposed and takes the following form: [C^{fD}-E], where such a changes of the vehicle quality vehicle and the type of relationship within the macrosystem are implied so they become a "friendly interface" and the "C^{fD}" component is treated as a "vehicle", designed to fulfil the requirements of the "driver's" human- and psycho- dimensionality, the advantages and weaknesses of latter. Then, by regulating the degree of matching (critical difference), one can influence safety in a fundamentally new way - by approximating the consistency of system behavior in terms of "openness/closure", "linearity/non-linearity", and their assembly. Traditionally, the design is aimed at creating an automated system [C–E] (3), which excludes attention to the person, but preserves, and sometimes exacerbates, the safety problem.

We propose to use the post-non-classical conceptual model "non-linear whole in non-linear whole" by prof. I.V. Ershova-Babenko [6, 7], in which both non-linear "wholes" and their combinations and the hyper-system can become and become a mega-level that fulfills the function of the "control parameter" of hyper-slow variables according to H. Haken. In [6, 7], the notion of a "floating" regime of the "control parameter" was introduced to emphasize that the evidence of this parameter, its "perceptibility" are not continuously fixed, although they can be detected by changing the scale of the examination and reaching an adequate scale.

The interaction of core meanings (the semantic kernel) of this work can be organized on the basis of Platonic solids, using the knowhow of the researcher V.B. Yezersky [6], the author of #AlphaGravity. Platonic solids are convex polyhedrons, all faces of which are congruent, regular polygons. Only five solids meet those criteria, as this was proved by Euclid: a regular tetrahedron, cube, octahedron, dodecahedron and icosahedron. Four of them personified four classical elements or substances: tetrahedron is associated with "fire", cube with "earth", icosahedron with "water" and octahedron with "air". The fifth polyhedron, the dodecahedron, symbolized the "whole universe". This work and its 12 key words correspond to the icosahedron, a body limited to twenty polygons; the regular icosahedron is bounded by twenty equilateral triangles. Revealing the opposition of conceptual pairs, the conflict energy begins to work for the creative one, non-destructive element of the

systems interaction in the [D–C–E]-type macrosystem, otherwise, when the "critical difference"/"critical threshold" is reached between the conflicting pairs, the destruction of the macrosystem is inevitable.



Pic.1 The semantic kernel of keywords

Conclusion

The results of our research suggest that the [D–C–E]-type macrosystem is an open, complex, non-linear, unstable system in which self-organization processes occur. To ensure the safety of the [D–C–E]-type macro system, it is necessary to take into account the role of post-non-classical macro- and mega-modeling in the presentation of the familiar "driver-vehicle-environment" [D–C–E] system from the current scientific positions in aspect of the "whole in a whole" concept. In addition, it should take cognizance of new interpretation of the macrosystem "integrity" through the multidimensionality and inherent conflict of its constituent components. As a result, we obtain a (Open-Closed-Open)-macromodel, in which openness, self-development and self-organization prevail. With the exclusion of human, this prevalence is lost. Formally, there is an equilibrium in which there is no human. Nature and machines coexist perfectly, but this is another civilization.

Recommendations

A new [C^{fD}–E]-type macrosystem will ensure and improve the level of safety for a driver by:

1) reduction of the "critical difference" due to the rate of class matching/mismatching of systems being combined into a macrosystem;

2) the approach organization level of the macrosystem to the characteristics of the human psycho-dimensionality, since this will ensure its safety, allow maximum intensification of human-dimensional and transport processes by using

their natural capabilities in accordance with the methodology of psychosynergetics, post-non-classics;

3) adaptation of resource-saving technologies, for example, the type of Sky Way string transport concept (levels of energy, ecology, information, comfort etc.);

4) taking into account not only the advantages, but also the "weakness" of this "-dimensionality", which is also included within the indicator "the degree of matching between systems assembled to a [C^{fD}–E]-type macrosystem" [2].

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АННОТАЦИЯ

Гончарова О.Е. Проблема безопасных экологичных взаимодействий человекомерных сред и технических систем на примере сложной системы «водитель/человек- автомобиль-среда» в аспекте мышления в сложности

Целью работы является исследование возможности нетравматичных экологичных взаимодействий систем разных классов таких, как «водитель» [В], «автомобиль» [А], «среда» [С] в единой макросистеме «водитель/человек–автомобиль–окружающая среда" [В–А–С] для обеспечения безопасности дорожного движения. ***Методология исследования.*** *Исследование ключевых положений проблемы безопасности сложной системы «водитель–автомобиль–среда» [В–А–С] проведено в контексте основных принципов постнеклассики и «мышления в сложности».* ***Результаты исследования.*** *Впервые введено понятие сложной* ***макросистемы нового типа****, соединяющей системы разного класса как самостоятельные «целые» на основе концептуальной модели постнеклассики «целое в целом». Выдвигается гипотеза, что главной причиной ДТП является определенная* ***несовместимость*** *в рамках макросистемы [В–А–С] соединяемых в ней систем [В], [А], [С] по показателям принадлежности к разным классам (1), что обуславливает возникновение критической разности/критического порога при взаимодействии сложных систем разного класса (2).* ***Практическая значимость исследования.*** *Рост дорожно-транспортных происшествий (ДТП) формируется совместным взаимодействием систем [В], [А], [С] в единой макросистеме. Новое качество макросистемы [В–А–С] определяется характером связей и возникновением согласованности / или рассогласованием между различными целостностями в единой макросистеме.* ***Выводы и перспективы дальнейших научных исследований****. Ставится вопрос о необходимости принятия* ***парадигмы безопасности*** *как научной отрасли на базе методологии нетравматического соединения систем разного класса в единую макросистему.*

Ключевые слова: *водитель, автомобиль, окружающая среда, «целое в целом», парадигма безопасности, мышление в сложности, открытость, нелинейность, самоорганизация, человекомерность, параметры порядка, критическая разница/ критический порог*

РЕЗЮМЕ

Гончарова О.Є. проблема безпечних екологічних взаємодій лудиномірних середовищ та технічних систем на прикладі складної системи «водій/людина – автомобіль - середовище» в аспекті мислення в складності

Метою роботи є дослідження можливості нетравматичних екологічних взаємодій систем різних класів таких, як «водій» [B], «автомобіль» [A], «середовище» [C] в єдиній макросистемі «водій/людина–автомобіль–середовище" [B–A–C] для забезпечення безпеки дорожнього руху. ***Методологія дослідження.*** *Дослідження ключових положень проблеми безпеки складної системи «водій-автомобіль-середовище» [B–A–C] проведено в контексті основних принципів постнекласікі і «мислення в складності».* ***Результати дослідження.*** *Вперше введено поняття складної макросистеми нового типу, що з'єднує системи різного класу як самостійні «цілі» на основі концептуальної моделі постнекласики «ціле в цілому». Було висунуто гіпотезе, що головною причиною ДТП є певна несумісність в рамках макросистеми [B–A–C] систем [B], [A], [C], що з'єднуються в ній, за показниками приналежності до різних класів (1), що зумовлює виникнення критичної різниці / критичного порога при взаємодії складних систем різного класу (2).* ***Практичне значення дослідження.*** *Зростання дорожньо-транспортних пригод (ДТП) формується спільною взаємодією систем [B], [A], [C] в єдиній макросистемі. Нова якість макросистеми [B–A–C] визначається характером зв'язків і виникненням узгодженості / або неузгодженістю між різними цілісностями в єдиній макросистемі.* ***Висновки і перспективи подальших наукових досліджень.*** *Ставиться питання про необхідність прийняття парадигми безпеки як наукової галузі на базі методології нетравматичного екологічного з'єднання систем різного класу в єдину макросистему.*

Ключові слова: *водій, автомобіль, навколишнє середовище, «ціле в цілому», парадигма безпеки, мислення у складності, відкритість, нелінійність, самоорганізація, людиномірність, параметри порядку, критична різниця / критичний поріг*