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To cite this article: S A Timashev 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **481** 012023

IOP Conf. Series: Materials Science and Engineering 481 (2019) 012023 doi:10.1088/1757-899X/481/1/012023

Infranetics: The New MAICS-convergent Technology Science

S A Timashev[1,2,3]

[1]Sci.& Engng Center “Reliability and Safety of Large Systems and Machines”, Ural Branch, Russian Academy of Sciences, Yekaterinburg 620016, Russia
[2]Ural Federal University, Yekaterinburg 620016, Russia
[3]Old Dominion University, Norfolk, VA, United States

E-mail: timashevs@gmail.com

Abstract. The paper describes the basics of a new convergent science- Infranetics- based on the MAICS-convergent technology (Digital Stochastic **M**echanics, **A**rtificial Intelligence, **I**nformation Theory, **C**ognitive and **S**ocial Sciences). The name Infranetics comes from I*nfra*structures + Cyber*netics.* Infranetics is being constructed for solving the central problem of safe innovative development of a region/territory/municipality by creating a methodology of harmonized regulation of regional risk. This methodology is based on optimal management of systems of interdependent critical infrastructures (ICI) that play crucial role in the sustainable development of a modern society of risk. To this end following four aggregate optimization criteria are proposed: 1) regional average life expectance at birth (RALE); 2) regional (municipal) life quality index (RLQI); 3) resilience of regional systems of interdependent smart infrastructures (RICI) and 4) spatial entropy of creation and destruction of a regional system of ICI. Infranetics is a useful tool of managing and governance for regional decision makers (DMs), as they can track how their decisions influence the RALE, quality of life and the wellbeing of their citizens/constituents. The paper demonstrates how Infranetics is used to solve real life problems related to regional resilience and governance.

1. Introduction

Current basic research develops simultaneously in two directions: 1) according to the internal logic of fundamental science, when solution of one problem usually automatically creates another problem for the researcher to tackle. In this case the form and time (if it ever comes) of applying obtained results is unknown; 2) following the demands of the society and the logic of technology development, when obtaining any fundamental or applied result is put into a specifically designed research plan (e.g., deciphering of the human genome, exploration of the surface of Mars, discovery of the Higgs boson). This kind of research is financed considering the assigned time table for receiving the needed results. Though both directions are equally important, the academic science suffers ever increasing pressure of the modern society to satisfy its requirements not only in the long-term, but also in the mid-range and even short-term perspective.

The infrastructures, facilities and machines to be designed or already in operation must have such crucial characteristics as reliability, *resilience*, safety, strategic preparedness and moral durability. It is not yet quite clear how to correctly formulate and solve variable problems of mechanics which account for all the enumerated above aspects of a future critical infrastructure, but efforts in this direction should be undertaken without delay.

In this aspect the approach based on a pre-fixed objective, that dictates the volume and composition of the needed basic research seems to be promising. To obtain in time an adequate and fast solution of the reliability and safety problems of complex systems it is necessary to be able to synthesize the already existing and proven theories. More and more often the problem definition must simultaneously consider the technological and social environment in which the presumed scientific result is planned for application, all other considerations being subjugated to this principle. Here we are talking about the methodology of solving *interdisciplinary* problems. Currently, there are two equal approaches to this problem. According to the first approach a scientific or scientific-technological problem of fundamental science (for example, Moon expedition or green development of the Arctic) is divided into components, each of them to be studied by a separate group of scientists. These groups are either independent from each other, or weakly coordinated. This kind of activity, though leads to new knowledge about basic patterns of the phenomenon under study, not necessarily leads to solution of the problem in consideration. This could be due to the lack of an umbrella-unified approach to the problem and, hence, inconsistencies between directly related results both in essence and in form. Here we purposefully do not consider usefulness of independent explorations exercised in smaller-scale or intrinsically narrow researches.

The second approach is logistically more complicated both in the scientific and organizational aspects and has not yet been widely used. Its essence is in that a unified concept is designed of how the considered problem can be solved. In the frame of this concept, the problem is divided in a way that a chain of interrelated tasks is arranged (Fig. 1). Solution (output) of the first task is the input data for the second task, and so on, until solution of the last task delivers the necessary new knowledge/product. This approach is likely to be the only one that allows obtaining new *basic* knowledge that is of immediate practical or commercial value.

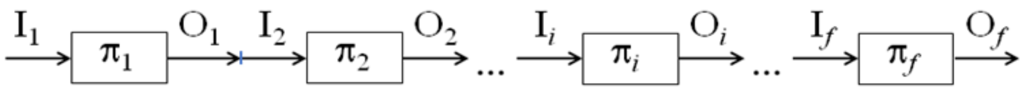

Figure 1. Flowchart of a novel solution of interdisciplinary problems.

I_i – i-th input; O_i – i-th output; π_i – i-th problem of the solution chain; O_f – final output that delivers the sought new knowledge/solution of a technical innovative problem. Each problem could be from a different science or branch of engineering

Recently, a new concept of solving interdisciplinary problems that shores up the second approach emerged. It started, unnoticed, much earlier within the community of engineering sciences, out of necessity, by default, when different types of specialists were brought together to form a team for solving practical scientific problems (say, quantification of the notion of resilience), or create a technological innovation (e.g., an smar**t** phone or an electric car). But officially it was consciously brought to life in the natural sciences, that picked up this idea in 2002, when M. Rocko and V. Bambridge introduced the notion of convergent technologies (sciences) [1].Convergence of technologies is the integration of various disciplines in the process of conducting scientific and/or research activities. The historically first basic convergent technology was dubbed NBIC-technology, as it refers to the process of interpenetration of four groups of technologies: nano-, bio-, info- and cognitive. Russian science added to NBIC one more component – social and humanitarian technologies, and named it the NBICS technology [2]. These are rapidly developing sciences and technologies with high economic potential and practical applications. The defining principle for them is the creation of a new, Nature-like technology-based economy, crucial to social development and national security.

2. Contemporary convergent technologies/sciences

In modern natural sciences several convergent technologies are used. Currently, NBIC is only one of the most common basic concepts in convergent technologies. For example, American NSF supports three such concepts:

- NBIC (Nanotechnology, Biotechnology, Information technology, + Cognitive Science),
- GRAIN (Genetics, Robotics, Artificial Intelligence + Nanotechnology) and
- BANG (Bits, Atom, Neurons, Genes).

The European Union is funding the concept called *Convergent Technology for the European Knowledge Society*. It wouldn't be an exaggeration to say that main features of modern development of the natural sciences are: transition to nano-scale; paradigm shift from analysis to synthesis; convergence of nonorganic and organic chemistry; *interdisciplinary approach* vs. narrow specialization. Some representatives of natural sciences believe that the future of science belongs to the development of multidisciplinary and interdisciplinary NBIC technologies [2, 3].

Modern technology needed for creating competitive products and providing support for high quality of life for the modern "risk society" is implemented using *infrastructure systems* which consist of: 1) *smart hardware* (instruments, appliances, machines, computers, robots, structures, buildings and facilities); 2) *software* (Internet of Things (IoT), software systems that implement the logistics of production, services and livelihoods, as well as systems using institutional knowledge, social and cultural practices, for creating industrial and social regulations), and 3) A *cohort of professionals* who manage and maintain those systems. Together, this *triad* forms the space of global *infrastructure*, distributed across the whole planet. In the apt words of the famous Russian writer, M. Gorky, it is the *second, manmade, Nature*, and in contrast to the first Nature, is a continuously and fast-growing global phenomenon. This, second universe, needs its own set of convergent technologies that could create synergy among the global infrastructure triad.

This trinity of infrastructures as an object of study is essential, as it naturally connects the materiel production, organization of its efficient operation, and the social and the cultural human factors. This fact directly links the infrastructures operation indicators with the quality of life and the gross domestic product (GDP) of a municipality, region, country and humanity as a whole.

For a full picture it is necessary to give a very short revue of modern infrastructures. As a scientific object critical infrastructure may be defined as a multi-component distributed bio-geo-technical system "society - man – critical infrastructure – environment" (SMCIE), consisting of a set of interdependent and interacting assets and groups of people considered in a particular area within a certain period of time. Such distributed system of ICI must: 1) provide stable operation of any potentially dangerous object (further PDO) or a whole industry sector; 2) sustain normal social processes and regional growth within a municipality.

Usually CIs are materialized as networks, distributed over a certain area. In general, there are hardware, software and social infrastructures. As separate infrastructure is a system, it is possible to speak of *system of systems*. The most important infrastructures created to provide safety and life security, stable growth of economy and society are termed critical infrastructures (CI). The most essential of them ensuring energy and economic security of a country as well as defending its core interests are termed strategic infrastructures (SI). Modern systems of infrastructures are specified as *interdependent* (SICI). SICI are a *conductor and mediator* between natural environment and the society (population of a certain region) and at the same time, the main means to maintain life support, and the main source of accidents that damage the environment, and disasters that negatively influence the population residing in the area.

Examples of critical infrastructures: mineral extraction/production, transportation and distribution of gas, oil and oil products, generation and transmission of electricity; chemical productions; water supply and heating; railway network, motor roads, airports, inland and coastal shipping; dams and levees; telecommunications, internet and world wide web including (enterprise) internet of things; agriculture, food production and distribution; scientific-educational institutions and public health; security services (Ministry of Internal Affairs, Ministry of Emergency Situations); banking and finance; postal services; commercial services, etc.

Examples of strategic infrastructures: nuclear reactors, materials and waste storage; defense industrial base; space infrastructures; critical manufacturing; information technology systems; central state institutions; some national monuments. Modern infrastructures are the backbone of the economy, the means of sustainable GDP growth, extension of the average life expectancy of a healthy population and an indicator of the country's power.

The convergent technologies are designed to respond to all the challenges of modern society, especially in the developing and poor countries. It is necessary to find effective solutions to refurbish such mega-objects as the energy and transportation infrastructures, the *construction sector*, as well as the basic production assets, networks, logistics, the sector of municipal services, and the like. In addition, there is a need to develop new industries of preservation and reproduction of human health, creating a highly organized living environment. This group of challenges *requires its own special set of convergent technologies.* Among them there is a separate group of unique challenges – the *need for a complex infrastructure upgrade* of developed areas, especially cities, where by 2050 more than 70% of the world population will live.

3. Infranomics – the universal discipline

The applied science and engineering community was seeking, in its own way, how to tackle the planetary scale problem of infrastructures design and control, viewing them as system of systems (SoS). The rapid growth of new types of infrastructures and high awareness of their role in sustainable development of modern society of risk, led to the concept of a new universal synthetic scientific discipline, namely, *infranomics (*or political economy of infrastructures*). Infranomics as a* term and its interpretation (*infranomics= infra*structures+eco*nomics)* was given in 2007 by Prof. A. Gheorghi of ODU (Norfolk, VA USA), to include *all the knowledge that ever may be required* to solve all the problems of critical infrastructures [4], but as yet, without reference to their relationship with each other (as it was done, in ancient times, by geography (a term, coined by Strabo),which included formalistically, almost all the knowledge accumulated by ancient Greeks, Egyptians and Assyrians. Gradually, it spun off over the centuries, such related to it disciplines as geodesy, geology, geo-physics, geo-chemistry, geo-ecology, geo-hygiene, geo-cancerology, and even geopolitics (see Fig. 2). Pursuing this line, it is appropriate to say that infranomics as a term is alike geography, a new universal umbrella science. Since none of the existing disciplines can provide the necessary decisions, *infranomics is meant to serve as the* discipline of disciplines, gathering all the knowledge required to solve critical infrastructures' problems.

According to [4], currently infranomics is a loose set of theories, assumptions, models, methods, and associated scientific and technical tools which are required for studying concepts, design, development, application, operation, management, maintenance, supply, resilience and survivability of meta-systems. Infranomics is meant to support analysis and decision-making process with respect to the meta-system (i.e., the entire plethora of technical components, stakeholders (those interested in financial success of the enterprise), ways of thinking, legal restrictions, etc.

4. Infranetics – an off-shoot of infranomics

Using the above geography-analogy, a new convergence science/technology should be shaped using the NBIC(S)-type concept in relation to the problems of the 21-st century second Nature. In order to achieve this, several issues should be first considered.

Infrastructures are the backbone of the world economy, the means of sustainable GDP growth, extension of the average life expectancy of a healthy population and an indicator of a region’s strength. Neither the regional authorities nor industry nor academic institutions can afford to ignore the observed onset of the new combination of possibilities and risks that accompanies the emergence of a new generation of infrastructures [4]. The shape of modern society in the nearest future will be defined by the characteristics and services provided by the next generation of infrastructures. It seems necessary to develop the concept of convergent technologies that would best fit the solution of infrastructure problems. The world science community as represented in the UN concluded that the solution of the central problem of safe innovative development of a region/territory/country can be found by creating a *methodology of harmonized regulation of regional risk that amounts to optimal governance*. This methodology should be based on optimal management of systems of interdependent critical infrastructures (ICI) that play crucial role in the sustainable development of a modern society of risk. Research in this area is conducted by intersecting and cross-pollinating many disciplines, including previously unrelated bodies of research from different branches of sciences and engineering, to holistically solve the problem of optimal functioning of the planet's second nature. To achieve this goal, in this paper following working hypothesis is formulated and used: T*erritorial risk management /governance can be boiled down to managing/controlling the system of systems (SoS) of interdependent critical infrastructures (ICI), including fully the human factor component.*

The basis for the convergence of engineering science and technology in the general and cross-cutting issues of managing systems of interdependent critical infrastructures, are to varying degrees based on 1) digital mechanics (of solids, hydro-and air-) including assessing the likelihood of the events that initiate the accident and are responsible for the consequences of infrastructure failures; 2) theory of control (cybernetics) of large stochastic man-machine-environment systems with uncertainties, and 3) human factor analysis on the personal and social level. The outlined above allows offering [5], as an option, the following abbreviation for the convergent technologies/sciences that aim to holistically and quantitatively solve the main current and future problems of optimal functioning of the planet's second nature: **MAICS--** Digital Optimal Design and Stochastic **M**echanics, **A**rtificial Intelligence, **I**nformation Theory, **C**ognitive Science, **S**ocial Sciences**.** MAICS-- technologies may be spun off of infranomics and named *infranetics* (**infra**structures + cyber**netics).**

Infranetics as a convergent science emerged not as a whim, but as a logical outcome of efforts to overcome the intrinsic difficulties that are specific to the problem of managing SoS of critical infrastructures. This new discipline deals with: problem formulation; decomposition and downsizing of the multi-dimensional problem; indicating and developing methods for describing a new highly specific mega-object; choice of solution methods with accounting for their mutual compatibility; discovery and filling of information gaps. It also provides for the first time initial means for studying the *quantitative relation between the tangible and the intangible*: the quality of performance of SoS of CI with the quality of life and wellbeing of the society (see Fig. 3).

Figure 2. Analogy between ancient geography and current infranomics.

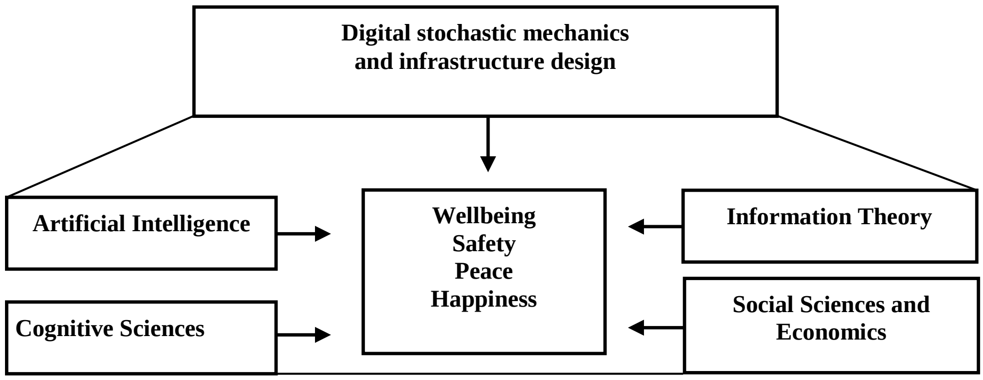

Figure 3. Framework of infranetics as a MAICS-convergent science.

5. Main Traits of Infranetics

The main features of infranetics as the research tool of modern infrastructure research and development could be formulated as follows. Infranetics uses goal-oriented approach according which a unified concept is formed that describes compatible ways and means for solving the problem in consideration. It manifests an *interdisciplinary approach* rather than narrow specialization, and accounts for *human factor* on each stage of the CI's life cycle. Infranetics transits from the analysis paradigm to the *synthesis paradigm* (especially, when using large amounts of raw data). It creates and uses *modern digital tools* for design (stochastic structural mechanics and mechanics of fracture, structural reliability and resilience), diagnostics, monitoring, maintenance/management and governance. It also transits to *nano-sizes* (in diagnostics, monitoring, protection against cyber-attacks).

6. Priority unsolved issues of Infranetics

From the stand-point of MAICS-technology following hot-spot issues are of first priority:

- Simulation of engineering and natural loads and impact on the elements, components and infrastructures as random functions/processes of time and coordinates, including global changes of climate;
- Methods of assessing the reliability and safety of multi-element systems subjected to combinations of random loads, physical fields and chemical processes;
- Diagnostics and monitoring methods of structural, functional and balance reliability and remaining lifetime of systems, structures and facilities;
- Damage assessment methods for infrastructures considering all the related uncertainties;
- Principles and methods of predictive maintenance of facilities, structures and systems;
- Methods and devices for systems condition and operation control and management;
- Theory of assessing complex risk of operating infrastructures;
- Optimization of selecting the devices and measures reducing the PoF and operating risk, under condition of restricted means;
- Practical methods of assessing *resilience and strategic preparedness* of critical infrastructures;
- Governance of SoS of infrastructures that connects their resilience with regional healthy life expectancy (HLE);
- Optimal governance theory of interdependent critical infrastructures.

7. Governance through infranetics

Safety protection is an important, but not the only purpose of the society. The society can allocate a certain share of resources for safety protection that must be continuously specified, since the society has other needs, such as clean air and water, healthy food, housing, health care, provision of pensions, education and other social services, which also increase healthy life time and its quality.

Management of a territory / region and its human conglomerates in the form of metropolis, cities, municipalities, companies, businesses, etc., is carried out by elected or appointed decision makers (DMs), each of which is expected to (quasi-) independently make decisions within her (his) competences and on their specific level. This group of DMs, together, collectively, but not in a tightly organized way, *de facto* controls (governs) such entities.

Governance as a term refers to all of the processes of state and social governing, whether undertaken by a regional government (city administration, directors of enterprises), market or network, whether over a family, tribe, formal or informal organization or territory and whether through the laws, norms, power or language [6,7]. Governance refers to the processes of interaction and decision-making among the authorized persons involved in a collective problem that lead to the creation, reinforcement, or reproduction of social norms and institutions.

Actually, current governance is about (quasi)collective management of territorial or regional risk in conditions of uncertainty of the modern world. In this general theoretical definition, we focus on the aspects related to management of SICI embedded into certain regional industrial or social networks, using confirmation or reproduction of national technical and social standards.

The practical conclusion from this concept is the need to orient theoreticians and applied scientists – experts in the field of risk – to meet the challenges of the tasks generated by the regional DMs in the daily management of the operation of the ICIs and ISCIs.

For this category of leaders it is necessary to create practical harmonizing decision-making support tools related to the effective functioning of regional enterprises and institutions, in the context of providing social needs and life options to individuals and regional society as a whole, according to the laws, ethical and aesthetic norms, historically formed in different regions of the country. This broader approach to governance allows selecting the best criteria for the design and long term operation management of ISCI that provides for sustainable development.

Key element in considering complex territorial risk is assessment of operation of interdependent critical infrastructures under the impact of natural, technogenic, mixed and all types of deliberate accidents and catastrophes. Safety and resilience of the existing and newly established ISICIs has a direct impact on the rate of innovations and adoption of new technologies, future industrial capacity and growth of the gross domestic and regional domestic product (GDP/RDP). The current stage of development of regional infrastructur**es** and their capacity to create principally innovative infrastructures (i.e., smart power grids with built-in diagnostics, monitoring and protection systems, “green” buildings with solar power supply, motor roads generating electricity from moving cars, etc.) determines the future investment attractiveness of the municipality/territory.

8. Regional governance criteria

The conditions of *regional governance,* when regional-scale DMs make decisions based on their corporative or territorial criteria, requires having *harmonizing* benchmarks for all the regional entities (actors/players).

This paper offers from interdisciplinary positions an essentially novel approach to proactive predictive management of operational regional risk of SoS of critical infrastructures using the maximum social benefit criterion. It involves designing a methodology of assessing and managing regional risk, based on following four novel generalized indicators: regional healthy life expectancy (HLE); regional (municipal) life quality index (RLQI); SICI resilience, and origination and degradation entropy of regional SICI.

Average life expectancy in good health. HLE is proposed as the first integral parameter of risk value because it is an imperative indicator of municipality/regional sustainable growth. Research demonstrates [8] that actual regional HLE, having a biological limit and certain fractal properties, is a solution of a system of differential equations and can be presented as a logistic function of time. HLE depends on the current value of territorial HLE and the society’s development level, as well as on optimality of the annual distribution of regional/municipal domestic product (RDP) for accumulation, consumption and safety control systems (protecting SICI, its staff and population against industrial accidents/catastrophes).The latter value indicates which means (a part of budget, RDP) may be used for reducing lethal accidents of ICI components and, consequently, the rate of decreasing or increasing death/ mutilation in a given area, and, consequently, its quantitative effects on the region's HLE.

Regional Life Quality Index (RLQI) is an integral social index that fuses the structural-functional reliability and safety of the elements, facilities and structures of ICI with economic indicators of their operation (regional domestic product) and social aspects of an area's sustainable growth (HLE and employment of population).Using RLQI allows the regional decision-makers (DMs) to pursue a balanced policy of managing the state, municipal and private property located in the given area (i.e. governance). RLQI is a non-additive parameter which provides seamless linking of indicators of mechanical, technological reliability and safety of the elements, facilities and structures of ICI with economic indicators of their operation and social aspects of sustainable growth of the area, including the generalized task of territorial safety and risk management.

Regional resilience is a very complex concept, which can be described as an *emergent* property of the territorial SoS, including the regional community. In a nutshell, regional resilience manifests itself in the quality of the reaction on a disaster or catastrophe: how fast and at what cost it rebounds to the pre-catastrophe state. The procedure of assessing this trait using infranetics tools is shown below.

Regional entropy. Modern physics supplies a useful tool – entropy principle - to generalize all the engineering and scientific parameters of an infrastructure problem. The principal idea of using entropic principle in interdisciplinary assessment of ICI efficiency is that the problem of the curse of dimensionality is removed due to reducing a multi-dimensionality task into (quasi) one-dimensional problem, since the dimensions of all the physics-engineering tasks under study are reduced to a single non-dimensional one – entropy. Simultaneously its correlation with probability of an accident or catastrophe (risk) is established.

9. Show-cases of implementation of the infranetics principles and techniques

The volume of the paper doesn't allow for any deployed examples of infranetics usage. So we restrict ourselves to two generalized cases. The first case shows how to parse an interdisciplinary problem into a solution-aimed chain of sub-problems which, in their totality, give the needed answer. In the second case the problem of regional governance is formulated, showing which disciplines, and who from the community of the municipality/region should be involved to solve the problem.

9.1. Case #1.Risk analysis of a main oil pipeline.

In order to conduct this kind of analysis it is necessary to verbally describe the whole chain of possible events that lead to the oil spill-catastrophe (Fig. 4). This will open the possibility to define/select the disciplines that could quantitatively describe each of the events (Fig. 5).

Then the problem is parsed into a chain of separate sub-problems, but in a way that the solution (output) of the first link in the chain serves as the input of the second link (problem) in the row, and so forth, until the output of the last problem emerges as the new-sought knowledge and gives the general solution of the problem (Figs.1, 4). Means and ways of parsing the considered convergent problem into a chain of consecutive problems, each of which is interconnected with the *previous* and the *consecutive* problem in the considered case are dictated by the risk scenario. Formalization of the choice of the mathematical tools to be used for solving each of the problems of the chain in order to achieve compatibility (in form and in dimension) of the pairs of the '*i*-th output with the *i*+1-th input" in this case is also rather simple, as it flows from the physical property of each considered event. The details of this case may be found in [8].

When solving such problems researcher often discovers some yet missing theoretical and/or calculus components that need to be immediately solved in order to obtain the needed result in due time. Such info-gaps usually occur, as a rule, at the cross-sections of the disciplines involved in the research.

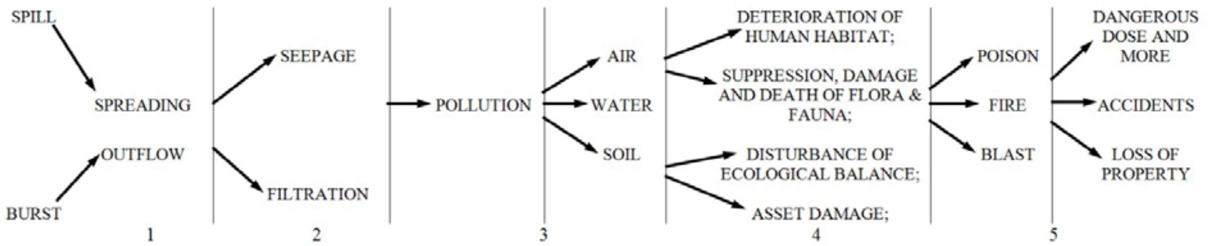

Figure 4. Main possible scenarios of a main oil pipeline spill.

STRENGTH OF MATERIALS, STOCHASTIC FRACTURE MECHANICS OF LARGE SYSTEMS, THEORY OF PLASTICITY AND STABILITY, STATISTICAL DYNAMICS, RELIABILITY THEORY OF LARGE SYSTEMS	HYDRODYNAMICS THEORY OF FILTRATION	AERODYNAMICS HYDRODYNAMICS THEORY OF FILTRATION	APPLIED BIOLOGY, ECOLOGY, THEORY OF ECOSYSTEMS, INDUSTRIAL MEDICINE	GAS DYNAMICS, COMBUSTION THEORY APPLIED AND BURNED MEDICINE, EXPERIMENTAL METHODS, COMPUTER MODELLING OF PROCESSES AND PHENOMENA
1	2	3	4	5

Figure 5. Main methods for describing stages of main oil pipeline critical failure (spill).

9.2. Case #2. Designing the regional risk management /governance strategy using infranetics concepts

The goal of the considered case is to build a strategy of optimal governance for a regional set of ICIs, using resilience as its main management tool.

This case is much more complicated than the previous one, because it deals with a set of interdependent critical structures, whereas case #1 considered just one critical infrastructure. The key element in considering complex territorial risk is in the assessment of resilience of interdependent critical infrastructures under the impact of natural, industrial/technological, mixed and all types of deliberate accidents and catastrophes, and its influence on the wellbeing of the community that works and lives inside the ICI cluster.

In Fig.6 the flow chart of constructing such strategy is presented. It can be seen that creation of such strategy involves a heterogeneous set of initial data and knowledge from multiple fundamental and applied, and engineering sciences. When solving this problem for several regions of the Russian Federation, author came across several info-gaps in macro-economics [9], demography, reliability theory of large systems [10], to name a few, which needed immediate attention, as they were road-blocks preventing reaching the assigned goal in due time. It seems that in this particular case infranetics concept threw new insight into the research problem; advanced research in several fundamental and applied disciplines; greatly enhanced and expedited the research.

Accumulating results of this kind of interdisciplinary research permits understanding what methods from what disciplines belong to infranetics. The results, obtained by the above scheme, make it possible to effectively manage the SICI in different types of municipalities and territories. Some details of this case may be found in [11-15].

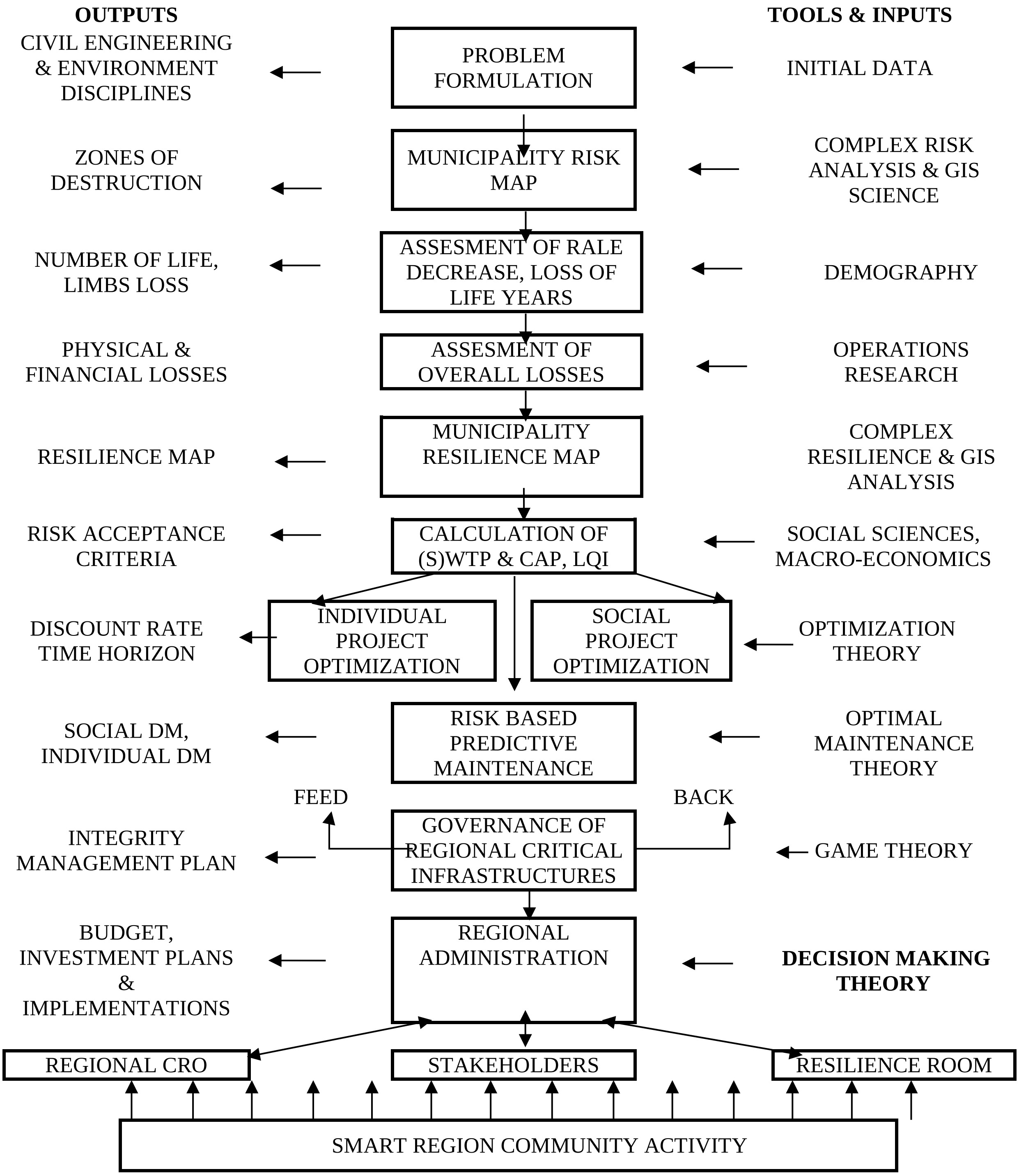

Figure 6. Regional governance strategy via regional resilience using infranetics principles and tools.

10. Conclusion

Infranetics manifests itself as a cross-pollinating complex-sciences discipline. It permits accurate-enough prognosis of the behavior of complex socio-technological and economic systems being designed or already performing, in usual and/or catastrophic situations. Infranetics uses goal-oriented approach according which a unified concept is formed that describes ways and means for solving the problem in consideration. If properly developed, infranetics could become the crucial discipline for governing municipalities and regions in the 21st century.

Infranetics creates practical harmonizing decision-making support tools related to governing of regional enterprises in the context of social needs and life options of individuals and regional society as a whole, according to the laws and historically formed ethical and aesthetic norms that exist in their region.

Infranetics makes possible effective regional governance via resilience of SICI in different moments of crisis, and to support decision-making in the daily operation of the CI, ICI and ISCI. The territorial and municipal level DMs receive a powerful tool for: monitoring and conducting predictive maintenance of CI; evaluating and minimizing territorial losses by *specific protection means*; supporting their intuitive and off-the-cuff decisions, especially in cases where the effects of these decisions will become apparent only in the distant future. DMs will also be able to monitor how their decisions affect sustainability of the quality of life, well-being and happiness of their constituents or employees in the long term.

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