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С 27 по 30 сентября 2021 года в Москве был проведен Конгресс WOSC2021 «Системный подход и кибернетика, устремленные в будущее человечества» – это XVIII мировой конгресс организуемый WOSC (World Organisation of Systems and Cybernetics). WOSC – организация с 50-летней историей, ее руководителями были Норберт Винер, Стаффорд Бир и ряд других ученых с мировыми именами. Подготовка конгресса велась в сотрудничестве с рядом ведущих международных ассоциаций и академий, в частности, WOSC (World Organisation of Systems and Cybernetics), ASC (American Society for Cybernetics), IASCYS (International Academy for Systems and Cybernetic Sciences), IFSR (International Federation for Systems Research) и др. С российской стороны в числе организаторов – Российская академия наук и ее специализированные институты, соответствующие тематике конгресса, а также ряд других научных и образовательных организаций. В каждой секции затрагивались в междисциплинарном рассмотрении проблемы цифровизации и искусственного интеллекта.

С учетом специфики сложившейся мировой ситуации конгресс имеет для России не только научное, но и научно-дипломатическое значение. Впервые научное мероприятие мирового уровня по проблемам управления социальными системами было проведено в России. Это, безусловно, успех нашей отечественной науки и наших ученых.

Сборник материалов конгресса представляет интерес для специалистов из гуманитарных, естественнонаучных и технических областей знания, ориентированных на проблемы управления и развития, для студентов и аспирантов, а также для широкой аудитории управленцев-практиков.

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From September 27 to 30, 2021, Moscow hosted the WOSC2021 Congress "Systems approach and cybernetics aimed at the future of mankind" - this is the XVIII world congress organized by WOSC (World Organization of Systems and Cybernetics). WOSC is an organization with a 50-year history, its leaders were Norbert Wiener, Stafford Beer and a number of other world-famous scientists. The preparation of the congress was carried out in cooperation with a number of leading international associations and academies, in particular, WOSC (World Organization of Systems and Cybernetics), ASC (American Society for Cybernetics), IASCYS (International Academy for Systems and Cybernetic Sciences), IFSR (International Federation for Systems Research), etc. On the Russian side, the organizers include the Russian Academy of Sciences and its specialized institutes corresponding to the theme of the congress, as well as a number of other scientific and educational organizations. In each section, the problems of digitalization and artificial intelligence were touched upon in an interdisciplinary examination.

Taking into account the specifics of the current world situation, the congress has for Russia not only scientific, but also scientific and diplomatic significance. For the first time, a world-class scientific event on the problems of social systems management was held in Russia. This is undoubtedly the success of our national science and our scientists.

The collection of materials of the congress is of interest to specialists from the humanities, natural sciences and technical fields of knowledge, focused on control and development problems, for students and postgraduates, as well as for a wide audience of practicing managers.

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The WOSC 2021 Congress Manifesto

Raul Espejo, Vladimir Lepskiy and Igor Perko

Important world institutions, such as the United Nations (UN), the World Health Organization (WHO), and the Organization for Economic Co-operation and Development (OECD) are publicly recognizing the highly interconnected nature of our world, and therefore the relevance of systemic thinking and cybernetics as leading knowledge foundations to deal with the complexity of economic, social and environmental issues.

The aim of the WOSC 2021 Congress is **to offer a platform for conversations and debates about societal issues from a CyberSystemic perspectives, reflecting upon aspects relevant to humanity's current and future viability**. WOSC and the Russian Academy of Sciences organised an online event for people from different parts of the world last September. Its focus was on climate change, water resources, immigration, health problems and other global and local strategic issues.

These conversations were underpinned by a cybernetic manifesto, driven on the one hand by the citizens' **rights** to possess **freedom, autonomy, and privacy** and, on the other hand, by their **responsibilities** to create, regulate and produce fair **social, ecological, and economic social systems**. People's rights and responsibilities emerge from their complex web of interactions as they constitute organisational systems.

We wish that the overall content of WOSC 2021 relates to these complex webs. **Citizens** contributions to society **need** more than information; they require **communications**. We believe this is an important distinction that this Congress wants to highlight. Messages exchanged by people are more than information bullets going from an origin to a destination through an empty space; the meanings of these messages emerge from the communication media underpinning these interactions (cf. Marshall McLuhan). Historically these media have been hierarchies and technology controlled by the few with power in society. Our proposal in WOSC 2021 is **to learn to how produce these networks through heterarchies**, that is, by non-hierarchical networks, **controlled by the power of the commons**. It is through these kinds of interactions that people can propose, **co-create, and produce social systems and construct better societies**. To achieve societies of the commons, we are proposing to overcome fragmentation and to learn more about how to develop holistic and socially responsible societies in the context of our current socio technical developments.

To address global research challenges, trans disciplinary, international, gender, age and backgrounds inclusive teams are required. Research communities are establishing, one way or the other, international networks, something that enable the exchange of research results and thus the sharing of knowledge. Nevertheless, the **research itself is often constrained** by national, regional or local organisations, restricting researchers to follow the limited agendas of their leaders and managers. Even with the desire to cooperate, global research teams serving humanity are hard to establish, manage and above all, finance. Thereby, in **WOSC 2021 we are advocating the support of global research collaboration, to enable formation of international research teams in pursuing goals beyond national, regional or business interests**.

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Since the postponement of WOSC 2020 last September was triggered by the huge impact of COVID-19, from the global society to the local individual, we think that we must highlight it in our conversations in WOSC 2021.

Focus on crises: COVID-19

COVID-19 is not only a global crisis for humanity, exposing the geopolitical weaknesses of nation/states to respond to a pandemic, it has also heightened a universal crisis by exposing individual people's weaknesses to cooperate, share resources and exhibit empathy in their daily behaviours. Similarly to the response to climate change, COVID-19 is making apparent that policies and mechanisms for global governance need much improvement at all levels. COVID-19 experiences are modifying social interactions and will profoundly alter the post-COVID-19 responses to current and future crises, such as climate change, unequal distribution of resources, different forms of discrimination, impact of digital technologies and others.

The lack of capabilities of the global and local communities to effectively fight against the pandemics has contributed to the awareness of wide sections of the population to their vulnerability in front to even relatively minor threats. And, we cannot ignore that the increase of interstate and civilizational tensions may be contributing to the emergence of new, potentially, devastating global threats.

The COVID-19 pandemic provides a cruel, but crucial lesson for understanding the readiness of humanity, and more widely of individual actors to adequately respond to global crises, as well as to study the relations between individual behaviours and their interests for the sustainable development of humankind. The pandemic is convincingly proving that the world community is lagging behind producing decisions to respond to emerging global threats. This leads to inappropriate waste of resources, the formation of unstable economic and political processes, and to the emergence of undesirable longer term consequences. The conclusion is obvious, humanity itself is in a state of crisis.

Researchers should offer new models of the consolidation of civilizations, states, corporations and society for joint organizations to act in the elimination of global threats. Can the perspectives offered by systems and cybernetics make a difference? What might be the role for new digital technologies and artificial intelligence? Can mankind find a means to overcome its reluctance to cognize and confront long-term systemic risks?

We are inviting to discuss in WOSC 2021 these crises from the viewpoint of the four themes that were presented in the WOSC 2020 programme and discussed in September of this year.

For a more enlightened crisis governance, it is fundamentally important to find the root causes of our societal lack of preparation to respond to crises. Various models have already been developed. We can draw our perspectives from the models that have been proposed in psychology, cybernetics, biology, law, economy and many others.

The analysis of the current situation starts with agents, which reflect the regulatory and interactive aspects of their activities (Lepskiy 2019, Espejo & Lepskiy 2020). We invite contributors to WOSC 2021 to explore five essential characteristics of CyberSystemic systems: purposefulness, reflexivity, communicative competence, networking capabilities and the ability for social development in complex environments.

Purposefulness. COVID-19 has convincingly shown that humanity lacks strategic goal-setting mechanisms. Humanity has not formed adequate mechanisms for aborting its outdated plans, for identifying global threats and for ensuring readiness to prevent and mitigate their effects. Systems thinking and cybernetics can provide mechanisms for the design and governance of inclusive interlinked purposeful systems.

Reflexivity. The COVID-19 pandemic has also shown that humanity lacks mechanisms to ensure adequate reflection related to the threats that have arisen, the methods of protection and neutralization of their consequences. We are lacking global institutions for scientifically grounded

operational reflection of emerging global threats and the mechanisms for developing a consolidated reflexive position of the world community on the emerging global threats. The systems approach and cybernetics can provide numerous studies on reflexivity related to the governance of social systems (Heinz von Foerster, Vladimir Lefebvre, Vladimir Lepskiy, Stuart Umpleby, Karl Müller, Dmitry Novikov and others).

Communicative competence. In the context of the COVID-19 pandemic, communication problems in the world community have clearly manifested themselves at a wide variety of levels from the state to the level of individual organizations and communities. The systems approach and cybernetics build on the early research and modelling of communications and media processes (cf. Norbert Wiener, Marshall McLuhan, Gordon Pask and others).

Social networking. In the context of the social orientation of humanity, the following aspects are most relevant: identity, freedom, social responsibility, ethics, spirituality of agents. We may be facing the disregard for these social dimensions in the process of overcoming the current crisis, which may continue way into the post-crisis period. Systems thinking can support aspects of social behaviour in works on social responsibility, participatory approaches and others.

Development in complex environments. In the context of the emergence of global threats to humanity, humanity must have the ability to self-organize, to form adequate types of agents. Systems thinking and cybernetics can provide models of self-developing, which would increase the ability to develop various types of social systems. It is fundamentally important to note the need to assemble agents into wholes based on a systemic approach that will integrate their characteristics beyond fragmentation (cf. Stafford Beer, Raul Espejo, Vladimir Lepskiy and others).

Taking into account the management and the consequences of COVID-19, the pandemic should guide the content of urgent problems to be discussed in WOSC2021. These guides are the proposed in the following four themes for this Congress:

Theme 1. Philosophical and methodological foundations for the development of the systems approach and cybernetics

Theme 2. Interactions in society: the cybernetics of society, ecology and governance

Theme 3. On digital technologies and human interactions: the co-development of a hybrid reality

Theme 4. Transdisciplinarity of systems sciences and cybernetics: developing areas of knowledge

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Keynotes

Removing Constraints on the Advance of Cybernetics

Stuart Umpleby

Purpose – Just as there are software versions, there are also versions of the prevailing conceptions of science and philosophy. Versions can differ by country or region. The purpose of this paper is to explain how the effort to develop cybernetics in the US has led to changes in the conceptions of science and philosophy in the US.

Design/methodology/approach – The approach of the paper is to explain what ideas in science and philosophy have been obstacles to the development of cybernetics and how those ideas are changing.

Findings As science has developed there has been a change from studying inanimate objects to working with thinking participants, both individuals and organizations. In the past scientists sought to use the same methods in the social sciences as were used in the physical sciences. Those efforts worked well for a time, but an interest in the roll of the observer and the relationship between theory and practice led to an awareness of the limitations of that approach. In management and operations research mathematical methods have been supplemented with group discussion methods.

Regarding philosophy, recent comparisons of cybernetics theories in several countries led to awareness that Europeans are using a larger set of conceptual possibilities than are Americans. Americans choose not to study a large part of philosophy. The history of philosophy can be thought of as a conversation between the followers of Plato and the followers of Aristotle. Europeans are familiar with this debate, but Americans are not. Europeans study the history of philosophy for two years in high school. They enter universities with a conception of how the knowledge in each field has developed from its roots in philosophy. One group, called realists, believes that knowledge is pregiven and needs only to be discovered. The other group, called idealists, believes that knowledge is created through our interactions with the world. The vast majority of Americans are familiar only with the realist perspective, having never encountered an alternative. The part of philosophy that has been neglected in the US was less important during an industrial society but is becoming more important due to the growth of an information society.

Europeans, by studying the history of philosophy, study the growth of knowledge in all fields. Americans tend to limit their studies to their primary discipline. They do not think about the growth of knowledge in general. This deliberate narrowing of interest makes Americans inexperienced in thinking about how knowledge grows in other disciplines.

There are several ways of describing cooperation among disciplines. Interdisciplinary research refers to research combining two or more disciplines, for example physical chemistry, statistical biology, or socio-economics. Multidisciplinary research occurs when several disciplines work together on a project, for example, how meteorology, hydrology, oceanography, and geology interact to produce the earth's weather. Transdisciplinary research refers to creating a more general theory encompassing the theories of several disciplines. Examples are systems science and cybernetics. Transdisciplinary research is important because it leads to knowledge that is helpful in facilitating communication among people in different fields.

Transdisciplinary research, which seeks to develop more general theories, has been neglected in the US because Americans have not emphasized the goal of unifying science by developing knowledge of how the disciplines fit together. In Europe scientific fields are thought to be rooted in philosophy. For example, Adam Smith, who founded economics, originally taught moral philosophy. Europeans enter universities with an understanding of how the various disciplines arose from philosophy. Among US scientists philosophy, beyond the philosophy of science is widely thought to be not practical or useful. Due to this belief there has been an overemphasis in the US on specialization. The consequence is that Americans have greater difficulty communicating with people in other disciplines than do scientists in

Europe. The part of philosophy that Americans are missing is important when conducting transdisciplinary research.

Originality/value – The value of this research is that it shows how Americans can become more effective at communicating across disciplines. Studying the history of philosophy and transdisciplinary theories such as systems science and cybernetics will aid the growth of knowledge in many fields.

Research/ Practical/ Social/ Environment implications - Changing assumptions in science and philosophy that limit innovation, will enable collaboration and cooperation among research fields and will help in generating more general theories, which is a goal in the effort to unify science.

Research limitations - Ultimate outcomes are speculative. Removing barriers in our thinking creates the possibility for more creativity, but it is not possible to know what specific new ideas will emerge.

Keywords:

Cybernetics, transdisciplinary research, innovation, questioning assumptions, philosophy of science.

Globalization 4.0: science and technology

Vladimir V. Ivanov

The world is in a state of global transformations caused by scientific and technological progress and the exhaustion of existing models of socio-economic development.

In the course of its development, humanity has passed through three stages of globalization: the exploration of territories, the spread of a single system of values through religion, the creation of a global market. At the same time, socio-economic development went parallel with scientific and technological progress.

One of the possible scenarios for further development may be the transition to a post-industrial society, in which the priority is human development, the predominance of intellectual labor over industrial. The formation of such a society will occur as a result of the humanitarian and technological revolution.

Meanwhile, significant changes will occur in the human environment, which in the new conditions should be considered as a system of nature-technologies-culture-information. Thus, humanity is moving to a new stage of development found on qualitatively new technologies that are based on the fundamental laws of the development of Nature, Human being and Society.

Reflexivity in cybernetics (philosophical and methodological analysis)

Vladimir Lepskiy

Reflexivity in cybernetics makes it possible to take into account not only the material, physical aspects of the description of systems, but also the subjective representations of various types of subjects included in social systems. The evolution of cybernetics is associated with an increased focus on reflexivity. Reflexivity was the key basis for the formation of the second-order cybernetics (V. Lefebvre, S. Umpleby) and the third-order cybernetics, self-developing reflexive- active environments (V. Lepskiy). For the philosophical and methodological analysis of reflexivity in cybernetics, we propose to use modern concepts scientific rationality - classical, non-classical, post-non-classical (V.S. Stepin). It is fundamentally important that the evolution of cybernetics corresponds to the evolution of types of scientific rationality. The report will analyze the specificity of reflexivity for various types of scientific rationality and cybernetics of the first, second and third orders.

Critical systems thinking and practice: what has been achieved and what needs doing

Michael C. Jackson

Critical systems thinking and practice began in the 1980s and is now an established part of the systems thinking tradition. Nearly 40 years later, it is possible to look back at what it has achieved in its lifetime and at what still needs doing if it is to fulfil its potential. To reach its conclusions, the review considers the theory and principles underpinning critical systems thinking – its commitments to ‘general complexity’, critical awareness, pluralism, and a radical change agenda. And it charts the development of attempts to translate those commitments into practice. In particular, the presentation discusses how the ideas can be made more accessible to decision-makers to enable them to manage the complexity with which they are confronted in today’s world.

From Homo Sapiens to Homo Digitalis

Sergio Barile

In the history of human evolution, we can recognize unique moments that, generally only by future generations, are definitively recognized as very important in the anthropological and social evolutionary process. These are those moments often remembered, conceptually borrowing from epistemology, as periods of paradigmatic change. Basically, in an interpretation translated from the philosophy of science in favor of a possible explanatory perspective of social phenomena, the paradigmatic change – which is essentially a cultural paradigm change –, can be considered a phase of profound change of those habits of thought and action that accompany the interpretative and behavioral dynamics typical of the ‘modus agendi’ of not less than 65% of the reference population.

In fact, even if it is difficult to understand and accept, most of our behaviors referable to the interpretation of information received, or to actions to be carried out in specific contexts of ordinary everyday life, are carried out through the application of interpretative schemes that lead to behavioral modalities well-established in practice. It is a mode of action common to almost all human beings who, in the desire to reduce the problematic anxiety of deciding, are led to act on the basis of well-known elementary stimulus-response mechanisms, thus creating a scenario, sometimes only apparent, of existential lightness. In such a context, the ideal condition in which ‘there is no problem for which there is no solution’ appears believable.

Normally, the temporal cycle of pro tempore validity of a given paradigm is interrupted by events that propose problematic scenarios that no longer appear to be resolvable through the application of known decision-making processes, and therefore, in this evidence, contradict the presumed certainty of resolute capacity.

It is important to underline that, to affirm that we are in the presence of a paradigmatic change, the above mentioned events cannot concern only some specific social contexts, such as, for example, the political legislative, the school or others, but it is necessary that, in a given epoch, all the different contexts, which represent the expressive and operative modalities of reference of an organized community, must be involved in the change as a whole.

Past studies explained the contribution of the Viable Systems Approach with reference to the conceptualizations summarized in the context of the consonance between information varieties, in order to better comprehend the factors that actually lead to the need for a paradigm shift. It is reasonable to believe that only the advent of a change in the values system and general schemes shared by a population of individuals leads to the need for evolution of the current paradigm.

According to these assumptions, certainly, what we are experiencing is a phase of epochal transition. We observe the passage from one paradigm to another, experiencing a phase in which the customs of the past gradually disappear to allow a ‘new world’ to come to light, in which we see the evolution from Homo sapiens to homo digitalis

We are well aware that phases of similar transitions have already occurred, and scholars from many and different disciplines have provided ample and interesting literature to best explain both the reasons and the dynamics of the observed changes. Think about the Fordism and post-Fordism epochs.

However, all these considerations, which range from apodictic evidence to common sense do not explain anything about the existence of a common denominator, capable of grasping the common features, epoch after epoch of transition, of the different transformations.

Hence the question arises: there may be a possible assimilating conceptualization of the observed transformations?

The hypothesis is that, given the necessity of a technological innovation that can act as a detonator, the explosion of change must concern a profound change in the perception of the time and space factors for a large, or in any case significant, part of the population. The advent of steam and the consequent development of motor traction have certainly, as many scholars claim, amplified the 'human muscularity', but above all they have changed the perception that most people had of distances. And the world has become progressively closer! Similarly, the discovery of radio waves has changed both the spatial and temporal perception previously existing.

A systems logic analysis, which considers the processes necessary to achieve any goal that can be practiced by any human being, regardless of ethnicity, class or culture, immediately highlights that the paradigmatic changes correspond to profound modifications of the approach in terms of method, technique and tools, which each individual uses to decide and act in their daily life.

However, there is more. It is possible to glimpse a more ambitious frontier than that of having found a common denominator to the processes of paradigmatic change. Digital transformation, highlighting the increasingly significant interchange relationship between physicality and virtuality of phenomena, makes it increasingly understandable that the concept of 'information' simplifies and unifies those apparently distinct and distant of space and time.

In the digital world, the representation of the materiality overcomes the limits of space-time dimensions allowing, on the one hand, proximity and ubiquity and, on the other hand, an optimization of the time dimension which results in a possibility of asynchronous representation of events.

Thus, the space-time dimensions find a synthesis in a mental representation of reality that has a common reference in information. Here, the information variety becomes a generalizable model of representation, opening up to a new way of reading, interpreting, analyzing, and measuring interaction based on information.

But, in the context in which multiple intermediaries operate who all have this ability to reduce spatial distances and compress time intervals, how can an ordered, non-entropic representation of interactions be conceived? What drivers will address the composition of clusters?

One possibility concerns the spontaneous regulation that derives from the concept of consonance: certain information varieties are led to composing together, to be attracted into unique clusters, sharing a sense of belonging and defining levels of information 'vibration', which compose them together. Thus, the entropy that would derive from the large multitude of interacting subjects thus becomes an organization.

The consonance principle, therefore, seems to inspire the composition of the different clusters making consonant entities vibrate together informationally.

Optimal Enterprise: Complex Activity and Mathematics of Knowledge and Human Capital

Dmitry Novikov and Mikhail Belov

An Enterprise is modelled and studied based on the concepts of the methodology of complex activity. The proposed representation embraces the following key aspects of an Enterprise:

Humans and their active choices as key elements of an Enterprise – Human Capital;

Nontrivial structure of the subject matter of the control, which is defined by the goal/logical structure;

Implementation of CA during all phases of its lifecycle;

Technology of CA – the system of conditions, criteria, forms, methods, and means to successfully achieve a stated goal. Technology is incorporated in the Knowledge of the Enterprise.

The Enterprise control problem is posed and solved as an aggregate of mathematical optimization problems. As a result, a harmonized set of mathematical models and methods is proposed that not only models the essential features of the Enterprise as a complex system of systems but also allows solving Enterprise control problems as formal mathematical optimization problems.

Slodderwetenschap Times Seven: Sloppy Science and Scientism in the COVID-19 Era

Michael Lissack

Trust in science is undermined when science is sloppy. Slodderwetenschap ("sloppy science") is a carelessness characterized by a willingness to tolerate scientific shortcuts and more. When scientism (the fetish-like belief of all that is labeled as "science" is good) combines with Slodderwetenschap, the mistakes and shortcuts which characterize the sloppiness can carry over into decision making. The public, the media, and relevant decision-makers were all too often misled by the many instances of sloppy science and scientism encountered as the world dealt with the unfolding of the COVID-19 pandemic. Bad decisions with huge costs were the result. COVID-19 demonstrated that good science seldom comes from taking shortcuts or relying on "truthies". Good science, instead, demands that we continually ask what about a given factoid, label, category, or narrative affords it meaning - and then to base further enquiry on the assumptions, contexts, and constraints so revealed. This talk will describe seven types of Slodderwetenschap, relates them to the very processes by which science makes use of abductive reasoning, and suggests how the risks of "sloppiness" can be mitigated. COVID-19 examples will be used throughout.

Operationally closed systems develop eigenbehaviour

Riding the Learning Curve Spinor in a Westphalian, corporate or imperial world

Clas-Otto Wene

A key finding from second-order cybernetics is the closure theorem (von Förster, 2003, p. 321), i.e., in every operationally closed system there arise eigenbehaviours (von Förster, 1984; 2003; Varela, 1979; 1984). The purpose of this presentation is to demonstrate how the theorem explains the well-known learning curve phenomenon, and to explore the embodiment of the operationally closed learning system and the ensuing implications for the development of cost-efficient low-carbon technologies to manage the risks of climate change.

On the most fundamental level, the learning system is viewed as a spinor with two superposed states; a reflexive state, Computing, and a physically active state, Producing. Theoretical results (Wene 2007; 2018) reproduce observations and measurements (Wene 2008; 2011; 2015). The Viable System Model (VSM: Beer, 1979) is used to explore the embodiment of the learning system and reveals contrapuntal learning. The learning curve makes the solution space non-convex and legitimizes Governments' deployment programmes as efficient and indeed necessary policy measures to manage the risk of climate change (IEA, 2000; Wene, 2016). A complicating factor is that the reach of the learning curve is global which requires concerted action among Governments to buy down cost.

What can the cybersystemic community contribute to human viability in an unfolding Anthropocene?

Ray Ison

In this address, Ray Ison, Professor of Systems at the Open University (UK), offers explanations as to why governance systems (of nations, organisations, programs and projects) are no longer fit for purpose, thus failing citizens and other stakeholders in multiple contexts. He goes beyond explanation to offer heuristics, narratives, systemic design principles and a case for investment in cybersystemic praxis so as to transcend first-order change and generate whole system change towards systemic governance.

In the age of the Anthropocene the need for new ways of thinking and acting have become urgent. But patterns of obstacles are apparent in any action, be they corporate interests, lobbyists, or outdated political and government systems. Drawing on his recent book (with Ed Straw) he will show how and why failure in governance is at the heart of the collective incapacity to tackle the climate and biodiversity emergencies. But analysis whilst necessary is not sufficient. Strategies and rationales for incorporating systems thinking into governance at every level are provided as a means to enable us to break free of historical shackles. 26 principles for systemic governance are proposed.

Ray Ison is Professor of Systems at the UK Open University (OU) where Systems education and scholarship began in 1970. As part of ASTiP (Applied Systems Thinking in Practice Group) he is responsible with colleagues for managing a post-graduate program in Systems Thinking in Practice (STiP). His teaching and research achievements from a base in academia are extensive and internationally recognized. His concern for governance effectiveness was first triggered by his work in post-apartheid South Africa. He has held a number of leadership posts within the international Systems and Cybernetics community including Presidencies of the IFSR (International Federation for Systems Research) and ISSS (International Society for the Systems Sciences). From 2008-15 he was also Professor, Systems for Sustainability, at the Monash Sustainability Institute (MSI), where he created and led the Systemic Governance Research Program. His research field is systems praxeology, institutional innovation and systemic governance.

Margaret's Elegant Question and #NewMacy in the 21st Century

Paul Pangaro

Margaret Mead once wrote that she felt compelled to recommend, during an organizational meeting in the 1950s for what became the ISSS, that this nascent society turn the precepts of its field upon itself. She was, in her own words, “slapped down without mercy.” I’m no Margaret Mead but I know an opportunity for Systems and Cybernetics when I see one — wait, make that many more opportunities than just one.

There are many pandemics of today’s world: population and climate, food and water, poverty and healthcare, inequality and racism, disinformation and artificial intelligence. Any pandemic is a systemic calamity; this entanglement of pandemics, so much more so. Responses without cyber-systemic viewpoints and practices will certainly fail. Knowing what **we** know, how can we stand by? If **we** don’t respond, then who will? This is not arrogance; this is responsibility.

Where to begin: we have precepts from the 20th-century origins of Systems and Cybernetics. These are numerous and powerful and ready for use in our current context of 21st-century pandemics. No short list of precepts is adequate but these are the most relevant to my argument today: understanding systems in terms of purpose; prioritizing human intention above techno-efficiency; designing collaborations for variety; seeing our own seeing and the responsibility that entails. |

Now consider contrasts and opportunities from Margaret’s exquisite invitation to apply our precepts to ourselves: her context was a single organization; WOSC is an organization of organizations (an entanglement of organizations?). We must compare and contrast our individual organizational strengths and variety, in order to coordinate our planning effectively. The mission statements of WOSC’s member societies propose activities to purvey the theories and methods of Systems and Cybernetics. But they need revision (and here I risk the same reaction that Margaret received): more than just evolving and purveying our knowledge, we must prioritize action. Of course, conversation is key, as it must precede agreement, which must precede coordinated action (this wrongly implies that all proceeds from talk; in practice, very soon the loops take over). But our conversations must become louder and our collaborations more urgent and more insistent, because pandemics won’t wait. To do less is to neglect our responsibilities.

Beyond just greater attention to our field, **we must prove how our theories and practices lead to action that will bring enduring, positive change**. This requires a transdisciplinary effort with the ambition of the original Macy Meetings, now revived and revised for the 21st-century entanglement of pandemics. With the American Society for Cybernetics as a seeding participant, an initiative to create a #NewMacy Network for transdisciplinary, transglobal, and transgenerational **conversations for action** has begun. You are invited to join.

Even after Margaret was slapped down, she didn’t hesitate to return to her elegant question. She posed it again in the 1960s at the first conference of the American Society for Cybernetics: “What in thunder are we founding” if we don’t apply our own precepts to what we are doing? I am asking this of all of us here at WOSC in our pandemic world. Slap it down if you like. But Margaret’s provocation, and the responsibility we have, won’t go away.

Go to <https://tinyurl.com/newmacy-distro-r> for more.

Social Cybernetics for the Future of Humanity

Raul Espejo

Stafford Beer, the acknowledged father of organisational cybernetics, defined cybernetics as the science of effective organisation (Beer, 1975a, 1975b). His invention, the Viable System Model (Beer, 1979), was hugely important for organisational cybernetics but its significance to humanity is much wider than a model of an enterprise in an environment, and it is this wider understanding of organisational cybernetics that I want to develop in this keynote. Often much attention is paid to an enterprise's mapping in the VSM's systemic functions, S1, S2, S3, S4 and S5, and into the principle of structural recursion, and furthermore their significance in diagnosing and designing of organisations (Espejo, 2008). However important are all these aspects to our understanding of organisations, users of the model would benefit by a deeper appreciation of its meaning in a complex world, where environmental and contextual challenges pose problems far beyond the application of a model to an institution or enterprise.

We may recognise epistemological, ontological and methodological aspects, that need further clarification. Among others I want to highlight the following aspects:

- Variety management (Ashby, 1964).
- Residual variety and organisational systems as explored in (Espejo & Reyes, 2011)
- Relationships of achievement, stretching and performance between an organisational system and its environment.
- Relationships of cohesion, with particular reference to coordination of actions, trust, allocation of resources and adaptation
- Relationships of structural stretching in the context of a demanding environment
- Relationships of policy-making, in particular with reference to participants in processes of adaptation and cohesion.
- Relationships of inclusion of the local in the global
- Relationships of belonging to self-developing reflexive-active environments (Lepskiy, 2018).

The above aspects are fundamental to problem solving in an uncertain world that is demanding sustainability for the future of humanity. It is with these aspects in mind that I'm proposing an enterprise complexity model as an extension of the Viable System Model for emerging organisational forms (Espejo, 2020).

Social Fröhlich condensation: Preserving societal order through sufficiently intensive information pumping

Andrei Khrennikov

The purpose – This paper aims to present the basic assumptions for creation of social Fröhlich condensate

and attract attention of other researchers (both from physics and socio-political science) to the problem of modeling of stability and order preservation in highly energetic society coupled with social energy bath of high temperature.

Design/methodology/approach – The model of social Fröhlich condensation and its analysis are based on the mathematical formalism of quantum thermodynamics and field theory (applied outside of physics).

Findings – The presented quantum-like model provides the consistent operational model of such complex socio-political phenomenon as Fröhlich condensation.

Research limitations/implications – The model of social Fröhlich condensation is heavily based on theory of open quantum systems. Its consistent elaboration needs additional efforts.

Practical implications – Evidence of such phenomenon as social Fröhlich condensation is demonstrated by stability of modern informationally open societies.

Social implications – Approaching the state of Fröhlich condensation is the powerful source of social stability. Understanding its informational structure and origin may help to stabilize the modern society.

Originality/value – Application of the quantum-like model of Fröhlich condensation in social and political sciences is really the novel and original approach to mathematical modelling of social stability in society exposed to powerful information radiation from mass-media and internet-based sources.

Keywords: Social Fröhlich condensate, Societal stability, Order preserving, Quantum-like modelling, High social temperature, Information field, Information reservoir, Bose-Einstein statistics, Planck formula, Information overload, Indistinguishability, Social energy, Social atoms

Hybrid Reality and Data Sharing concept proposal

Igor Perko

Purpose – Hybrid reality (HyR) definition as an ongoing process in which artificial intelligence (AI) technology is gradually introduced as an active stakeholder posts many governance options. Keeping the desired state of supportive active HyR stakeholders in mind, a proposal for replacing the data collecting concepts with data sharing is set on the table.

Design/methodology/approach – A combination of systemic tools is utilised to examine and assess the development of HyR. The research is based on evolutionary and learning concepts, leading to the new meta-system development. Building on a system dynamics-based interactions modelling, two models have been proposed: The state of the art HyR interactions model, and a desired final HyR model. Out of multiple governance policie options, a switch from data collecting to data sharing is proposed for examination

Findings – HyR introduces multiple governance mechanisms to guide us to the desired final state. Some of them are addressing the capacities of the AI technology: sensing, reasoning and acting capacity. The data sharing concept is focused in addressing the sensing capacity of the AI technology. More importantly, it has a profound effect on all HyR stakeholders behaviour and therefore requires for a thorough systemic research.

Originality/value – We are opening the research on multiple dimensions of the proposed data sharing concepts.

Research limitations – Since we are proposing data sharing as one of the governance mechanisms, and opening a space for a new transdisciplinary research, this should be complemented with empirical research results.

Research/ Practical/ Social/ Environment implications – Invoking data sharing concepts may have profound influence on the interactions and thus the relations in the Hybrid reality, we are encountering.

Keywords: Data Sharing, Hybrid Reality, CyberSytemics, Artificial intelligence, Interactions model, Governance.

Artificial Intelligence: Achievements and Perspectives

Andrey Leonidov, P.N.

The keynote includes a review of the latest achievements in the field of Artificial Intelligence (AI) related both to Deep Learning (DL) applied to image, speech and language processing and applications of AI to solving problems in real economics. Special attention is paid to applications of knowledge graphs as a universal means of realization of machine-readable ontologies.

Scientific research related to the development of AI has distinct interdisciplinary flavor. In the talk we briefly describe these connections through viewing from the three following directions:

- AI and theoretical economics and game theory
- AI and brain functioning
- AI and statistical physics

Finally, we briefly discuss strategies of development of AI approved and realized by the key players (USA, China, EU) and forecasts for development of AI technologies and their contribution to world economy.

Theme 1. Philosophical and methodological foundations for the development of the systems approach and cybernetics

Vladimir Lepskiy, Raul Espejo

Challenges and threats to the future of humanity are increasing pressure to develop and implement systemic approaches and cybernetics. We want to debate their philosophical foundations, with particular emphasis in ontology, epistemology and methodology. Focusing on the specifics of the formation of self-developing reflexive-active environments of hybrid reality. New ideas are needed concerning scientific rationality, the problem of the observer, transdisciplinary approaches, and problems related to complexity, reflexivity and ethics. We must increase the convergence of civilization and culture in the development of systemic approaches and cybernetics. Systems thinking and cybernetics should enable a rich social construction for an interrelated and coherent world.

WOSC 2021 invites congress participants to reflect upon today's critical crises situations, such as pandemics, climate change and social and environmental sustainability, from a systemic perspective with an increased awareness of the complexity of the contextual constraints imposed by the structural coupling of social agents in co-evolution with their ecosystemic chains. In this context of systemic thinking we invite reflections about designing communication mechanisms, from the local to the global, for which cybernetics should be a major contributor. Social designing of communications and conversations, as well as the development of organisations with requisite variety are proposed as tools to respond to our current crises situations.

Awareness of complexity offers opportunities to develop the functionality and coherence of societies. Meta-contextual aspects go beyond the interactions of organisational actors and environmental agents, but need to consider their framing in cultural and meta environmental interactions. This way we can reflect on aspects of societal significance, such as ecological chains, constrained resources, as well as economic inequalities limiting fairness and justice. WOSC 2021 wants to make inroads into the mechanisms shaping interactions, communications and relationships in complex systems, whether communities, enterprises, government agencies, small businesses, families or people. In particular, we want to offer an opportunity for Congress participants to contribute empirical approaches, emerging from their practical experiences in the life-world of societal, ecological and economic situations. Epistemological and methodological debates about social boundaries, systemic structures and communication and interaction mechanisms can influence good practice and improve people's contributions to society.

Section 1.1 A World in crises; how can Cybernetics, Systems Thinking and new technologies help?

Stuart Umpleby, Vladimir Lepskiy, Michael Lissack, Paul Pangaro

COVID-19 caught the world unprepared. Yet, warnings of pandemics had been prominent for at least a decade. COVID-19 saw vaccines developed in record time, while simultaneously the planet suffered from an inability to properly deal with the ever present threat. Warnings of the impact of climate change have been with us for more than a quarter-century. Despite these foreshadowing, mankind allows crises to occur. The uniqueness of the threats of the COVID-19 pandemic and the threats of climate change lies in the fact that concerted actions of all mankind are required to effectively overcome them. At the present time, the historically established international political, legal and economic regulators have proved to be ineffective. For all mankind, the problem of overcoming individual egoism and the formation of planetary social responsibility is urgent. Scientists must offer the world community new models of the consolidation of civilizations, states, corporations and society for joint organizations to act in the elimination of global threats. Can the perspectives offered by systems and cybernetics make a difference? What might be the role for new digital technologies and artificial intelligence? Can mankind find a means to overcome its reluctance to cognize and confront long-term systemic risks?

Discussion points

- Are modern systems approaches and cybernetics ready to help adequately respond to the challenges and threats to humanity at the beginning of the 21st century?
- Civilizational differences in modern ideas about the systems approach and cybernetics. Integration of research and development in the interests of human development.
- Reflexivity and social responsibility as the most important factors in the development of cybernetics.
- Cybernetics in the organization and control of environments of hybrid reality (subject, digital, physical).
- Perspective directions of development of systems approach and cybernetics.

Humans-Governing-the-Loop: Natural & Collective Intelligence (NCI) Meta-Science Complimenting & Regulating AI/ML

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The purpose – "Humans-Governing-the-Loop" asks a simple question: "What if our current paradigm of science that generated our information revolution and its vectors of Artificial Intelligence and Machine Learning (AI/ML) is inadequate and insufficient? The objectivity assumptions of understanding Nature give science tremendous power. As AI/ML advances creating thinking prostheses the assumptions and culture of science/technology develops major anomalies as it extends into the social estate of humans.

Design/methodology/approach – Findings (COMBINED)

Through the use of case studies, a research agenda and new methods of whole system analysis/critique open possibilities of:

- How to map a whole system with tools arising from Safety analysis of the anatomy of failure
- How in high-risk environments to intervene in the communications structures to engender self-governing processes where collective intelligence and perception emerge from a nine-point process.
- Three Level Model of 1) command and control consciousness, 2) formation of the guidance image that precedes perception and decisions, 3) Ontological principles that must be honored for self-governance and transformation resulting in 360 intelligences.
- Case studies from nursing training using symbolic interactionism (G.H. Mead), to navigate and orient in whole systems of care

Originality/value – This research advances the formation of constructivist, systems and cybernetic threads over the past 40 years into a research agenda. Focuses on the asymmetry between artificial intelligence of thinking machines and natural intelligence arising out of structured/designed human interactions with the environment. This outsourcing of answers to AI and increased dependence on our thinking prostheses is hollowing out the native capacity to solve complex problems

Research/ Practical/ Social/ Environment implications – Demonstration of a prototype of necessary methods and theories to create a meta-science of 2nd Order formation of the observer's axis/images. It opens up new social science tools of working within a system. In anthropology looking from the outside is (ETIC) whereas the needed work is from within the system (EMIC)

Research limitations – In "Structure of Scientific Revolutions" Kuhn rightfully discusses how a current paradigm will ignore its blind spots and anomalies. The term used is "Incommensurable" meaning no common measure. Science can be seen as the measure of movement. Cybernetics of Cybernetics meta-science is the Measure of Measurement.

Keywords: Cybernetics of Cybernetics, 1st Order Cybernetics of the observed, 2nd Order Cybernetics of the Observer, Artificial Intelligence, Machine Learning, Black Box, Science of the Image, von Foerster, Bateson, Boulding

Cybernetic observations re scientism and COVID-19

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The purpose – Trust in science is undermined when science is sloppy. Slodderwetenschap ("sloppy science") is a carelessness characterized by a willingness to tolerate scientific shortcuts and more. When scientism (the fetish-like belief of all that is labeled as "science" is good) combines with Slodderwetenschap, the mistakes and shortcuts which characterize the sloppiness can carry over into decision making. Bad decisions with huge costs were the result. COVID-19 demonstrated that good science seldom comes from taking shortcuts or relying on "truthies." This talk describes seven types of Slodderwetenschap, relates them to the very processes by which science makes use of abductive reasoning, and suggests how the risks of "sloppiness" can be mitigated.

Design/methodology/approach – Examines the methodologies of good rigorous science, maps them to the five domains of the Cynefin model and then does the same for "sloppy" science.

Findings – Good science offers cogent explications to a third party of the foundation (taken for granted based or fundierung) by which the shortcuts/shorthand used (synecdoche) evoke meaning, afford indexicality, and have a basis to be used as a constructor. Good science is thus defined by process. By contrast, what sloppy science offers a third party is labels, evocations of truthies, and affordances of confirmation biases. All of these get amplified by scientism. Process is discarded while verificationism is affirmed. Our modern society's focus on efficacy and efficiency has led to a focused on the evaluation of results. But, as COVID-19 has made all too clear, efficacy and efficiency are rather meaningless concepts when dealing with unknowns, inarticulables, emergence, and exponential growth. Slodderwetenschap can supply neither efficacy nor efficiency. What is needed is some form of making informed guesses, testing hypotheses, assembling data, and asking new questions in an effort to better cope with reality. Such good science can evoke and trigger resilience.

Originality/value – This is the first systematic exploration of the processes which allow Slodderwetenschap to occur.

Research/ Practical/ Social/ Environment implications – Every researcher has a set of assumptions, presuppositions, contexts, and constraints which are part of their cognitive habitus and thus "taken for granted." Only when that "taken for grantedness" can be openly explored and challenged can others have a firm basis for trust in the methodologies employed and conclusions reached. Good science happens when the researcher is able to offer a cogent explication of (1) the choices made that afford the conclusion reached its specific meaning, (2) the conditions under which that conclusion can be generalized, and (3) what linkages the conclusion offers for expansion to/application for/ exploration of adjacent possibilities. These choices include assumptions, values assumed for key presuppositions, contexts in which the research and its conclusion hold, and constraints that apply to the research subject, methodologies employed, and conclusion reached. The key variable here is the cogency of the explication on offer. When the choices made are not explicated, are hidden by jargon, are treated as "obvious assumptions," or are accessible only to an expert, the science performed cannot be examined for alternatives, and the researcher cannot be questioned re the effects which might ensue if different choices had been selected. It is all too tempting for both researcher and observer to skip past the necessary step of questioning the choices made and instead asserting that the "science speaks for itself." That shortcut is both what enables Slodderwetenschap and creates opportunities for scientism. The key to good science is to avoid such temptations. The "devil" lies not in the details – but in an overt refusal to explicate each and every one of them.

Research limitations – The material presented is reflective of the cognitive habitus of the researchers involved. Those with a different cognitive habitus may find the framework presented as limiting instead of insightful.

Keywords: Science, Design, COVID-19, Cynefin, Cybernetics

A Framework for Dissecting Organisational Systems

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Purpose – The framework for Dissecting Organisational Systems was created to work with artificially organised systems like firms, companies, and institutions, to bring about a directed and democratically agreed change within them. This is done, firstly by understanding the cognitive model of these systems. Secondly by impinging the system at micro and macro level, by learning the language of the system and by implementing a method of recursive interaction with the object of knowledge. With this framework knowledge is generated about artificial systems, in the very process of democratically transforming them, as a performative ontology.

Design/methodology/approach – With this framework an intervention in the object of knowledge may be undertaken with the primary objective to grasp an understanding of various stakeholders and their decision-making parameters. The aim is to use this understanding to facilitate a directed change in practice. This framework is built based on the understanding of Stafford Beer's Viable System Model (VSM) and Gordon Pask's Conversational Theory. Ontologically, this tool is also situated in Sami Ahmed's diversity work for institutional setup.

Findings – The framework discussed in this paper shows us how design increasingly forms into a branch of knowledge which is not discipline oriented but is mission, process, and systems oriented. The practice of design is conceived in the conjunction between the human users and the materiality of the world that surrounds them. It is this proximity of purpose to the natural, formal, and social structures of the world that makes the nature of design issues inherently systems oriented. What this means is that design problems are deeply connected to processes, to name a few: social, ecological, cultural, - which are tied to open systems entailing larger interconnected networks of systems and subsystems. Design's main investigation is to understand what separates a desired situation from the existing one, and how we may correct this with a system's intervention.

Originality/value – This paper argues how the idea of novelty, in which the design profession was intrinsically assigned to "do something magical" and to "find the new", has given way to understanding designers as negotiators of intractable (wicked) systems. Design as a discipline is well suited to dealing with wicked problems, as it involves framing, documenting, working with and reflecting on the problem directly in the process of addressing it. Due to the convoluted nature of wicked problems, a methodological precision is often difficult to adhere to, though a practice-based methodology offers the flexibility one needs to deal with it. This paper demonstrates how praxis may be used to narrow the gap between the generation of new knowledge in the very process of its enactment.

Research/ Practical/ Social/ Environment implications - The framework for Dissecting Organisational Systems as discussed in this paper shows us how design discipline increasingly forms into a branch of knowledge which is not discipline oriented but is mission, process, and systems oriented. This is because design's propinquity to the 'real' human issues has formed it to be a branch of knowledge that is collaborating with disciplines and skills to deal with 'real' problems in their wicked context. As the design theoretician J.P. Protzen commented, design goes 'beyond being an encyclopaedia of findings to becoming one Theory of Action'.

Research limitations - The framework for dissecting organisational systems needs to be tested on several projects and in-field experiences to refine it and make it more adaptable for varied tasks.

Keywords: Design Cybernetics, Organisational Systems, Wicked Problems, Management Theory

Digital Earth and Hybrid Crises of XXI: Remedy or Disease?

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The purpose – To discuss the essence of the Digital Earth and its civilizational consequences in the scope of cybernetics and semiotics and in the context of the variety of modern "digital" initiatives of nowadays. To present the Digital Earth as a new geospatial paradigm, to discuss its philosophical, cybernetics and social implications. To explain semiotics roots of hierarchical governance architectures and how the Digital Earth triggered the developing of subject-oriented net-centric architectures. To unveil the semiotic "non-digital" conundrum of the Digital Earth. To discuss the ambivalence of the Digital Earth as a decision-making environment and how it can be used to prevent the new hybrid crisis typical of the 21st century. To discuss the emerging of new type of world wars triggered by the COVID-19 pandemic. To manifest the subject-oriented nature of Digital Earth.

Design/methodology/approach – The design of the work is focused on the task of revealing the general civilizational implications of the scientific geospatial revolution and is based on the discursive-dialectical approach. The general methodological basis of the work is systemic, interdisciplinary and integral approaches, which allow revealing the specifics of geospatial approaches deeply rooted in human culture. Semiotic and cybernetic approaches are also used. The method of identifying and rationalizing paradoxes as well as retrospection are widely used.

Findings – The Digital Earth is presented as a paradigm of the new geospatial revolution. Its semiotic foundations are shown, and the concept of the "zero sign" in semiotics as a factor determining a qualitative leap in the principles of governance is proposed. The typology of visualization methods has been proposed. On the basis of semiotic and cybernetic approaches, different digital initiatives are analyzed, and a semiotic definition of the digital economy is given. The practical involvement of the Digital Earth in the formation of a new architecture of the struggle for global dominance is shown, and an explanation of the phenomenon of the "end of art strategy" is proposed.

Originality/value – The scientific novelty of the proposed work is based on the author's original work, partly debated and partly already included in the official body of knowledge about the Digital Earth, summarized by the International Society for Digital Earth (ISDE). From a methodological point of view, the novelty of the work is based on the use of innovative approaches for this interdisciplinary field.

Research/ Practical/ Social/ Environment implications – Digital Earth as an geospatial approach directly impacts on decision-making practices and command and control architecture on global and governmental levels. Also semiotics issues of Digital Earth has and directly subject-oriented approach will contribute to the development of systems approach and cybernetics, which will create new paradigms and systems of ontologies adequate to the challenges and threats of the 21st century. Based on this approach, criteria for assessing innovations in social systems using digital technologies and artificial intelligence will be developed and are already being developed.

Research limitations – due to global spatial and very wide temporal context of the research, it's limited mainly by its methodological framework and clash of the scientific paradigms in the geospatial realm. Due to the high level of involvement in current geopolitical and sustainable development agendas, research may be limited by subjective factors due to the self-interest of the group involved.

Keywords: Digital Earth, cybernetics, subject-oriented approach, semiotics, scientific paradigm.

Cybernetics of Cybernetics

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The purpose – Cybernetics is a Science of Communication + Control = Influence, i.e. Managing Complex Phenomena (= Systems) by Creative Interdisciplinary Cooperation. There are several groups of Cybernetics: 1. Engineering Cybernetics, 2. Biological Cybernetics and 3. Social Cybernetics – (where Morphostasis is in Observation); the Social Cybernetics is the one, we are in particularly worried about. Founding Fathers: A. Bogdanov + L. von Bertalanffy + N. Wiener = their efforts for, and many users and uses of, CyberSystemic approach are rather shockingly absent. Such deficiency / gap is unfortunately a fact and is natural because of absence of interdisciplinary external influence of authority / learning methods; causing serious and even catastrophic / fatal one-sidedness and overlooks. What happens in the natural ecosystem is not reflected in Education Systems and elsewhere by an inverse miracle!? Between nature and humans, as well as between professions, alienation persists. One might think that the “Observation Operator” (Vallée, 1951; Mulej, 2000) used by the Cybernetic System to observe everything around humans is in fact human state; it hardly takes into account both the past and the present (for influence and future)!? The overall message is distorted, if not completely absent, no essence = CyberSystemic Sanctimony! Humankind needs a requisitely holistic influence over cybernetics – realised by interdisciplinary creative cooperation, aimed at action beyond finding facts. Truth matters, but is not enough; so does criticism. Creativity and innovation must be added.

Design/methodology/approach – Based on the research and use of Mulej’s Dialectical System Theory (1974, 1979 2020) as a methodological foundation, authors hypothetically suggest (arguably) that Cybernetics which is not a 4th order Cybernetics (including creative and innovative influence) is not Cybernetics; in fact, (hypothetically) there are Anti (In)-(R)(e)verse Cybernetics because the endeavor for Requisite Holism is insufficient. Authors discuss the hypothesis: Cybernetic Systems are not Cybernetics ... Has N. Wiener ever considered his Cybernetics as a System? Or: did Cybernetics “face” unmodified (+ increasingly complex and leading to collapse) positive feedback loop, after Wiener?

Findings – A new Cybernetics circle of revision / redefinition of Cybernetics will follow = Cybernetics of Cybernetics (Ivanuša, Mulej, 2020). This belongs to scientists’ social responsibility.

Originality/value – Such interpretation of Cybernetics is unique, (r)evolutionary / controversial in some selected viewpoints, and beyond the state of art of describing-only Cybernetics.

Research/ Practical/ Social/ Environment implications – The paper will have (hopefully) a significant impact on traditional interpretation of (Social) Cybernetics.

Research limitations – Since the research proposal is theoretical (even philosophical) in its nature, the projection may not display a fully holistic perspective and can/should be complemented with additional research results.

Keywords: Creativity, Cybernetics, Cybernetics of the 4th order, CyberSystemic Approach, Cybernetics of Cybernetics, Dialectical System Theory, Innovation, Social Responsibility of Scientists

The Systemic Approach to Psychosomatic Health in the Era of COVID-19 Pandemic

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The purpose – The paper is aimed to substantiate the prospects of using a systemic approach to maintaining and strengthening the human psychosomatic health in the current period of the coronavirus pandemic. The systemic approach is based on the consideration of the human organism as a complex system or a risky structure in accordance with the conception of self-organized criticality within the framework of systems science. The systemic vision of human health consists in a) considering the human body as a complex system, where all organs are interconnected, b) overcoming of the Cartesian dualism, the opposition of body and mind, c) taking into account the person and his environment, Umwelt, d) understanding of psychological holism, the integrity of the relationships between a doctor and a patient.

Design/methodology/approach – systemic and holistic approaches have proven to be effective.

Findings – a systemic vision of human psychosomatic health is becoming a fairly promising and justified approach both in the treatment of diseases, and to improve human health, and to combat current and possible future pandemics.

Originality/value – The holistic approach in medicine is usually used in connection with alternative, unconventional healing practices (acupuncture, meditation, biofeedback, reflexology, etc.). The systemic approach, built on the achievements of systems science, works in mainstream medicine, i.e. evidence-based clinical thinking and practices.

Research/ Practical/ Social/ Environment implications – the proposed approach can be used in medical practices, from public health protection to personalized treatment methods

Research limitations – the systemic method for psychosomatic health needs to be adapted to the specifics of the medical vocabulary and treatment methods.

Keywords: complex systems, mind-body problem, psychosomatic health, self-organized criticality, systemic approach, holism

Trends of transformation of socio-economic cybernetics

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The purpose – It is proposed to consider high-order socio-economic cybernetics as the basis of a new socio-economic structure. Which with the economy of individual subject-oriented production (SOP) will ensure the transition from a mass consumer society to a society of producers and consumers of custom-made intellectual products, and it can be defined as a creative society - a society of Creators.

An attempt is made to substantiate that the transition to SOP will change the psychology of consumption in the spirit of post-nonclassical rationality, rationality of consumption harmonizes the cognitive personality with the noosphere, and the use of evolutionary developments of living nature will contribute to the conservation of resources and energy. Since the new structure is impossible without the transformation of the political system, it is proposed to consider the transition to the polity of the Democracy of Creators, which is the convergence of direct democracy and a broad creative aristocracy.

Design/methodology/approach – When analyzing the problem under consideration, were used the works on the general theory of systems, the concept of V. S. Stepin on post-non-classical rationality, G. G. Malinetskiy and other authors on synergetics and prediction of the behavior of complex systems, the works of V. E. Lepskiy and his colleagues on control systems in the context of postnonclassical scientific rationality and the formation of third-order cybernetics based on self-developing reflective-active media, and also were took into account work on Decision-making theory, Political science, Sociology, Behavioral economics, Ecological economics and the Ecosystem economy.

Findings – The transition to ISOP will stimulate the formation of a new socio-economic structure. In the spirit of postnonclassical scientific rationality, taking into account the pluralism of views and different positions of members of society, the new structure will lead to more harmonious cognitive competition and the formation of constructive ethical norms of interaction in society.

Socio-economic cybernetics, which is the development of third-order cybernetics in the direction of providing each subject with creative independence in the development and adoption of collective decisions, will correspond to this structure. It relies on a collective mind, built on decentralized human interaction based on subject-oriented intelligent information technology.

The reliability and robustness of state decisions is significantly increased due to the formation of a collective decision-maker who, using Blockchain technology, will quickly make decisions in real time.

System, in the spirit of multi-valued logic, will go through three cyclic stages: samples, estimates and generation of a optimal system using positive feedback; yawing within the achieved level of multi-parameter optimization; stabilization within the new homeostasis.

The proposed solutions based on a wide planning horizon correspond to modern conditions and trends in socio-economic development, including decentralization based on new principles and the reasonable formation of a new environmental reality.

Originality - The socioeconomic cybernetics under consideration is based on the paradigm “cognitive subject - decentralized interaction system - cognitive subjects” and for distinction it can be defined as 4th order cybernetics. In such a system, each subject is approached from the standpoint of the requirements of the polity Democracy of Creators, considering it as a cognitive personality.

Research implications According to the author, the work may be useful to researchers in the field of analyzing the work of complex social self-organizing reflective-active systems.

Limitations The author considers general approaches that, with further analysis, can be supplemented and adjusted.

Keywords: customer-centric smart economy, human-instrumental interaction, Democracy of Creators.

Subject-Oriented Approach - an Adequate Response to the Challenges and Threats of the 21st Century

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The purpose – To substantiate the relevance of the subject-oriented approach as a promising direction in the development of the systems approach and cybernetics for an adequate response to the challenges and threats of the 21st century. To describe the logic of the formation of a subject-oriented approach in the context of the development of ideas about scientific rationality (classical, non-classical, post-non-classical). From the standpoint of this approach, to make an analysis of a crisis of a model of a technogenic civilization and to show the non-subjectness of humanity on the example of the Covid-19 pandemic. To propose a promising direction of the system approach and cybernetics based on the subject-oriented approach.

Design/methodology/approach – The basic philosophical and methodological foundations are the ideas of three types of scientific rationality (classic, non-classical, post-non-classical), which are associated with three stages (paradigms) of the development of science (V.S. Stepin). Humanistic interpretation of philosophical constructivism, interdisciplinary and transdisciplinary approach, methods of organizing reflexivity and social responsibility, ontologies and principles of organization of hybrid reality environments, focused on the integration of natural and artificial intelligence. The development of scientific rationality corresponds to the stages of development of cybernetics (first, second and third order). The subject-oriented approach provides post-nonclassical cybernetics of self-developing poly-subject (reflexive-active) environments - third-order cybernetics (Lepskiy 2018).

Findings – The subject-oriented approach corresponds to the logic of the development of scientific rationality, systems approach and cybernetics. This approach will contribute to the development of systems approach and cybernetics for an adequate response to the challenges and threats of the 21st century. It will allow to solve the problems of overcoming the non-subjectness of human development, assembling the subjects of development and their protection from manipulative influences.

Originality/value – The scientific novelty of the research is connected to the original philosophical and methodological justification of the relevance of the subject-oriented approach for the development of system approach and cybernetics. For the first time, this approach is used to develop third-order cybernetics (self-developing poly-subject environments). The use of a subject-oriented approach to analyse the crisis of a technogenic civilization also has scientific novelty. Modern approaches to innovations of social systems using digital technologies and artificial intelligence do not take into account the paradigms of the subject-oriented approach, which makes it difficult to create adequate criteria for their assessment and development of mechanisms for integrating natural and artificial intelligence.

Research/ Practical/ Social/ Environment implications – The subject-oriented approach will contribute to the development of systems approach and cybernetics, which will create new paradigms and systems of ontologies adequate to the challenges and threats of the 21st century. Based on this approach, criteria for assessing innovations in social systems using digital technologies and artificial intelligence will be developed and are already being developed.

Research limitations – Possible opposition to the implementation of the proposed approach in the control and development of social systems. The initiators can be corrupt officials and organizers of unauthorized (hidden) management projects of the world community, states and societies.

Keywords: subject-oriented approach, control, systems approach cybernetics, scientific rationality

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Cybernetics and the AI Crisis: A Bilingual Synthesis

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Just as warnings of biological pandemics have been prominent for at least a decade, fears of the algorithmization of society by digital computers are also acute and recurring, going back many decades. Just as society is unprepared to address the pandemics of biology—as well as racism and inequality, environment and economics—we are not prepared for the pandemic of “Today’s AI.”

To forefront just one class of exploitative AI, four billion of us are monetized to powerless numbness by gargantuan Internet platform companies that dominate our time, attention, and emotions every day, with no countervailing forces to reign them in. What can be done? What can we, as the systems and cybernetics community, achieve with any degree of authority or effectiveness? And if we do not respond, who will? What will lead to remediation and what new technologies could help?

This presentation proposes specific actions in response to the negative facets of widespread deployment of commercial AI platforms—Facebook, Youtube, Google, Twitter... Specifically, it is argued that AI’s functioning derives from the presumed and embedded logic in AI systems, a codification of the digital subversions of interaction, information, and intelligence. Cybernetics, however, offers analog and humane embodiments of those concepts in an alternative codification, grounded in a ‘logic’ of purposive systems that encompasses the analog (the biological, linguistic, and social) as well as the digital. Thereby Cybernetics offers a bilingual sensibility that can bridge the gaping divide between the two cultures of analog and digital that are currently opposed.

This opens a fertile path for developing analog interactional frameworks, comprising design patterns and prototypes of systems to offer communities of practice (designers, engineers, entrepreneurs, teachers, students). While such alternatives on their own will not displace the obsession with the market’s monetization that sacrifices the individual and the common good, it offers socio-technological alternatives to today’s digital hegemony.

Cybernetics in the Computer Epoch of Digital Transformation

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The purpose – The development of social systems is accompanied by growing volumes of produced, consumed and accumulated information. Sustainable development is achieved with growing demand for information and balanced production-consumption of flows/volumes information. The produced flows/volumes should not exceed the total throughput capacity of processing actors when consumed. Increasing the throughput actors is a necessary condition for social progress.

In pre-computer epochs information processing within framework of anthropocentric models of development was carried out by person, thanks to his natural monopoly of universal perception/processing of information. The scale and throughput of anthropocentric models grew as they became more complex and the number of actors performing them increased.

Computers, having property of "digital" universality, opened the epoch of digital transformation. Their appearance violated uniqueness of "non-digital" universality of person. When performing routine (algorithm-based) control processes, orders of magnitude higher throughput of computers allows processing flows and volumes of information that are orders of magnitude greater than human capabilities.

The global computer environment (GCE), consolidated local universality of billions of computers, has formed an unprecedented phenomenon of global information strong connectedness: "Everything affects everything and at once." Cybernetics has not yet considered globally distributed objects with such scales and properties.

The article purpose is to identify strategic ways of developing digital transformation, which will ensure transition from monopoly of anthropocentric models to bicentric model of systemically holistic integration of human and computer environments. Such integration combines advantages of each of the environments and will allow:

- redirect most of the information flows/volumes to full-scale processing in GCE in order to control sustainable development;
- maintain supremacy of natural ("non-digital") universality of Homo Sapiens, by freeing his intelligence from unbearable burden of processing information routine and by his focusing on formation of sustainable development models for execution in GCE.

Design/methodology/approach – Network consolidation of computers did not ensure the system-balanced development of GCE. Of the three basic types of actions with information – storage, transmission, and transformation -- only the first two are globalized. Without system-complete globalization of all three types of actions, the GCE as a whole does not have emergent property of universal programmability inherent in each of its computers.

Findings – The unbalanced growth of GCE is accompanied by an avalanche of poorly formalized information that is not suitable for computer processing for sustainable development. The lack of emergent universality does not allow integrating the total productivity of GCE for full-scale processing of growing flows/volumes of information in order to control the sustainable development of sociosystems. At the same time, biologically and socially limited throughput of actors of anthropocentric models does not allow to "digest" the growing "excess" of information.

The article presents the following results of the study of causes of intra-system imbalances in the development of GCE and ways to eliminate them

- the generalization of Ashby principle is proposed, which allows extending its effect to globally strongly connected distributed systems implemented in GCE;
- mathematical model of distributed computing based on Calculus of Tree-Like Structures (CTLS) is presented (it provides globalization of property of universality by seamless expand of the property of universal programmability from internal computer resources on GCE as a whole);
- cybernetic concept of the bicentric model of joint functioning/development of human mind environment and computer environment is proposed (which makes it possible to use the CTLS formalism both for building development models and for computer implementation of models in the GCE).

Originality/value – The original approach to research of information capabilities of social and computer information environments is presented.

Research/ Practical/ Social/ Environment implications – The obtained results substantiate the strategic directions of digital transformation, which open ways to the system-holistically integration of the natural ("non-digital") information universality of Homo Sapiens and the algorithmic ("digital") universality of GCE for the sustainable development of sociotechnosphere in the conditions of global information strong connectedness.

Research limitations – The obtained results show the ways of further development of research aimed at the development of methods, computer-network architectures and technologies of new generations, aimed at digital transition from anthropocentric models of sustainable development to bicentric ones.

Keywords: Global Computer Environment, global information strong connectedness, sustainable development, the Ashby principle, the distributed computing model, anthropocentric and bicentric models of development.

Philosophical and methodological analysis of ideas about governance in the information society

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The purpose – The article deals with the problem of development of management approaches in the context of ethical system and ontology of post-non-classical scientific rationality, analyzes possible directions of information society development from socio-humanitarian positions. The aim of the research is to describe the management system adequate to the complexity of the modern information society and the hybrid physical and digital realities.

Design/methodology/approach – The research is based on modern philosophical and methodological analysis of evolution of ideas on management in the context of scientific rationality development (classical, non-classical, post-non-classical). The problems of cybernetics of the third order on the basis of the transdisciplinary approach, the contexts of socio-humanistic trend of development of management technologies, and management of self-developing reflexively active multisubjective environments are considered. The effectiveness of management under the conditions of information environment and the complexity of society is supposed to be solved by means of the assembly of strategic subjects and the construction of information environments - platforms of interaction and communicative activity.

Findings – The conclusion of the research formulates the main approaches to the development of socio-humanitarian technologies of management and their prospects of practical applicability. Ways of solving the problems of hybrid reality, human interaction with artificial environment, ineffective interaction on existing communication platforms, information overload, etc. are shown.

Originality/value – The originality of this research lies in the creation of basic approaches to the development of managerial socio-humanitarian technologies, systematization of the directions of their possible development, and description of the main tools and principles. The article substantiates the necessity of transition to the post-nonclassical paradigm of management, the environmental and transdisciplinary approach as tools, adequate to the complexity of society, technologies, communications.

Research/ Practical/ Social/ Environment implications – The significance of the research is assumed to be in the indirect policy implications of the institutions and actors exercising managerial functions on personnel and education public policy.

Research limitations – The main limitations of this study relate to the subjective nature of many of the concepts used and the low level of evidence.

Section 1.2 Critical Systems Thinking and the Management of Complexity

Michael C. Jackson, Viacheslav Maracha

The world has become increasingly networked and unpredictable. This is reflected in, for example, climate change, rapid digital transformation, and the Covid-19 pandemic. Vast complexity pervades the social, political, economic, and environmental domains. Decision-makers at all levels are required to manage the consequences of complexity. Simple solutions to complex issues are usually inadequate and risk exacerbating the very problems they are designed to solve. Leaders of international bodies such as the UN, OECD, UNESCO and WHO, and of major business, public sector, charitable, and professional organizations, have all declared the need for systems thinking an essential leadership skill for managing the complexity of the interrelated issues they face.

This session welcomes papers which discuss systems thinking, and the various systems and cybernetic approaches, and which show how they can be employed to navigate complexity. Papers that illustrate their arguments using examples of practical application will be much appreciated.

The argument of 'critical systems thinking' is that the various systems and cybernetic approaches have different strengths and weaknesses and have to be used in combination to tackle different aspects of complexity in a way that will lead to overall, sustainable improvement. Papers that offer critiques of particular systems and cybernetic approaches are therefore very welcome. They should suggest how best to use them in combination, and reflect on what 'improvement' means (from systems and cybernetic perspectives).

Finally, papers that discuss how systems and cybernetic approaches can be used to assist restructuring in the post-Covid world are encouraged.

Discussion points

- What is complexity?
- How can systems and cybernetic approaches help us deal with complexity?
- What are examples of the use of systems and cybernetic approaches to manage complexity?
- How can different systems and cybernetic approaches be used in combination to manage complexity?
- What are the strengths and weaknesses of the different systems and cybernetic approaches and how do these impact their ability to manage complexity?
- Can a 'general systems' framework be established to co-ordinate such activity?
- Can a communication space be established for systems thinkers operating from different systems/cybernetic traditions?
- What does 'improvement' mean from a systems perspective?
- What kind of society do we want post-Covid?
- How can systems and cybernetic approaches help us to restructure society and its systems of governance, health, education, etc., post-Covid?
- How can new information technologies be used alongside systems approaches to help us achieve what we want?

Philosophical and methodological bases of integration of cybernetics, system and transdisciplinary approaches

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The article offers a justification for the definition of the concept of "system" based on the synthesis of the philosophical principles of holism and unicentrism. The thesis is substantiated that an essential feature of an idealized object called a "system" is the order that determines its integrity and unity. The statement about the uniqueness of the order makes it possible to translate the philosophical arguments of the system approach, transdisciplinarity. It is shown how a single order of existence and development of the system allows us to justify isomorphism and makes it possible to build models of this order. The author substantiates the conclusion that the unified order is a system-forming factor and its models allow to correctly identify objects considered as systems. The isomorphism of the order of existence and development of the system provides the necessary level of universality, transdisciplinarity of research and the emergence of a system-transdisciplinary approach. Interpretation of the object and the subject of management as fragments of an ordered environment allows for a new interpretation of their relationship in second- and third-order Cybernetics. At the same time, the uniqueness of the order allows you to delineate the boundaries of managerial influence. This applies to setting goals, timing, and the nature of management impact.

Modalities of control in self-organizing systems: Implications for a general theory of communication

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The purpose – Recent advances in cybernetics and general systems theory, and in particular advances in the understanding of self-organizing systems, have evidenced the limitations of classical theories of information and regulation and the need for a more general framework for the analysis and design of communication and control processes. The present paper offers preliminary insights on how the concept of control can be reframed to account for the complexities and higher-order effects manifest in self-organizing systems, as well as a speculative assessment of the implications of these insights for a general theory of communication.

Design/methodology/approach – The central questions addressed in this paper essentially coincide with the central questions of R. Kalman's paper "On the General Theory of Control Systems": What types of control are possible and what kind of information is needed to achieve a certain type of control? These questions are explored by examining the possible modes of model-based interaction between an observer-controller and a self-organizing, adaptive system, and describing their possible outcomes in a fully parallel, discrete-time, discrete-state, stochastic setting.

Findings – A systemic, operationally meaningful typology of control functions can be obtained by analyzing control actions in terms of the models that the observer/controller uses to predict their effects on the state as well as on the transfer, modelling and goal-setting characteristics of a self-organizing system, under various sets of constraints. Of the known algebraic structures, partial groupoids (magmas) may be useful for modelling the structures underlying the functionality of communication and control processes in self-organizing systems.

Originality/value – Conceptual frameworks for characterizing communication and control in simple systems are well established; however, there is no unified, overarching framework for communication and control in adaptive systems. The taxonomy of control functions proposed in this paper covers a wide array of processes, both simple and complex, it accounts for failures, higher order effects and unintended effects, and, due to its high level of generality, can serve as a basis for evaluating and interpreting existing theories and a starting point for a unified approach to control processes.

Research/ Practical/ Social/ Environment implications – The theoretical framework sketched in this paper provides the basic organization of a functional approach to communication in complex systems and opens a pathway for exploring the metaphor of communication as control in a purely cybernetic/ system theoretic setting.

Research limitations – The theoretical findings presented here are preliminary and speculative. The analytical framework developed is purely system theoretic in nature and does not directly address any of the traditional concerns of communication studies; further development is needed before the discipline specific relevance of the theory can be fully assessed.

Keywords: control theory, communication theory, systems theory, cybernetics, functions of language

Beyond the Black Swan. Managing Complexity: a contradiction in terms?

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The purpose – The primary purpose of this paper is to enhance the capacity for recognizing, comprehending and learning how to inhabit complexity, in particular social complexity, on the part of both experts and laymen, by describing the unique characteristics of complex systems, and above all by clarifying the crucial differences between complex and complicated systems, so often confused even among prominent scientists and researchers. Equally important is the purpose of changing the trajectory of those experts, educators, economists and political leaders who persist in the erroneous conviction that in the near future, it will be possible to obtain a thorough understanding of virtually all phenomena, controlling and managing their complexity, and eliminating error, doubt and unpredictability from our societies and our lives.

Design/methodology/approach – Beginning with a brief historical description of the scientific awareness gradually acquired on the implications of complexity, hierarchical systems and the capacities for self-organization and emergence inherent to all biological, physical, human and social complex adaptive systems (CAS), and the inadequacy of defining reality through mathematical formulas or sets of rules, as had previously been used, we will provide: 1) a working definition of social complexity and hypercomplexity; 2) epistemological methods for teaching and training students to undertake a systemic approach, engage in systems thinking and understand the full implications of the “observer/participant” and of qualitative factors; 3) techniques for including error, uncertainty and unpredictability, conflict and debate in education, training hybrid figures capable of intersecting inter/multi/transdisciplinary fields of knowledge.

Findings – We will identify the illusions of the hypertechnological, hyperconnected civilization and its ongoing anthropological transformation, including: 1) the “tyranny of concreteness” and “great mistake”:

the belief that all problems can be solved by delegating solutions solely to technology, and that complexity can be measured, managed and predicted through data, algorithms, formulas and statistics; 2) the fracture between the sciences and the humanities, and between the natural and the artificial represented by “false dichotomies”, 3) the illusions of social control and elimination of error; 4) the vision of an ordered, regular society occasionally interrupted by “black swans”, without recognizing that emergency, error, uncertainty and unpredictability are intrinsic to all complex adaptive systems, which follow an irreversible arrow of time.

Originality: 1) Bringing forth evidence that managing complexity is impossible; at best, we can only cope with or inhabit complexity;

2) Rethinking education and training radically and not simply as adaptations and extensions of educational processes to the technological changes; technology is a part of culture and can never be separate from it.

3) Introducing the concept of the “overturn”: today biological evolution is being determined by cultural evolution.

Social and Environmental Implications: Profound and systemic change can only be triggered from grassroots communities and individual actions, and can never be imposed top-down by intelligentsia, elites or governments. This implicates the fundamental importance of educational processes teaching systemic and critical thinking. Otherwise, any innovation will simply become a “would-be” innovation. It is furthermore essential to understand that innovating means destabilizing, at least temporarily.

Research limitations – An intrinsic limitation to the approach described in this paper is based on qualitative methods and factors, which are impossible to measure, classify, or in general translate into quantitative data, as each person and/or community is unique and in continual interaction with others. Although this is can be considered a criticality, it is useful for avoiding the standardization of the findings obtained.

Keywords: error, uncertainty, unpredictability, great mistake, false dichotomies, complex adaptive systems

Strategic Management of the Peruvian Natural Gas using Soft System Dynamics Methodology (SSDM)

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The purpose – The present article shows how a soft system dynamics model was used, in a dynamic and interactive manner, as a tool for the management of strategic “soft” issues existing in the Peruvian natural gas problematic situation.

Design/methodology/approach – For doing it, Soft System Dynamics Methodology (SSDM) was applied. SSDM was created at the Instituto Andino de Sistemas – IAS (Peru), and arose as a result of the fusion of two well-known systemic methodologies: Soft Systems Methodology (SSM) developed by Prof. P.B. Checkland from Lancaster University (UK) and System Dynamics (SD) developed by Prof. Jay W. Forrester from MIT (USA).

Originality/value – The main particularity of the approach is that it applies a phenomenological-hermeneutic and nominalist approach in contrast to the usual realist practice of System Dynamics Methodology (SDM), when system dynamics models are built. Additionally, SSDM goes further than Soft Systems Methodology (SSM), in its late developments, considering, when analyzing complex situations, the intervention of human and non-human stakeholders, breaking in this way, the anthropocentric approach of SSM, that only considers as stakeholders, human beings and/or human groups in its application. For considering no-human stakeholders, SSDM uses creativity techniques coming from Synectics, a creativity approach developed by G. M. Prince and W.J.J. Gordon, thus non-human stakeholders can be considered in the study, as representants of the flora, fauna or the environment (land, water, air, covid-19 virus, etc) from whom their “weltanschauungen” must be considered as it is done with human stakeholders. The idea of considering non-human stakeholders came from the traditional thinking practiced by ancient Peruvians who believed that the mountains, the rivers, the sun, the moon, the land (“pachamama” in Quechua language), were living beings, to whom human beings can “communicate” and establish a “living” relationship with them. This approach, using Synectics, have been extended to work with representants of the flora and fauna as important stakeholders to be taken into account in SSDM interventions as it was in the present case study, where the “pink river dolphin” was representant of the Peruvian fauna and the “caoba tree” (Mahogany tree) was the representant of the Peruvian flora. Additionally, it is important to mention that SSDM is composed of 10 stages and uses three “worlds” for collecting, in a hermeneutic manner, the soft and hard data, and for doing the analysis and synthesis of a problematic situation being studied in a specific case. These “worlds” are: (1) The Real World, (2) the Problem-Oriented World and the (3) Solving-Oriented World. Besides, it is important to mention that SSDM is oriented to implant viable changes in the eco-social systems pertaining to the real world. For doing that, it also applies, the Wilson’s variant of SSM, called Issue Based and Primary Task Analysis (IB&PTA), which is used for obtaining consensual conceptual models that can satisfy the expectations of the stakeholders (human and non-human), considering as well, the analysis and management of diverse kind of power that stakeholders (human and non-human) can exert in the problem situation being studied. For all mentioned previously, SSDM can be considered a multi-methodology and a multi-paradigmatic approach.

Findings – The article explains how, following the 10 stages of SSDM, it is possible to study a complex situation like the Peruvian natural gas problematic situation, considering diverse hard and soft problems, as well as diverse stakeholders (human and non-human), their worldviews (weltanschauungen) and their power exerted for directing the future of the Peruvian natural gas. Thus, SSDM was used to analyze the hard and soft problems in an integral manner and to get a systemic, dynamic, interpretive, causal and prospective view of the problematic situation and from there it

allowed to elaborate viable dynamic intervention policies for the mentioned problematic situation. These policies should be culturally feasible and systemically desirable for the diverse human and non-human stakeholders, with the support of critical systems thinking (CST).

Research/ Practical/ Social/ Environment implications – SSDM can be considered as a tool for the analysis, design and strategic transformation of eco-social systems of any size. Thus, it can be used to conceive and implement complex eco-social changes with the guarantee to do them in a viable way, looking for culturally feasible and systemically desirable no-zero sum changes to implant in eco-social systems pertaining to the real world with the help of extended soft systems thinking, synergetics, critical systems thinking and the support of system dynamics models to visualize past, present and future scenarios.

Research limitations – Finally the paper mentions the implications and limitations encountered, in diverse aspects, when SSDM was used, like: issues related with cultural and ethical considerations and restrictions that should be taken into account in systemic methodologies for doing interventions in complex problems, the weltanschauungen and the management of stakeholders' power needed to be taken into account to get policies which allow to implant viable strategic changes in eco-social systems, the possibility for obtaining consensual conceptual models, using soft approaches need the use of creativity and imagination, the ethic orientation of the policies to be developed and applied is a very important issue to consider, in order to obtain non-zero sum strategic changes to be implanted in the real world, considering human and non-human stakeholders (clients, actors and owners).

Key words: Soft Systems Methodology (SSM), System Dynamics (SD), Soft System Dynamics Methodology (SSDM), Strategic Management, Natural Gas, Peru, Pollution, Power, Stakeholders, Critical Systems Thinking (CST), Synergetics, Weltanschauung

Using Requisite Variety: a Novel Approach to Enhancement Technologies

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The purpose – The goal of this research is to situate enhancement technologies within a second-order cybernetic framework. Enhancement is here characterised as the process of developing sensing systems to expand an agent's internal variety in response to hidden affordances available inside the environment in which they are embedded and interacting. This article, in particular, suggests the Law of Requisite Variety (1956) as a valuable perspective for decoupling the subject matter from some of the ethical and practical challenges surrounding enhancement technologies, such as defining species-typicality and the notion of 'better'. Requisite variety provides a fruitful framework for approaching enhancement technologies as it outlines a systems perspective on the matter that focuses on communication rather than specific technologies. Based on this new operational framework, this study offers guidelines for approaching the design of enhancing technologies.

Design/methodology/approach – Ashby's Law of Requisite Variety (1956) offers the basis for this paper's core thesis, which contextualises the theory within an agent's interactions with its surroundings. The environment involves a range of sensory affordances (Gibson, 1977, 1979). However, the agent's body – whether human or nonhuman – often is not equipped with the sensory systems required to engage with all of the affordances available. Therefore, this study proposes redefining enhancement in a cybernetic context as the practice of revealing the environment's hidden affordances. To this end, the agent's body must integrate with novel sensing systems that reveal these hidden affordances via embodied sensory feedback loops relying on the agent's previously existing sensory systems.

Findings – As an alternative way to tackle the enhancement debate, this paper proposes focusing on increasing agents' internal variety regarding its environment. By focusing on the agent's body and its distinct sensorimotor properties, enhancement is reframed as the intentional layering of new capacities onto pre-existing ones.

Originality/value – This work proposes an epistemological shift that integrates cybernetics into the debate on enhancement technology. The argument presented here provides a pragmatic foundation for academics and practitioners designing novel enhancement technologies to address the subject matter. Further, this research offers an alternative to established approaches to enhancement technologies, such as Savulescu et al. (2011) and Cabrera (2017).

Research/ Practical/ Social/ Environment implications – This research's perspective will aid in the development of cybernetic approaches to the unresolved issue of enhancement technology. Furthermore, by focusing on the body of the agents and their individual sensory systems, as proposed in this work, much of the debate surrounding enhancement technologies can be avoided.

Research limitations – The arguments presented stem from the notion that cognition is embodied, embedded, enacted and extended. As a result, they might be challenged by alternative epistemological positions.

Metamodels - The 2nd order cybernetic recursion in the GIS+BIM Agency framework

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The purpose – This article intends, based on the basic precepts of 2nd order cybernetics (HEYLIGHEN & JOSLYN, 2001), to establish an interoperable, interactive and interdisciplinary line in the framework related to the data flow between GIS (ESRI, 2019) and BIM (SUCCAR, 2009), which operate and become viable in other managerial metamodel interactions, depending on characteristics directly related to the appropriate empirical approach, such as the City Information Modelling (OGC - Open Geospatial Consortium, 2012), the Districtal Information Modelling (DENZER-KEMPTER et. al., 2019), in addition to other possible systemic combinations to the framework.

Design/methodology/approach – The spatial data processes of surveying, organizing, modelling and manipulating for design actions, whether architectural, urban, landscape, etc., through information technology, have been supported by increasingly optimized and interconnected digital platforms and algorithmic operations. In this sense, the meta-methodological integration and interoperation between the Geographic Information System (GIS) and the Building Information Modelling (BIM) foresees an integrated process of data, and its framework, more openly susceptible to creative and self-recursive interconnections and interoperability, potentially autopoietic, therefore.

Based on these assumptions, this article will present a literature review, which investigates and deepens the metatheoretical framework on Agency (PRATSCHKE, 2020) and the GIS+BIM framework, as well as the realization of a metamodel experiment, based on spatial data collected from sources research studies, critically analyzed, in the constitution, calibration and generation of an interactive metamodel for its latent self-recursion, for a desired, necessary self-management.

In this aspect, the cybernetic Agency, whatever the size and complexity of the spatiality experienced, has the observer-operator (or observer-operators), potentially and more fully related to the powerful, latent recursions of its information, data and metadata disposed and concerning their more complex spatialities. More than that assumed to a merely representative three-dimensional model, still incipient for most GIS and BIM platform operators in activity.

Findings – The adoption of an optimized interpolation, with data fluency, between available spatial information modelling platforms.

Originality/value – Establishment of methodological, analytical and theoretical guidelines more dynamic, simplified, less entropic and accessible, for carrying out similar interoperable experiments.

Research/ Practical/ Social/ Environment implications – provide alternatives for the proper treatment and modelling of the data concerned, as well as the observation and resolution of potential and possible interface gaps in the fluency and pregnancy of data and metadata between files shared between platforms.

Research limitations – Access to educational licenses of specific and indicated software.

Keywords: 2nd order cybernetics; Agency; metamethodologies; metamodels; GIS + BIM framework.

Section 1.3 Ontological Cybernetics; methodologies to support self-developing reflexive-active societies

Vladimir Lepskiy, Raul Espejo

We need designing mechanisms to achieve social coherence and integrity in the current problems of humanity and societies. Subjects' contributions towards their better future are necessary in this designs. Communication technologies and in particular artificial intelligence, are contributing towards dealing with these problematic situations, in particular with problems of sustainability in a rapidly changing world. We believe that solutions to these problems require systems of ontologies which depend on the existence of natural and artificial active elements. These considerations allow us to speak about ontological cybernetics, in which basic systems of ontologies are proposed and pursued. We invite particular attention to the ontologies of S. Beer's complexity management models, in particular his Viable System Model and the extension of this model, as proposed by R. Espejo's Viplan Methodology, as well as by V. Lepskiy's cybernetic models of self-developing reflexive-active societies.

How do we make more transparent key mechanisms for social responsibility in the context of self-developing reflexive-active environments.

In WOSC 2021 we invite for epistemological and methodological clarifications of social responsibility, based on modern philosophy of science and different epistemological stances, which include considerations for social values, worldview principles, multiple viewpoints and subject-oriented information and communication platforms. We invite contributions towards overcoming abuses of power in current socio-economic and environmental developments. People need effective governance mechanisms and look for methodologies to ensure interactions of stakeholders towards creating, regulating and implementing societal problem solving. All this through a more humane use of AI and digital technology.

Ontological cybernetics uses the "subject/ meta-subject" paradigm. Subjects create, regulate and implement their individual, organizational and social tasks as they interact with each other in their environmental spaces for action, at the same time that they are constrained by metasystemic contexts, which provide wider innovative, technological, ethical, historical and other factors shaping culturally their spaces for action and development, beyond their interactive capabilities. These are the platforms of subject-metasubject relationships.

Ontological cybernetics highlights recursive, invariant organizational structures as a complexity enhancement management approach for social subjects. While the meanings of social interactions between organizational and environmental subjects are about the adaptation and implementation of their tasks, the meanings of belonging to a larger metasystemic context are about social responsibility in self-developing reflexive-active environments (within social constrains). It is different to interact with environmental subjects than to be part of a larger context.

In this section we invite proposals that clarify these distinctions; in other words we invite contributions to discuss the rationale for developing cybernetic ontologies.

Discussion points

- Philosophical and methodological foundations and principles of creating new paradigms and ontologies of cybernetics
- Requirements for ontologies of joint existence of carriers of natural and artificial intelligence.
- Ontologies of S. Beer's Viable System Model and R. Espejo's Viplan Methodology.
- Ontologies of V. Lepskiy's self-developing reflexive-active environments.
- Promising directions of ontological cybernetics.

The blind spot of observations as operational tool for epistemologies of complexity

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The purpose – The purpose of this talk is to contribute to the epistemologies of complexity with a research concerning the position of the “blind spot” as a precondition of the process of knowing complexity. The cybernetic principle that every complex system is self-referential, self-organising and autonomous entails a radical change in the sciences. Objective reality is replaced by the power of intervention of the observer in the system. This reveals that there is no external position of observation. This statement, however, entails the ontological problem of how to establish the reference to reality outside the observer. My contribution consists in explaining de-paradoxification strategies of operational theories for the cognition of complexity. To this end, I will make use of the metaphor of the “blind spot” contained in operational constructivism.

Design/methodology/approach – The blind spot thesis was developed on the basis of the operational theories of the 1970s. From a methodological perspective, it marks the turn to a second-order cybernetics. The turn to second-order cybernetics, so-called “Observing Systems”, serves as a basis for redefining the epistemological position within the framework of the sciences of complexity. The operational theories, especially those of the neurobiologists Maturana and Varela, as well as the socio-cybernetics of Luhmann and Günther, interpret the blind spot not only a phenomenon of the absence of perception, but also a condition of the possibility of cognition. The incompleteness of all observations, the fact that one cannot observe everything, become a transcendental condition or condition of possibility of a theory of cognition for the operative theory approaches.

Findings – The first hypothesis of this paper is that the blind spot represents a double limitation of cognition of self-referential processes or systems: 1) One cannot recognise complexity outside of the respective observation taking place at any given time, so that the holistic subjective basic assumption of cognition of unitary systems becomes invalid. 2) The inner observation of the system is also excluded. Ergo, the inner and outer limitations of observation are a possibility-prerequisite of cognition. From this hypothesis, a subsequent one can be derived, according to which the unobservable and recognisable “topos” corresponds to the unmarked space of every system.

Originality/value – The novelty of this contribution is to apply the operational theories and especially the blind spot approaches to an epistemology of complex systems. In this respect, the blind spot positions are revisited and their validity for complexity is tested.

Research/Practical/Social/Environment implications – Accordingly, this research makes an important contribution to the social sciences and humanities on epistemic boundaries and their de-paradoxification strategies. In particular, this paper contributes to the further development of constructivist theories and is suitable for both philosophies of complexity and neo-cybernetic theories.

Research limitations – Since the research underlying this lecture is concerned with a philosophical and theoretical explanation of the epistemological problem of complexity, the empirical aspects of experimental methods are omitted. The omission of empirical methods should be understood as a methodological delimitation.

Keywords: epistemology, complexity, observation, environment/system, interiority/exteriority, operationally closed systems.

General Artificial Intelligence (AGI) in Context of the Self-Developing Reflective-Active Environments

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Purpose – Identify the features of the paradigm and ontologies of General Artificial Intelligence (AGI), from the standpoint of the system of scientific rationality types (classic, non-classical, post-non-classical), and differences of AGI from traditional Artificial Intelligence (AI). The latter is currently implemented mainly with discrete computer calculations and already quite well implements the functions of recognition, forecasting and preparation of answers to simple questions. New conditions force to consider AGI from the standpoint of functionalism, as a meta-subject-subjective man-machine system, purposefully functioning in a self-developing reflexive-active environment.

Design/methodology/approach – The change of AI development paradigm should consider the aspects of its immersion in the social and humanitarian environment and the venture innovative atmosphere, its inclusion in management systems and decision support. The new paradigm of AI development should reflect the unformalized cognitive dynamics of AI models and support the self-development of AI systems under pressure from the external environment, taking into account collective consciousness and unconscious activity. In many cases of using traditional AI, the listed aspects exclude the possibility of revealing the causality of the development of events, which, in turn, closes the path to constructing explanations of decisions. The main approach to achieving the goal of this work is the use during creating AGI of the ideas of the subject-oriented and ontological approach, functionalism, the phenomenology of subjective reality, the construction of convergent cognitive architectures, as well as the methodology for the construction of self-developing reflexive-active systems in polysubject environments. At the same time, AGI becomes a hybrid, purposefully integrating the capabilities of a machine and a person.

Findings – General properties, value-semantic and intentional-volitional operational structures of the phenomenon of subjective reality, realized in a collective self-developing reflexive-active environment, which does not lend itself to direct formalized and algorithmic representation in discrete computer systems of von Neumann architecture. The study of consciousness in the context of subjective reality made it possible to formulate the main systemic, structural, functional, and operational characteristics of human cognitive activity, which allows a new approach to the modelling of cognitive architectures that meet the tasks of building AGI. In this case, the characteristics of subjective reality include, e.g., the fact that it cannot be fully represented in the paradigm of physicalism; that is, it cannot be represented only with the help of physical devices. The paper proposes a non-reductionist way of taking this characteristic into account by considering the problem of consciousness in an ontological and epistemological context, which allows to indirectly and inversely represent the processes of consciousness and cognitive activity of a person and a group of people.

Originality/value – Modern cognitive architectures, in the list of which there are more than 300 items, practically ignore solving the problems of AGI. They are more focused on the formalized construction of a thinking model, identifying physical blocks and processes of mental activity. At the same time, for AGI, ontological issues are of most importance, especially in explanations of the activity of consciousness, which can act purposefully in conditions of goal uncertainty. The issues are of great importance for AGI as awareness of the collective members of unconscious and causeless processes, how the phenomena of subjective reality can cause physical changes, how to explain the ability of goal-setting, free will, the ability of self-management by the physical actions of an individual in a team, the influence of the conceptual environment on subjective reality, etc.

Research/ Practical/ Social/ Environment implications – The work results give rise to a new type of control, which differs from the traditional control in digital and algorithmic reality, which is the characteristic of modern AI systems. The results achieved make it possible to uniquely find the optimal measure of centralization and autonomy of control loops that can ensure the preservation and strengthening of the integrity of a complex polysubject system functioning in a reflexively active environment, the interpretation of which does not fit into the narrow framework of digital and algorithmic reality. The need and expediency of fundamentally new approaches to the design of AGI systems, which are based on the ideas and principles of constructing subjective reality, become obvious.

Research limitations – Although in the formation of the AGI paradigm, the inconsistency of explaining the phenomenon of human consciousness from the standpoint of orthodox physicalism becomes obvious, the approach based on exceptional methods of constructing subjective reality also has its limitations. For example, the approach we propose to explain the connection between the human brain, consciousness and thought processes does not yet allow us to explain the information and cognitive processes generated by the effect of quantum nonlocality, which arises at the atomic level of the structure of the human brain and, apparently, must be taken into account when constructing cognitive semantics of AGI models.

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Resources, Requisite Variety and the integration of first, second and third order cybernetics into ontological cybernetics

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The purpose – Lepskiy and Espejo have been collaborating for some time (Espejo and Lepskiy 2020) towards a unified view of ontological cybernetics. Here we offer an alternative to Lepskiy's and Espejo's abstract to this Section, more focused on the Law of Requisite Variety. To discuss the effective use of all kind of resources to support the ontological requirements, necessary to respond to the challenges and threats experiencing organizational systems in the XXI century, such as sustainability and pandemics. People and systems in our societies need to clarify the designing of ontological approaches to achieve good cybernetics based on epistemological and methodological propositions grounded in the concepts of scientific rationality (classical, non-classical, post-non-classical). Increasing our understanding of subject oriented first order cybernetic interactions, subject-subject, second order cybernetics interactions, and subject-metasubject, self-developing reflexive active environments, third order cybernetics interactions. Our purpose in the discussions of this section of the Congress is inviting people to propose reflections and case studies based on the paradigm of ontological cybernetics, towards developing good social cybernetics.

Methodological approach – The philosophical and methodological foundations for reflections and case studies in this area of research are the ideas about three types of scientific rationality (classic, non-classical, post-non-classical), which are associated with three stages (paradigms) of the development of science (V.S. Stepin) and the three orders of development of cybernetics (the first, second and third), which we understand have the potential of integration in a strong ontological approach for the social sciences. We are inviting contributions based on Beer's Viable System Model (VSM), Lepskiy's self-developing reflexive-active environments and Espejo's organizational systems as an extension of the VSM. We are inviting an integration of subject-oriented approaches with the humanistic interpretation of philosophical constructivism.

Design/Approach – An ontological approach to cybernetics corresponds to the development of the philosophical and methodological foundations of cybernetics and systems towards the formation of subject-oriented approaches, grounded on Ashby's Law of Requisite Variety. These are approaches to contribute to achieving adequate responses, based on resources, to the increasing challenges and threats of the 21st century. They should be focused on adequate performance to achieve necessary outcomes for sustainability and viability on the grounds of socio-humanitarian desirable innovative criteria, using today's digital technologies, creating responses correlating and converging with the development of social systems in line with the increasingly powerful ontologies of artificial intelligence. We invite propositions of modern paradigms and ontologies for organizing hybrid reality environments. As a result, cybernetics should be able to claim the role of a conceptual leader in the creation of modern control and communication mechanisms using high technologies.

Originality/value – The novelty of the research proposed for this section of the Congress is its connection with the original philosophical and methodological relevance of the ontological approaches currently being develop in system and cybernetics. For the first time in the research of S. Beer, R. Espejo and V. Lepskiy, attention is been drawn towards the integrated ontologies of humanistic and social developments of social systems and cybernetic models. The novelty of the research is also connected with the representation of cybernetics as an integrator of ontology systems in hybrid reality environments.

Research implications – The ontological approach proposed in this research will contribute to the development of systems and cybernetics, which will create new paradigms and systems of ontologies adequate to the challenges and threats of the 21st century. This approach will allow us to develop

adequate paradigms and ontologies for the safe and effective use of digital technologies and artificial intelligence in improving the control and communication mechanisms of social systems.

Research limitations – An ontological development of systems and cybernetics will require increasing the levels of competence of developers of qualitative and quantitative models, digital technologies and artificial intelligence in the philosophical and methodological aspects of management and development of social systems. This is a significant transdisciplinary challenge that may not be well received by disciplinary specialists.

Keywords: ontological approach, subject-oriented approach, integration, systems and cybernetics, scientific rationality

AI as a reflexive management tool for self-organized innovative ecosystems

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The purpose – Purpose of the work is to specify the objects of management in relation to the tasks of reflexive management and construction of self-organized environments of innovation activities, to demonstrate the vector of application of AI technologies in the area of development and implementation of innovative ecosystems, to formulate and emphasize the functions of humanities in the processes of generating economically significant ideas.

Design/methodology/approach – Methodology of the research is determined by Vladimir Lepskiy's theory of reflexive management, general semiotic mechanisms of modelling and is built on the critical interpretation of the classical theory of knowledge and the "triact" of P. K. Engelmeyer, the Stevens-Burley formula, the idea of the "innovation rocket" of the Agency for Strategic Initiatives. We proceed from the idea of a reflexive spiral of receptive cognition and projective activity, which sets the boundaries of the activity of a subject taken as an individual, community or society.

Findings – In this study, we emphasize that human management through AI technologies needs a serious analysis of the functions of traditional humanitarian knowledge in the context of digital transformation, the transition to a "society of imagination". With the digitization of activity "innovative" vector of public life should be accompanied by the digitization of the receptive, "humanitarian" vector. The objects of reflexive management are the processes of individual perception, the processes of taking language into account, and the processes of rational interpretation. These objects are combined into a system of technical and economic balance, modelled by means of AI as a "reflector of ideas".

Originality/value – Innovation management in its current form does not take into account the act of imagination and desire, as well as the conditions for generating new ideas in receptive cognition procedures. If the current models of the technical and economic balance in innovation studies set the processes of turning an idea into an artifact, then the "idea reflector" system complements them with models of the emergence of ideas based on artifacts providing the reflexive helix of self-organization for innovative ecosystem. The originality of the "reflector of ideas" is associated with the task of introducing a system model of cognition and activity into the practice of digital management as a tool of social reflection that consolidates society.

Research/ Practical/ Social/ Environment implications – This kind of technical solution is able to prevent the regression of society to a disparate set of communities, which is observed today.

The significance of the research is determined by the task of overcoming the crisis of systemic thinking in the management of social processes based on the example of innovation activity or, in the context of Ivan Lapshin's theory of invention, the task of transition from system modelling to environmental modelling, the implementation of reflexivity in management practices.

Research limitations – The limitations and content aspects of the applied methods are highlighted in the publications of the authors' team in relation to problems of innovation, the philosophy of technology, and the theory of invention.

Keywords: third artificial nature, innovation, future, humanities, social technologies

The Methodology of Construction of Active Self-Developing Media from the Standpoint of Enactivism

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The purpose – The paper aims to show the importance of the conception of enactivism as a methodological basis for the construction of active self-developing reflexive media (environments). Active self-developing reflexive media (environments) are subject-oriented: the actions, the control and prognostic activity of subjects are to fit into the environment, into a small world, into a more or less large world, as well as into a global perspective, world-system. The concept of enactivism in modern cognitive science just speaks about the ways of embedding thinking and acting subjects into the environment, constructing the surrounding world and constructing oneself from the reverse impact of the surrounding world on the subject. The report traces the connections of the conception of enactivism in the conception of Umwelt developed by J. von Uexküll as well as with the ideas of autopoiesis elaborated by H. Maturana and F. Varela.

Design/methodology/approach – The main methodology is enactivism, coupled methodological approaches are Umwelt analysis and autopoiesis.

Findings – The concept of enactivism is of great methodological significance and allows us to reveal additional and unexpected meanings and methods of effective management of complex landscapes of self-organizing media (environments).

Originality/value – The approach from the point of view of enactivism is insignificantly used in management and forecasting practices, therefore, the presented study has methodological novelty and is practically oriented.

Research/ Practical/ Social/ Environment implications – Ways of enactive building active self-developing media (environments) can be innovative solutions that go in line with the principles of the conception of sustainable development and social constructivism.

Research limitations – Conceptual links between enactivism and a systemic vision of social activity are not always obvious and require additional reflection, the creation of conceptual and practice-oriented bridges.

Keywords: active self-developing media, autopoiesis, constructivism, enactivism, non-linear synthesis, Umwelt.

Ontological cybernetics as an integrator of ontology systems in hybrid reality environments

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The purpose – To substantiate the relevance of the ontological requirements for cybernetics, which claims to form adequate responses to the challenges and threats of the XXI century. To describe the logic of the formation of an ontological approach to the development of cybernetics based on the concepts of scientific rationality (classical, non-classical, post-non-classical) and the trend of increasing the role of the subject-oriented approach. To propose the basic principles of the paradigms of ontological cybernetics. To analyze examples of ontological types of cybernetics: ontologies of S. Beer's Viable System Model and R. Espejo's Viplan Methodology,

ontologies of V. Lepskiy's self-developing reflexive-active environments.

Design/methodology/approach – The basic philosophical and methodological foundations are the ideas about three types of scientific rationality (classic, non-classical, post-non-classical), which are associated with three stages (paradigms) of the development of science (V.S. Stepin) and the three orders of development of cybernetics (the first, second and third). We also use the subject-oriented approach and the humanistic interpretation of philosophical constructivism as well as philosophical and methodological foundations for the development of models of S. Beer's Viable System Model and R. Espejo's Viplan Methodology and V. Lepskiy's Model self-developing reflexive-active environments.

Findings – The ontological approach to cybernetics corresponds to the development of the philosophical and methodological foundations for ensuring cybernetics and the system approach, primarily to the trend of the formation of the subject-oriented approach. This approach will contribute to the development of systems approach and cybernetics for an adequate response to the challenges and threats of the 21st century. It will also allow us to develop socio-humanitarian grounds for evaluating innovation criteria, using digital technologies and artificial intelligence, based on the correlation and convergence of the ontologies of the development of social systems and the established ontologies of artificial intelligence. This will allow us to develop modern paradigms and ontologies for organizing hybrid reality environments. As a result, cybernetics will be able to claim the role of a conceptual leader in the creation of modern control mechanisms using high technologies.

Originality/value – The novelty of the research is connected with the original philosophical and methodological substantiation of the relevance of the ontological approach for the development of the system approach and cybernetics. In the research of S. Beer, R. Espejo and V. Lepskiy, attention was drawn to the ontologies of life support and the development of social systems in the development of cybernetic models. Today, the results of these studies are reflected in the development of promising areas of the system approach and cybernetics. The novelty of the research is also connected with the representation of cybernetics as an integrator of ontology systems in hybrid reality environments.

Research/ Practical/ Social/ Environment implications – The ontological approach will contribute to the development of systems approach and cybernetics, which will create new paradigms and systems of ontologies adequate to the challenges and threats of the 21st century. This approach will allow us to develop adequate paradigms and ontologies for the safe and effective use of digital technologies and artificial intelligence in improving the control mechanisms of social systems.

Research limitations – The ontological approach to the development of the systems approach and cybernetics will require the increasing of the level of competence of developers of mathematical models, digital technologies and artificial intelligence in the philosophical and methodological aspects

of management and development of social systems. This may cause some opposition from these specialists.

Keywords: ontological approach, subject-oriented approach, control, systems approach cybernetics, scientific rationality

Problematization of the modern technogenic civilization's recursive potential

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The purpose of this work is to search for answers to fundamental questions: how does a modern technogenic civilization reproduce itself and, accordingly, can it continue to do this further, or has it already exhausted its potential and soon it will be possible to talk about a change in the civilizational type? All these questions arise, because despite all significant achievements of the technogenic civilization, society has visible difficulties when it comes to reproducing its own structures and maintaining its integrity – the difficulties we are also going to examine.

Design/methodology/approach – We use a concept of recursive systems (by Stafford Beer) as a methodological approach in our research, regarding the technogenic civilization as one among such systems. In societies of any kind, there are processes that Beer called recursive. These processes ensure the viability of the system at all levels due to the self-repetition of the fundamental structures that ensure the system viability. So, the concept of recursion provides the opportunity to emphasize the question of the technogenic civilization's ability of self-reproduction and the mechanisms thereof.

Findings – Modern technogenic civilization faces a number of difficulties and problems with its own recursion, since the accelerated development of its technical potential creates new conditions within this type of society – the ones to which it is necessary to adapt. In order to understand whether the recursive potential of the technogenic civilization is enough for its further existence, it is necessary to find out which of its structures should be reproduced to preserve the viability of the entire system. It can be assumed that, with all the constant variability of social institutions, the structures responsible for fundamental choices – the value systems underlying the worldview and goal-setting – should be reproduced as mostly invariant. These structures should have the property of recursiveness for all levels of the social system – from the individual to the largest social institutions and society as a whole, in order to be reproduced on a permanent basis through the processes of socialization. It is to these fundamental value systems, shared by the majority, that society owes its integrity and what E. Durkheim called social solidarity. The value systems can be seen as the system-forming principle for the society and the civilization as a whole. At the same time, technogenic civilization reproduces and supports mostly the foundations of scientific rationality, neglecting the justification of other values that form ethical and teleological aspects of the worldview. So, the latter ones are not reproduced properly. That is why there are doubts about the ability of the technogenic civilization to long-term reproduction and also there are assumptions about its replacement by a new type of civilizational development.

Originality/value – consists, firstly, in identifying those structures that should be recursive in such complex supersystems as society or even civilization – these are, first of all, value systems that unite all levels of social existence: individuals, groups, social institutions. Secondly, the study of the recursive potential of social systems is combined with the consideration of their ability to change, whether it is adaptation, evolution or failures, crises and conflicts.

Research/ Practical/ Social/ Environment implications – If we turn to the problem of the variability of social systems, the first thing that comes to mind is the need for their adaptation to external or internal challenges. If external challenges may not depend at all on the activity of the system, which is simply forced to adapt to them to the best of its capabilities, then internal problems show that the recursiveness of systems is far from comprehensive. The analysis of such problems can let us anticipate the possibilities of future social crisis situations. As we assume that a change in the civilizational type can bring a long and difficult crisis, especially in the areas that had problems with their reproduction,

then special attention paid to these particular areas can be a contribution to maintaining social stability.

Research limitations – The possibilities of studying the recursive potential of such supersystems as civilizations are partly limited by such a factor that an observer is inside this system. In this case, the observer is also involved in the recursive processes being examined, which requires the construction of a research methodology that would take into account this state of affairs.

Keywords: Technogenic civilization, recursion, value systems, adaptation

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System-Institutional Approach and the Reflexive Model of Socio-Cultural Institution in Third-Order Cybernetics

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The purpose of this paper is to introduce the main idea of system-institutional approach and the reflexive model of socio-cultural institution.

We consider system-institutional approach as a transdisciplinary systems methodology in the fields of social knowledge and practices (Maracha 2014). It works in problem contexts such as preventing and resolving socio-cultural conflicts or institutional transfer from one socio-cultural background to another. In both types of wicked problems we deal with some socio-cultural units which are the “cells” of a society, preserving its “cultural code” (or identity). “Cultural code” is a normative pattern for social relations of a certain kind, which are reproduced for a historically long time in continuously emerging new situations.

The hypothesis is that socio-cultural units and their interaction are sustainable when they are institutionalized. So we should build the reflexive model of socio-cultural institution which based upon “General Social Analysis” (GSA), answering the call to social sciences from “economic imperialism”, sociologism and the other kinds of reductionist social thinking. The method of GSA is based on a conjunction of institutionalism with the achievements of the contemporary systems thinking and leads us to system-institutional approach. By this way we offer to integrate social sciences basing on the metaphor of “Schengen area”: borders become transparent, but “states” (i.e., scientific disciplines) remain.

Originality/value – We accept the hypothesis (Polterovich 2011): in GSA the object of research is the functioning and development of public institutions, the collective human activity within these institutions. We are based upon the presumption of transdisciplinarity: the basic concepts of system-institutional approach are interpreted as general and “cross-cutting” for social disciplines. So the systemic principle of holism should be applied primarily to the system-forming concept of “institution”: there are no legal, economic, political, cultural, etc. institutions – but there are “integral” institutions that have legal, economic, political, and cultural etc. aspects.

The reflexive model of socio-cultural institution includes: 1) formal places and procedures + regulatory principles (a scheme defining the basic norms of transactions); 2) symbolic fastening (with the function of “protective layer”); 3) material supporting mechanisms; 4) a value idea (an ideal “core” that sets the meaning and value purpose of a given institution); 5) spiritual supports (cognitive and moral mechanisms for awareness of norms and socio-cultural rooting of the institute). Thus, socio-cultural institution is socio-cultural unit with reflexive mechanism acting through spiritual supports and symbolic fastening. The ultimate framework of the institutional self-awareness that sets its integrity is the value idea. Another system-forming factor for the reproduction of the institution as a whole is the form/mechanism of its social organization: law, custom, ritual, routine practice, procedure/order, etc.

Research/ Practical/ Social/ Environment implications - System-institutional approach gives a general framework for collective problem-solving by joint teams of social researchers and practitioners in polysubject reflexive-active environments with complex problems.

Research limitations of presented methodology are determined by its place in third column of the System Of Systems Methodologies – SOSM (Jackson 2003). It correlates with the problem contexts of post-non-classical rationality (Stepin 2005) and third-order cybernetics (Lepskiy 2018).

Keywords: system-institutional approach; transdisciplinarity, General Social Analysis (GSA); socio-cultural unit (unit of social reproduction); socio-cultural institution; post-non-classical rationality; System Of Systems Methodologies (SOSM); third-order cybernetics.

A Systemic account on hybrid reality: Unfolding constitutive ontologies in an informational age

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The purpose – Using the Ontology of the Observer as developed by Maturana, this paper proposes a conceptual framework to explore the relevance and impact of technologies of information and communication in unfolding the dialogue amongst human beings when it refers to organizational processes where consensus actions are required to pursue agree objectives. Furthermore, the paper highlights potential conflicts arising from different accounts on reality and allowing the people engaged in it to deal with such differences from a more comprehensive standpoint. In doing so, it identifies how the process of dealing with reality implies ethical as well as ontological and epistemological issues.

Design/methodology/approach – The systemic features of Maturana's Ontology of the Observer allow us to consider the systemic approaches based on the provision and acknowledgment of different contexts of meaning and actions. This systemic account is deemed as the appropriate framework to deal with hybrid-reality; a systemic perspective in which the observer is another standpoint in a complex network of meanings, actions and accounts of reality.

Findings – The unfolding of a conceptual framework from Maturana's Ontology of the Observer when facing a hybrid-reality becomes relevant to grasp ways how human beings build up their own account of reality. This unfolding can be connected to systems thinking principles in order to identify possible patterns of complementarity and enrichment.

Originality/value – In the current informational era, in which we are all connected and individual realities seem to be merged into a plural and shared realities. Relations and communications increasingly take place in a 'digitalised' scenario in which the 'digital' individuals being seems to be more 'liquid', 'changeable', ubiquitous and holder of multiple identities. The new challenging issues that emerge for human beings in their praxis of living, thinking, acting and feeling in a digitalised/shared reality, can be seen as restrictions or opportunities. The originality of this paper lies in the use of Maturana's ideas to explore both restrictions and opportunities to unfold the dialogue between human beings.

Research/ Practical/ Social/ Environment implications – The issues of human beings' identity and conversations in the informational era will be addressed using Maturana's ontology of the observer to shed insights into the path of hybrid reality.

Research limitations – The paper offers a conceptual framework to discuss these issues. No empirical findings are revealed

Keywords: Ontology of the Observer; Informational era; constitutive ontologies; hybrid reality; Maturana

Governing innovations: role of inter-system communication and reflexive activity

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The purpose – On the example of US innovation policy the philosophical and methodological foundations of intersubjective interaction in the context of scientific rationality development (classical, non-classical, post-non-classical) are considered. The basic elements of the US innovation policy are distinguished. Based on their functions, the typology by the nature of arising interactions and the dominant types of activity has been carried out. According to the results of the research, the conclusion is made that at the modern post-non-classical stage of science development, there is an increasing need to create reflexive communicative platforms for intersubjective interaction within the framework of the innovation policy.

Design/methodology/approach – The aim of the article is to conduct a philosophical and methodological analysis of US innovation system at the present stage in order to identify the role of inter-system communications of diverse actors, and to research patterns of reflexive activity.

Findings – Based on the philosophical analysis of innovation development models and basic trends of scientific rationality development, it is concluded that in modern conditions there is an increasing need to create new forms of communication of subjects of innovation policy on the principles of post-non-classical rationality.

Originality/value Research/ Practical/ Social/ Environment implications – Theoretical, practical, social and environment implications of the study is in the providing conditions for involving government authorities, scientific organizations and corporations in the development and application in practice of governance of complexity for innovation and creativity.

Research limitations – The main limitations of this study are connected to the subjective nature of many of the used concepts and with a low level of evidence.

The category of image as an ontological unit of the hybrid reality description

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The purpose – The ontological approach to the study of hybrid reality involves its analysis from a single and sufficiently simplified theoretical positions that allow us to systematically consider objective, physical, virtual, subjective and social realities in their semantic interrelation. It is necessary to develop an approach that would include the possibility of analyzing the interaction of a person as a subject with mixed artificial (in particular, artificial intelligence) and natural systems (nature), using a single unit of description, as with a polysubject hybrid reality and would ensure an increase in the systems subjectivity level (Lepsky, 2019).

Design/methodology/approach – As the most generalized philosophical position for describing hybrid reality as a whole, the present study used the idea of the possibility of the development of nature and its subjectivity (Plato, Schelling), in contrast to the traditional Hegelian idea that only changes are possible in nature. Natural science methods describe the structural and dynamic characteristics of the development of systems. It was shown that the description of the socio-humanitarian systems development is possible from the standpoint of humanitarian and natural science methods when using as a general unit of description the category of the “image” as a limited part of the space that characterizes various components of hybrid reality – mental, virtual, physical, etc. (Shikhirev, 1993; Sukharev, 2019). Both artificial and natural, socio-humanitarian and natural, real and virtual systems are perceived by a person as images, i.e. isolated parts of an arbitrary space that have a regulatory function in the behavior of the subject. One of the most discriminating and essential differences for a human being of all possible systems, in our opinion, is the measure of their artificiality and naturalness. In philosophical and methodological terms, the natural development is considered as a degree of approximation to the ideal of “synthesis of chaos and cosmos”, both in structural and dynamic terms (Bransky, 1999) and figuratively (Sukharev, 2019). At the same time, the measure of artificiality can be determined by the degree of anthropogenic nature of the system.

Findings – The development of V. P. Bransky's philosophical idea of the structural-dynamic “synthesis of chaos and cosmos” as an ideal and a condition for development in relation not only to natural, but also socio-humanitarian systems. Taking into account the ethnic function of the unit of description, i.e. its natural and cultural specifics, this approach was to a certain extent verified as an ethno-functional concept of the synthesis of chaos and cosmos and for humanitarian, virtual, and other systems (A.V. Sukharev). In general, the chaotic, cosmizing and ethnic function of its images are considered as the ontological characteristics of being in this concept. Experimental and empirical studies show that it is precisely the increase in the degree of synthesis of comizing (artificial) and chaotic (natural) of ethnointegrating figurative components in the hybrid mentality of collective and individual subjects that ensures their development and adaptation not only according to psychological, but also non-psychological indicators – medical, demographic, socio-economic, environmental, etc. (Sukharev, 2008, 2017, 2019). It is essential that the results obtained reflect the ontological relationship of various types of reality, taking into account their natural and cultural specifics. The approximation of arbitrary systems to the ideal of development also contributes to an increase in the level of their subjectivity according to A. L. Zhuravlev (2009), which can serve as a basis for overcoming the subjectivity of hybrid environments.

Originality/value – The originality of the research is due to the novelty of the philosophical and anthropological concept of the ethno-functional synthesis of chaos and cosmos, taking into account the natural and cultural specifics of the functioning of systems. This concept implements the ontological approach to the study of the laws of the development of hybrid reality. The novelty of the

conceptual provisions, in turn, ensures the novelty and, in part, the paradoxical nature of the obtained theoretical, experimental and empirical results in various fields of human life (Sukharev, 2008, 2017, 2019, etc.)

Research/ Practical/ Social/ Environment implications –At the individual level, the practical significance of the research results is to identify the role of real, virtual, and other figurative components in the development and adaptation of a person to increase the level of his intelligence, the level of mental and somatic health, biological reproduction, development of socially significant qualities. At the collective level, the role of these images in the socio-economic, environmental etc development of the subject is revealed. The identification of the role of mental images in the development and adaptability of hybrid systems, taking into account their natural and cultural specifics (the ethnic function of the image as a unit of description of systems) allows us to significantly more flexibly and concretely predict and manage the behavior of the subject.

Research limitations – Possible restrictions at the moment are presented as organizational measures to limit further experimental and field studies due to the paradigmatic novelty of the approaches used and the results obtained.

Keywords: ethno-functional approach, synthesis of chaos and cosmos, psychic image, hybrid reality.

Vertical Development of the Systems Approach and Cybernetics: Issues and Opportunities Primary tabs

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The purpose – Currently, the development of a systems approach has acquired a “horizontal” direction, in which only the forms of application of already established fundamental ideas are increasing. Such ideas include the idea of dynamic systems (Birkhoff D; 1930), the idea of purposeful behavior (Zommerhoff G., 1930), the idea of open systems (Bertalanffy L., 1950); the idea of purposeful behavior (Ackoff R. & Emery F., 1972), the idea of self-organization (Saridis, 1977), the idea of autopoiesis (Maturana H. & Varela F. 1973), and some others. The purpose of the report is to return the “vertical” direction of development to the systems approach.

Approach – The results of the research are based on an analysis of the reasons for restraining the “vertical” development of a systems approach and the search for opportunities for the next rise in systemic thought. This search is based on the ideas of systems theory as the theory of system classes (Boulding K., 1968) and the methodology of conceptualization of subject areas (Nikanorov S., 2009).

Conclusions – A systems approach can be developed in the following areas:

1. The study of systems capable of providing homeostasis by managing contradictions. Such a branch of cybernetics was initiated in the WOSC space (Gorsky Yu, 1990).
2. Resuscitation of a systems approach based on the ideas of classes of increasingly complex systems. At present, the simplest classes of systems (compositions; networks; distributions, etc.) and simple classes (processes; flows) are most fully investigated. Less studied are the classes of medium complexity (focused; growing; organizing). Extremely poorly researched are higher classes of complexity - developing systems.
3. Development of instruments of tectological research of reality. These are instruments of thinking that could allow through the phenomena of reality to penetrate into its mechanisms, into tectonics (Greek tectos - dispensation), to the reasons for its essential properties.
4. The appeal of system research to the most complex objects of reality, which include objects of the “second nature” (Schelling F., 1797). Currently, this reality is being investigated by representatives of the humanities who are not armed with system instruments adequate to complexity.

Originality – Instrumental use of concepts for restoration of invariants of the studied works in the field of systems and cybernetics can claim originality.

Results – The conclusions of the report can be useful for orienting WOSC not to expand the scope of application of understandable, already systemically clear ideas of a systems approach, but to aimed, concentrated research of the most complex classes of systems. This may reorient researchers towards accelerated mastery of the Unknown.

Restrictions – Conclusions relate to the development of the theoretical resource of a systems approach.

Keywords: Theory of systems, classes of systems, vertical and horizontal development, tectology, concept

Viable System Model for the design of on-demand Service Systems: A Case Study

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Purpose – This paper attempts to frame the design of service systems as the design for viability of service organizations, recognizing the need to model the complexity of both the service organization as well as the in-use service system

Methodology – Viable System Model, Viplan Method; exploration of a case study

Findings – The case study illustrates and corroborates the conceptual claims made regarding the design for viability of service systems and organizations

Value – This paper proposes a fundamental reframing of the design of service systems in terms of the viability and the Viable System Model. It illustrates the power of the model in describing, within a single framework, organizational design requirements in service organizations as well as complexity modelling of their “product”, service systems.

Research – With further study, it may be possible to extend it to link approaches from other service disciplines within a cybernetic, viability-based framework for service systems

Limitations – The conceptual framework discussed has been illustrated by the means of a single case study.

Keywords: Viable System Model, Viplan Method, Service System, Service Organization, Software-as-a-Service

Theme 2. Interactions in society: the cybernetics of society, ecology and governance

Raul Espejo, Vladimir Lepskiy

From the perspective of current social crises, such as COVID-19, climate change and in general sustainable development, this theme wants to explore the interdependence of global and local policy making. The reach of national policies today may be distorted by poor understanding of autonomy. While autonomy may be desirable, when nations overreach this autonomy and make dysfunctional their relations with more global institutions, such as the United Nations Environmental Programme, the Organisation for Economic Cooperation and Development, the World Health Organisation and others, the policy outcomes for the world as a whole can be disastrous. Nations are behaving beyond their natural autonomy with an unrestricted independence, thus making their contribution and collaboration to global policies dysfunctional and costly to humanity. This theme relates to the governance of pressing social and environmental issues in the age of the Anthropocene, experiencing institutional failures. Powerful insights are provided by the Westphalian dilemma, one of the sessions in this theme. This dilemma, by increasing the relevance of national decisions at the expense of a world in need for global decisions, makes responses to different forms of global crises extremely difficult. In this theme, we want to open conversations around policy issues in their local and global aspects, with an emphasis in ecosystems and organisational structures.

Therefore, this theme aims at exploring cybernetics in several aspects of society, including its contributions to the development of healthy global ecologies, to the strengthening of participatory democracies, to decentralization of control, to effective governance of communities, institutions and nations. What can cybernetics and systems thinking contribute to debates about the network democracy and to the emergence of distributed collective intelligence? What can local, regional, international bodies of knowledge say about strategic control and development centres to initiate and support the consolidation of state, business and societal institutions?

It is recognised that current democratic models are often dysfunctional, overwhelmed by big data, weakly supported by artificial intelligence, battling with an increasing variety of cloud computing suppliers and dealing with algorithms built upon a top-down direction, which, as implied by the Westphalian dilemma, built upon poor multilevel interactions. This makes it increasingly difficult to bridge global and local constructs and to provide constructive feedback loops. Effective interactions between citizens, experts and policy-makers in a world in which people's actions are increasingly damaging the environment are posing uncontrolled challenges to the future of society.

In democratic societies, we often relate decisions and policies as outcomes of direct, representative and participative forms of democracy, which need further development to be effective. This theme invites discussions of the significant distinction between the "wisdom of the commons" emerging from the citizens' agency as they interact with policy-makers' decisions supported by experts, think tanks and political parties, and all together, by citizens and policy-makers influenced by an ever stronger media. This distinction between people and policy-makers touches key aspects of communications in a complex world, dominated by big data, which in practice implies data overload for both of them. How do we increase societal capacity to identify, understand and react to the dynamics of their environment? For citizens of a country, big data may conflate their very local experiences with aspects such as the economy, migration, health services, environment and so forth, with the requirements and demands of global policies. Politicians, overwhelmed by data -in an uncertain world- may construct and impose their ego influenced truths propelled by their ideology, weak exposure to expert advice and short-term political interests.

In WOSC 2021, we invite reflections on how to reduce the gap between sound evidence and wild emotional constructions, through effective 'hybrid organisations' and necessary innovation. We need

to discuss our responsibility to create regulatory procedures to contextualize what we read and hear in the media and social networks. We invite reflections about the authenticity, legitimacy and truthfulness of the arguments advanced by those forming public opinion. It may be argued that the complexity of societal processes make impossible dealing with these challenges. However, it can be argued that complexity management tools such as organisational models, artificial intelligence, real time decisions, situation centres, operation rooms and shared media, displayed in the digital society, need the support of systems thinking and cybernetics to improve the quality of decisions. These tools carry some risks but also have the potential to increase the opportunities for more effective participation in policy and decision-making processes. We want to learn how to keep open checks and balances between multiple viewpoints to bridge gaps between emotional and empirical truths. We need to learn how to construct dialogues enmeshed in multiple moral mazes. This proposal for WOSC 2021 is an invitation for participants to contribute to the creation, regulation and implementation of more transparent societies.

Section 2.1 Governance of pressing social and environmental issues in the age of the Anthropocene

Ray Ison, Sandro Schlindwein, Igor F. Kefeli, Shann Turnbull

The prevailing paradigm in the governance of the relationships between humans and the biophysical world has led us to the Anthropocene, a new geological epoch in planetary history in which humans take an active part, affecting a range of biophysical and social processes leading to complex global changes and global risks. Congruent with these global changes, there is increasing evidence from different contexts that many “governance systems” are not fit for purpose under contemporary circumstances. The COVID pandemic has exposed many of the vulnerabilities in our governance systems.

Symptoms of governance failure vary across policy domains and scales (from local to the global), occurring within nations, organisations and multilateral programs. The Anthropocene imposes new challenges for governments, demanding capabilities for dealing with complexity and uncertainty and signalling the ‘death of stationarity’. Given the scale, significance and magnitude of the challenges arising in the Anthropocene it seems necessary to invent and make radical changes i.e., to create transformative governance regimes able to manage global risks for the purpose of providing safety and viability of human life into the future. Institutional innovations that break the current structures and relationships within governance systems are needed accompanied by recovery of human systemic sensibility, expansion of cybersystemic literacy and investment in cybersystemic thinking in practice capability. New governance systems not only need to be imagined but enacted- hence the urgency for systemic praxis.

If we wish to share a common future on Earth, it is urgent to utilise cybersystemics to shift also the political landscape needed to achieve necessary transformations in human - biosphere relations into the future. Changes include managing human populations in equitable and ethical ways along with an increase in systems of polycentric self-governance adapted for a modern era. Cybersystemic insights and support are needed from every region of the world.

Contributions are invited to this session that explore theoretical, methodological and empirical cases enabling innovations in cyber-systemic thinking and practice with promise for revitalising institutions and practices that deliver effective governance in the age of the Anthropocene.

Discussion points

- Institutional and policy innovation/design
- Climate emergency and resilience
- Social inequality and politics in the Anthropocene
- The praxis of polycentric and/or cybersystemic governance
- Governance of social-environmental risks

Indicators as a systemic problem of economic development management

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In the practice of management, there are often situations when, despite the rather attractive goals that are formulated by managers, the result of the activities of subordinates is the opposite of what was intended. The article substantiates the thesis that the cause of this is systemic patterns. The main system regularity is the desire of the system for stability and self-preservation. Planned target and evaluation indicators are external factors that deviate the employee (as a system) from a stable state. The article shows that any employee, acting as a system, strives for stability and self-preservation. Therefore, the employee always strive to achieve quantitative knowledge of indicators in the least energy-intensive way. The main problem of social management is the development of a system of indicators in which, working on the indicator, workers would change the state in the right direction. It is shown that the existing system of target indicators used as indicators for assessing the effectiveness of management does not correspond to the goals and objectives of socio-economic development. The article defines the vector of change in the system of indicators for assessing the effectiveness of management at the regional and state levels, based on the fact that the key element is the household.

Keywords: indicators in management, system approach, transdisciplinarity, socio – economic development management, cobra effect.

Some eco-cyber-systemic tools that could be useful for the challenges of tomorrow

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The purpose – The challenges of tomorrow need an eco-cyber-systemic perspective today. From social to environmental, from governance to developmental, the crisis changed the rules of engagement for all.

Organizations of all sizes rest on planning for discrete amounts of time: a five-year pro forma, full-year budget, weekly schedules, and daily stand-ups. These plans give a pathway, keep people on task, and provide a sense of certainty. But what happens when time effectively stops or slows down dramatically? When an extraordinarily disruptive external event forces large parts of the economy to shutter? The time horizon both contracts and expands. As the structures that keep people focused fade away are replaced with uncertainty at best, and existential dread at worst.

Are the methodologies and tools that have been used still useful? Which ones can be used, and which ones should be modified or discarded?

Design/methodology/approach – Some systemic tools of strategic planning are reviewed, prospective techniques and scenarios, as well as their approaches.

Findings – Using the cyber-systemic methodologies and tools that are reviewed is a good choice, but it is not sufficient. It also needs to tackle, directly, both the human dimension of system changes and their ethical values, so that people can engage productively and inclusively in economic life, take advantage of escalated opportunities, and fulfill their potential. And overall, take care of the natural environment.

Originality/value – This is not pretending to be an original, but a starting point for future developments.

Research/ Practical/ Social/ Environment implications – If any impact this article could have, it should serve to experience the usefulness of the exposed approaches, criticize their limitations and errors, and help improve them. This must be a call to researchers, scholars, and members of the professional community.

Research limitations – It is not yet known when or how it will be considered that the risk of the virus has been reduced enough to not be considered a pandemic, and neither will be the characteristics of that future. Therefore, the conclusions of this article are not such, just an attempt to improve business planning.

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Keywords: Pandemic, organizations, strategic planning, cyber-systemic, prospective, scenarios

Typology-based systemic governance approach to crisis management

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The purpose – Systemic governance is an integral part of addressing complex crises as it provides an overarching decision-making platform that can integrate organisational, technological, administrative, operational, and other critical management functions. Both proactive and reactive measures for coping with major disruptive events are enabled by systemic governance. This paper considers best approaches for governance under the circumstances of crisis management and uses the well-known typology of simple, complicated, and complex to map out appropriate governance styles. Since crises vary greatly across many dimensions, governance approaches need to be adapted to suit the particular circumstances being faced. Key questions in developing systemic governance include how to make the infrastructure more resilient to complex crises such as natural and man-made disasters. Mitigating systemic risk is highly important, as is the appropriate allocation of resources.

Design/methodology/approach – There are different types of governance: some approaches are based on control by directive whilst other approaches rely upon softer methods of influencing through the environment. Just as governance can vary, so can the complexity of crisis, as characterised by one well-known typology of simple, complicated and complex. The paper uses literature search in the fields of crises, their type and extent, governance styles, and levels of complexity to come up with a proposed template for managers who are facing crisis conditions.

Findings – The paper presents an approach that can assist decision-makers to assess the situation with which they are faced by applying the most appropriate form of governance to that crisis. The main conclusions of this paper are that the three styles of governance, including hierarchy, distributed network, and holarchy, are suited for crises showing different levels of complexity. In particular, a hierarchical approach is best suited to simple crises where all of the factors are known. A distributed network approach is more appropriate when managers are dealing with a complicated crisis in which there are known unknowns. An integrated holarchical approach is most fitting for dealing with complex crises in which we are facing unknown unknowns.

Originality/value – The field of crisis management is somewhat fractured, with contributions arising from many different disciplines and covering a variety of crises such as corporate crises, natural disasters, and crises arising from many different sources, including man-made sources technological, social, and malicious actions. Crises also have been studied in terms of their consequences, whether these be social, economic, environmental or reputational. Because of this great inconsistency in approaches and understanding, there is no clear direction for managers to cope with crises of different origins and levels of complexity.

Research/practical/social/environmental implications – Contemporary organisations operate now under extreme level of uncertainty. Whether crises are arising from external conditions such as natural disasters or internal conditions, including complacency, inertia and poor strategy, among others, managers and decision-makers need appropriate governance structures to survive the crisis and perhaps even turn it to their advantage into the future. As we continue to face an increasing frequency of crises often of a high level of complexity, academics and professionals need guidance about best ways to formulate their approaches under crisis conditions. Better governance of crisis will obviously have a strong impact on the individuals and groups involved, and the environment in which the crisis is being experienced.

Research limitations – The proposed framework needs to be tested by means of data collection from academics and practitioners to gain their perceptions about the usefulness of the proposed

framework. In particular, it would be helpful to examine whether the suggested fits with their experience and if they can envisage scenarios in which these types of approaches would be feasible.

Keywords: systemic governance, crisis management, complexity, governance typology, typology of crisis

The dynamics of governance failure in the context of the Anthropocene: Brazil, UK and Australia

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The purpose – across countries as different as Brazil, the UK and Australia there is a growing critique of contemporary systems of governance. Questions concerning how a national governance system responds to the Anthropocene are central to our times. Current governance mechanisms and institutional designs are inadequate for the tasks at hand. Therefore, to transform for governing in the Anthropocene, a departure from current governance systems based on the contemporary, inadequate, two-dimensional set of relationships (state-judiciary-private sector-civil society) towards a ‘three-dimensional’ governance ‘diamond’ is presented and discussed.

Design/methodology/approach – based on generic heuristic devices systemic governance failings and innovations are explored. Differences and commonalities between three nations are presented. The research draws largely on systems approaches and their understandings and practices to fundamentally alter governance systems in the Anthropocene and in light of the global pandemic.

Findings – the countries of concern in this research have in common that the reasons for governance failure in the context of the Anthropocene are largely institutional and cultural; each are, despite their unique histories, on a perverse trajectory in their relationship with the biosphere. In all exemplar countries, institutions of the state no longer function effectively. They do not deliver on the primary purposes of the state and meet the needs of the citizenry in the face of the climate emergency.

Originality/value – current governance systems have failed to deal effectively with the biosphere. For this reason governance system reinvention is warranted. We explore what this might entail in terms of praxis and institutional innovation.

Research/Practical/Social/Environmental implications – the proposed three-dimensional governance ‘diamond’ favors variety-creation and variety-maintaining based on practices that are self-organizing in nature, allow for emergence and are contextually and historically grounded.

Research limitations – so far, results of the adoption of the three-dimensional governance ‘diamond’ to enact new governance systems through innovate institutional design are not yet available in a coherent, narrative form for the countries of concern.

Keywords: Anthropocene, systemic failure, governance systems, systemic governance

Framing matters: how does 'Anthropocene' enable and constrain cybersystemic governance of social-environmental issues?

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The purpose – 'Anthropocene' is a neologism coined by Crutzen and Stoermer (2000) to manifest their experience of global phenomena from a perspective of Earth System Sciences (ESS). They highlight positive feedback loops between chemical, atmospheric and biological phenomena triggered by anthropogenic factors, and creating biogeochemical conditions that increasingly threaten human life. The ESS scholarly area has evolved from more a systematic thinking separating the studies of physical, chemical and biological phenomena, to an increasingly systemic view of a whole 'earth system', or biosphere, that recognises dynamic relations between these phenomena. The conceptual boundary of 'Anthropocene' includes a human component with 'Anthropos' and identifies social activities as causes of environmental issues. However, to what extent does a first-order cybernetics' framing of 'Anthropocene' enable cybersystemic governing in Anthropocenic situations loaded with economic inequalities, political tensions and ethical dilemmas? This inquiry suggests a systemic inquiry framework to explore these issues.

Design/methodology/approach – A review of the literature (i) examines the concept of cybersystemic governance, (ii) explores the 'Anthropocene' metaphor, (iii) studies alternative perspectives of a planetary problematique and (iv) proposes a systemic inquiry framework for an 'Anthropocene' framing more conducive to a cybersystemic governance of social-environmental issues.

Findings – The findings are based on a literature review that precedes a field research aiming to appreciate how to institutionalise cybersystemic governing in the Anthropocene. In the context of the literature review, the findings are framed by the following questions:

- What is meant by cybersystemic governance?
- What does the 'Anthropocene' metaphor reveal and conceal?
- What can we learn from alternative perspectives on the 'Anthropocene' situation?
- How to transform framing dualisms of the 'Anthropocene' into conceptual dualities?
- How might an alternative framing of 'Anthropocene' enable cybersystemic governance of social-environmental issues?

Originality/value – The literature reveals a plethora of neologisms coined by scholars outside the area of ESS to frame their particular experience of the Anthropocene. Ison and Straw suggest that "framing choices create initial starting conditions that become conserved as lineages (pathway dependencies) and as institutions" (2020, p.147). If we consider that naming is making a framing choice, Ison and Straw's suggestion indicates that the tradition underpinning a naming might become a rule in governing the situation thus named. Hence, considering a tradition of first-order cybernetics underpinning 'Anthropocene', it is important to (i) examine how this tradition enables and constrains cybersystemic governance of social-environmental issues, (ii) see the 'Anthropocene' through the eyes of others and (iii) create a framing of 'Anthropocene' that is more enabling to cybersystemic governance praxes.

Research/ Practical/ Social/ Environment implications – While the discourse on cybersystemic governance in the 'Anthropocene' is developing, the 'Anthropocene' paradigm that conditions such governance seems to be taken as given. This paper offers second-order insights about the implications of the 'Anthropocene' concept, metaphor and framework, on thinking and practicing cybersystemic governance of social-environmental issues.

Research limitations – The proposal of a systemic inquiry into an alternative framing of ‘Anthropocene’ emerges from a conceptual analysis based on a literature review. The validity of this proposal will be assessed in real-world situations of governing social-environmental issues in later case study research.

Keywords: Anthropocene; Cybersystemic; Framing; Governance; Social-environmental issues; Systemic inquiry

Soft Systems Inquiry and Covid

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The purpose – In this paper we describe the way a Soft method of Action Research was adapted in order to overcome the restrictions of face to face communication resulting from the Covid pandemic.

Design/methodology/approach – Investigations of urban food systems have been predominantly tackled by the adoption of reductionist methods of inquiry mapping areas at high risk of no or limited fresh food access (known as ‘food deserts’) in the cities. But there is limited holistic research undertaken to increase our understanding of the complexity of the factors surrounding access. In this research we adopt a method of Soft System inquiry namely the Appreciative Inquiry Method (AIM). This method is usually undertaken with groups of participants, but unavoidably it had to be adapted to the current Covid restrictions in the UK. These restrictions meant that a new way of undertaking the cycle of Action Research has been explored.

Findings – The main discussion in this paper relates to undertaking Action Research in a remote online environment with diverse stakeholder representatives. Many lessons have been learnt throughout the field study and from a previous pilot study about the best practice to simulate face-to-face meetings with individuals and groups in online settings, without affecting the nature of the method of inquiry. Adjustment of AIM was necessary to deliver convenience and time effectiveness to all parties involved in online meetings and to all phases of Action Research cycle. We found that adapted use of AIM created opportunities that may overcome some difficulties encountered in face-to-face settings, but it also showed its drawbacks in other phases.

Originality/value – The importance of this paper is two-fold. First, restrictions with Covid-19 pandemic created an issue we haven’t faced before and therefore made an impact on how we use Soft Methods and adapt them to the online environment. Second, the adoption and adaptation of a method of Soft Systems inquiry to gain understanding of some of the complex issues surrounding this important area of concern has not been reported before.

Research/ Practical/ Social/ Environment implications – Covid-19 pandemic has highlighted our dependence on face-to-face meetings and created an opportunity to explore new ways how Soft Methods may be adapted to online settings. Whilst researching the system of interest, namely the food systems in the Portsmouth community, it was clear that it had implications upon the whole Action Research cycle of learning. Our research will inform researchers and professionals using a Soft Systems method of inquiry and open an opportunity to explore further the benefits/disadvantages of its online version.

Research limitations – The severe restrictions upon face-to-face meetings and the vast numbers of the UK population working from home raised significant limitations for field studies. The application of online platforms and their embedded features also created a new set of issues. These shortcomings have been addressed and re-designed to suit AIM, whilst maintaining its fundamental Soft Systems principles. The absence of such ‘normal’ human interaction such as non-verbal communication, found in face-to-face settings, was highlighted.

Keywords: Soft Systems, Soft Methods, Action Research, AIM, food access, food deserts

Basic Principles of the Theory of Evolution of Economic Relations Management Systems (TEMS)

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The purpose of the article is to outline Basic Principles of the developed theory of the evolution of economic relations management systems (TEMS).

Methodology – Principles of dialectic of evolution and principles of conceptual design and system analysis are cornerstones of TEMS creation methodology.

It is assumed that:

- theory can be created for a holistic system only, i.e. for a system that comprises both the managed object and its management system(MS).

- evolution of management systems corresponds to evolution of managed object, i.e. management system is adequate to managed object.

Economic relations evolution theory is based on identifying pre-economic relations(PrER), embedded into each other:

- Impact/Appropriation (independent)
- Exchange (interrelated Impact/Appropriations)
- Distribution/Concentration (bunch of Exchanges)
- Production (networks of interrelated Distributions/Concentrations).

Corresponding elementary pre-management forms are:

- Accounting/Transfer(AT) of data (independent data).
- Coordination(C) (establishing links between relevant AT)
- Search (formation of a choice space. Synthesis) and Selection (comparison of alternatives. Analysis).(SS)

Findings – Most important properties of constructing an evolutionary line:

- in each stage of development of IER and their respective management systems (IERMS) are embedded, as subordinate elements, all previous stages-types of IER and ERMS and more progressive stages-types of IER and ERMS (in the form of reasons-sources of further evolution).

- an essential characteristic of basic forms of evolution of PrER is that they turn into types of IER, acquiring two properties - a private or public nature of connections between a pair of subjects. This system-forming property indicates either an individualistic form of IER implementation, or their generally public nature, or a combination of private/public characters of relations.

- for the concepts of ERMS, the main characteristics are dual - to have a private or public nature of relations, in managerial terminology - authoritarian or democrati. It must be emphasized that the nature of relationship extends to both participating subjects, that is, relationship cannot be private-public or public-private.

- subsets of pairs of relations are considered, i.e. binary relations between subjects according to the quad of PrER, which belongs to each of the interacting persons-subjects of relations.

Therefore, specific MSs types are identified by a quad of features of basic primary ERMS development forms.

Transition from one quad of characteristic features to another is carried out according to the dialectical law of withdrawal (step-by-step change in the subsequent form of MS implementation with the restoration of the significance of weaker previous form).

Transition from consideration of relationship between a man and nature to relationship between group of people - group of people carried out in two stages. First elementary step is transition to consideration of human-human relations for four types of PrER (IER). Second elementary step is assumption that one or both of subjects in IER can be IER. Strictly speaking, economic relations are relations between IERs, the operands of which can be both subjects and IERs.

It was formulated 16 evolutionary stages of IER and 16 their equivalent evolutionary types of IERMS from Universally-Authoritarian MS through 7 Partially Authoritarian MSs and 7 restricted Partially Democratic MSs to Universally-democratic MS.

Originality – TEMS was built on the basis of an analysis of a long historical period - from origin of economic relations to present time, indicating the prospects for their further development. TEMS claims to be exhaustive, i.e. on the fact that it describes all variety of MS under accepted constraints.

Research implications – Created TEMS identifies classification basis and facilitates detailed further analysis. MSs types 1,3,5,7 are expected to be stable, while types 2, 4, 6 are transient.

Universally-democratic MS is an Ackoffs purposeful system, and its evolution is the eternal striving for the ideal, which provides methodologically correct approach to further study of this class of MSs.

Classification of MSs given in the article allows predicting changes in MS at large time intervals, as well as assessing its progressiveness/regressivity.

Limitations — TEMS created for a holistic system only

- MS evolution is consistent with object evolution
- all variety of economic relations can be described by four generalized subtypes: Action/Appropriation; Exchange; Distribution/Concentration; Production
- most important property of ER and MS is their nature - private or public (autocratic or democratic).

Keywords: Theory of Evolution, Economic Relations, Dialectics, Conceptual Design, Political Economy, Management System.

How cybernetics explains behavioural Tensegrity and its advantages for organisations

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The purpose –This article explains: the concept of Tensegrity, why it is ubiquitously found in living things, and how the Law of Requisite variety explains: (a) why evolution hardwires social creatures to possess Tensegrity; (b) the advantages of organisations possessing the contrary ~ complementary characteristics of Tensegrity and (c) why self-regulation, self-management and/or self-governance is incompatible with simple hierarchical organisations. Buckminster Fuller (1961) coined the word Tensegrity from “Tensional Integrity” to explain how materials with contrary characteristics allowed geodesic domes to cover the greatest area with the least material. Cell biologist Ingber (2006) described Tensegrity as “The architecture of life”. Neuroscientists Kelso & Engstrøm (2006) introduced the tilde “~” notation to indicate the Yin ~ Yang Tensegrity relationships found in our brains.

Methodology – All communication and control processes within and between living things involve the transaction of data. Shannon (1948) used bits for the analysis of communications systems. Bits are perturbations in energy and/or matter that make a difference. Eight bits are described as bytes. Transaction Byte Analysis is used to indicate the amount of energy and/or material required to create living things and provide them with the ability to become self-regulating, self-managing and self-governing as individuals and/or in groups. To achieve these outcomes living things require a requisite variety of data senses with a requisite variety of communication and control channels to survive their creation and reproduce in unknowable dynamic complex environments that includes the behaviour of other forms of life.

Findings – Three hypotheses are developed: 1. Tensegrity creates a requisite variety of instinctive and learned behaviours for livening things to survive their creation and to reproduce in dynamic unknowable complex environments while minimising the material and energy required in their DNA for their creation; 2. Tensegrity is required in social organisations to provide a requisite variety crosschecking communication and control channels to reliably and comprehensively identify and control internal and/or external risks, threats and opportunities to its existence. 3 Tensegrity is frustrated, denied and/or excluded in centralised command and controlled hierarchies that become systemically subjected to “Group think” so as to reduce the ability of the organisation to become self-regulating, self-managing and/or self-governing like living things.

Originality – Transaction Byte Analysis is a methodology for organisational analysis created by the author’s PhD original research. Another original contribution of the Thesis was to apply the concept of Tensegrity to social organisations. This in turn provides original insights into how centralised command and control hierarchical organisations can fail to be fit for purposed and/or even fail to exist. In this way, the article to contributes original insights for biologists and scholars of management and governance. For biologists it explains why the DNA of social creatures hard wires them to possess contrary ~ complementary behaviour like approach ~ avoidance, trust ~ suspicion, cooperation ~ competition and so on. For management and governance scholars it explains why current risk management practices fail.

Implications – The giants of management scholarship have made their reputations from researching the dominant form of modern organisations without tensegrity. As a result, the general public and influential educational management institutions find it incomprehensible that any organisations can become self-regulating and self-governing. However, Ostrom (2009) has identified numerous examples in both modern and pre-modern times. This paper reformats Ostrom’s design principles so that they apply to corporations. In this way corporations can be designed to provide benefits for all

their stakeholders as wanted by the US Business Round Table (2019). Tax incentives are identified to transform corporations so that they promote the common good locally and globally. This would allow corporations to counter existential risks to the environment and so humanity.

Research limitations – Finding co-researchers and other authors as the author lacks requisite variety of data and data processing capabilities to identify limitations. Empirical research is lacking into ecologically governed organisations that possess tensegrity to investigate the hypotheses presented.

Keywords: Amplifying control, Ecological governance, Explaining behaviour, Global governance, Governing complexity, Organisational design.

Section 2.2 Institutions, nations and distributed organisation and control (the Westphalian Paradox)

Raul Espejo, Clas-Otto Wene, German Bula, Markus Schwaninger, Allenna Leonard

Coping with Complexity – How to master a Pandemic

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We aim to contribute to improving the management of pandemic crises from a complexity stance.

“Only Variety can absorb Variety” is the classic and inexorable Law of Requisite Variety, which stems from the eminent cybernetician Ross Ashby. The implication of that Law is that the regulator of a system must have a variety (repertoire of behavior) that matches the variety of the system regulated. We are using the Covid-19 crisis for the case study in this paper. In this context, the system regulated is the crisis, and the regulator is the organization that has been created to manage this crisis.

If Ashby’s Law is inexorable, as claimed at the outset, then it must also be unachievable. Variety is a technical term for Complexity, and Complexity can never be fully understood nor mastered in a literal sense. However, this contribution is not grounded in a technocratic hubris that assumes the possibility of total control of complex systems. Take a pandemic: If the virus seems under control, mutants can emerge, which might call into question all previous successes. Yet, all that Ashby’s Law does, is establish a condition under which control can occur. It does not assert that control can occur in any case. Therefore, “mastered”, as used above, is a relative term.

The purpose of this contribution is to shed light on the Covid-19 Pandemic from the cybernetic stance of Variety absorption, and draw lessons to improve the state of crisis management. We are building on a case study. Our focus is on federal systems, as these are particularly powerful in coping with environmental complexity. Using the case of the Swiss Federation, we have studied the Covid-19 pandemic in that country for more than one year.

The Swiss Federation has been chosen as a case study, - for two reasons: First, Switzerland has built an effective response system for coping with the crisis. Second, and more important, the form of state here is the federation and the form of governance is democracy. Both are classical approaches to enabling the survival of social systems: Federal structure and democratic participation are the two pillars of viability.

To be concrete, this research concentrates on three research questions:

- 1.) How is the management of the Covid-19-Crisis organized in Switzerland?
- 2.) How effective is this organization in coping with the dynamics of emergency?
- 3.) What lessons can be learned for the design of a crisis management in the future?

In sum, we address the question of how the crisis organization within a country must be designed for mastering the crisis. This can only be achieved if the Variety of the organization equals the Variety of the environment, which in our case is the pandemic. In other words, that organization must develop Requisite Variety, i.e., a repertoire of behaviors that matches the repertoire of that pandemic.

We apply the Viable System Model (VSM) by Stafford Beer as a framework for our study. That model is based on the Law of Requisite Variety. It has been widely used for both diagnosis and design of organizations. It also embodies the structural concept with the most rigorous theoretical claim. We

carefully elaborate a diagnosis and a design for the management of pandemic crises. Both the analysis and the synthesis of our study are based on Ashby's Law. The VSM is a conceptual tool that is particularly strong for analyzing federal systems. Hence, substantial insights have surfaced to orientate a future crisis management. In a nutshell, the implication is what we call "Variety Engineering".

Keywords: Crisis Management, Complexity, Requisite Variety, Variety Engineering, Organization, Diagnosis, Design, Covid-19 Pandemic

Institutions, states, autonomy and distributed organisation and control (the Westphalian Paradox)

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The purpose – The Westphalian Treaty (1648) created our modern nation-states that today operate in the context of increasingly challenging global problems, such as COVID 19, climate change, sustainability of natural resources, terrorism and many more. These problems require to different degrees global, regional and local policies as well as regulatory and operational responses. Our purpose is contributing to policy and operational processes at multiple levels through the discussion of structural responses to problematic situations.

Design/methodology/approach – At the core of our discussion is clarifying the relationships between nation-states, regional organisations, distributed institutions and their environmental contexts. At a general level these relationships are about the management of complexity in situations with different complexity and more specifically they are about the modelling of policy issues, recursive organisations, and the application of Ashby's Law of Requisite variety.

Findings – the historic Nation-states, that emerged from the Westphalian Treaty, often lack resources and are inadequate to provide effective responses to their own problems let alone to the increasingly demanding social challenges that humanity is confronted with at the global level. At the same time global institutions lack resources, strength and power to deal effectively with these challenges.

Originality/value – While the theme of these local-global problems is well recognised in the literature, the application of tools, such as the Viable System Model in their study is less advanced and needs new perspectives to deal with them.

Research/ Practical/ Social/ Environment implications – we expect to provide new insights about the management of complexity in recursive organisations as well as about policy learning in situation of social significance, such as sustainable development.

Research limitations – This paper offers the beginning of a research programme that will need more human and technical resources to have implications for policy making, which indeed is its **The purpose** –

Keywords: Nation-State, Institution, Management of Complexity, Recursive Organisation, Policy issues

Semiosis of Politics

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The purpose – Morphogenetics of political action presupposes transdisciplinary immersion in the experience of solving complex problems, that constantly intrude into the stable sign systems of political subjects and their order parameters, thereby changing precursors to intentional activity. Layering of political orders of sign systems, facilitating the emergence of mutually intersecting, complementary, competing or accommodating modes of political complexity embodiment, creates a pulsating problem field that requires analytical isolation and subsequent synthesis of real political experience constellations using semiotic tools of cognition.

Design/methodology/approach – Semiotics occupies supra-disciplinary position in the system of sciences, having no clear-cut boundaries - its place in the research space is isomorphic to research object of the political science: it is always “between”, always “at junction”. Conceptualization of political complexity requires a switch from dichotomies to the triangulation of logos, pathos and ethos with a space for creativity of political imagination, which replaces abstract ideas of common good with the future vision as a well-founded integral synthesis. Transdisciplinary experience of philosophizing accumulates and condenses the results of disciplinary thought in communication here and now, that stretches the life-giving thread of community over the abyss of hermetic disciplinary discourses, which is relevant to solving complex issues in gradation from the individual to the supranational level.

Findings – Political action combines both expression and preliminary premise of political complexity, inviting the researcher to plunge into an expanding universe of experience, framed by moving frontiers of space and time, within which the division between theory and practice is being emergently abolished. Semiotics of the sensual in politics refers to the vitality of matter, through which the self-organizing chaos of the world of things brings order to the living space of political subjectivity in the affective act. The affective action mode combines authenticity with the scaling of political action, creating space for phase transition from stability to change. Political action is a meeting point of contingency and determination, intentionality and blindness, the fruit of the tension of overcoming and the game of dichotomies of adaptability and pre-adaptability, tradition and innovation. The arteries of reciprocal interaction between the environments of political order formation branch out in a multiplicity of effects of political action, where the target reason for the distribution of powers becomes the dominant configurator, which can take both a latent form and performative forms of events that translate language into speech.

Originality/value – Disclosing specific attributive characteristics of political action requires accentuation of the procedural nature of political morphogenesis, which unfolds in exchange between discrete political subjects. The procreative interval of politics is fractally reproduced in the space between determinism and randomness, creating a request to abandon the paradigm of “taken for granted” in understanding, conceptualizing and explaining the nature of politics.

Research/ Practical/ Social/ Environment implications – Language fulfills the functions of transfer, fixation and distribution of the sign systems that underlie the political form by selecting morphogenetic meanings of political action. Political morphogenesis is triggered, provided and overturned by recursive repetition in the language, built according to the logic of positive and negative feedback. Center-peripheral polarities between interpretations of concepts in political science are smoothed out when using the emerging transdisciplinary language of semiotics, which freely operates in the space of new challenges for political science.

Research limitations – The canvas of text, articulating and reinforcing, restraining and invoking, transforms information into frames containing reference points for political action with hotbeds of flame of new meanings in the intervals of the accelerating pulse of digital life mode. Normo-genesis embedded in morphogenesis as a “core practice” includes the reproduction of “norm” statements often out of touch with the ideal and every time through a concrete solution to the issue of inclusiveness / exclusivity and the included Third, where what is verbalized is actualized, what is drowned in silence is deprived of the right to exist, and what is between them procreatively sprouts with new life in the aesthetics of politics.

Keywords: complexity, political action, political morphogenesis, reciprocity, semiosis.

Theories of (Complex) Change: Multi-order anticipation in transformation narratives

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The purpose – The purpose of the paper is to define a novel framework with potential to move the practice of theories of change to enable description of high-complexity transformation programs. The claim is made that large-scale systems change and planning programs, such as those associated with the UN Sustainable Development Goals and foundation-supported social change investments, are risking failure of outcome due to contradictions between their audacious objectives and underconceptualized approach to planning and evaluation. We report on the advancements proposed through studies of SDG program theories of change and the variables to be represented for requisite expression of real world complexity.

Design/methodology/approach – We advance the findings after a year of prior studies, including literature reviews, critical analysis, centrality analysis, and comparative analysis of programs associated with the UN Sustainable Development Goals program. The current work extends prior research, wherein we criticized conventional theories of change (Jones, 2020; Murphy & Jones, 2020). Murphy and Jones examined the ToCs embedded in the United Nations' Joint SDG Fund's portfolio of programs, analyzed the ToCs by category and model type, performed leverage analysis on systemic phenomena in the program activities, and assessed program outcomes to determine their potential for systemic acceleration. The study led to the formulation of nine elements that should be included in a systemic theory of change, and for which we assessed the sample in the context of SDG acceleration. This report is based on the recommendations for further research from the previous work.

Findings – The predominant concerns were found that while ToCs are usually developed to address complex issues, they usually fail to capture the potential for emergence leverage, feedbacks, side effects, and other systemic behaviors common to complex systems. We proposed alternative approaches to ToCs that account for these ideas that are so crucial to systemic change. We map several cybernetic functions to the concept of the theory of change that would significantly enhance its potential to facilitate inquiry into the future unfolding (or relative success) of systemic change programs. Among these that we have not addressed in the prior study we have assigned: a) assessment of organizational fragility and anticipatory tail-risks b) Reformulating stages of the logic model as cycles, c) Assessing the requisite variety of resources, stakeholders, and feedback controls, and several others, that will be defined and evaluated for the paper.

Originality/value – The research agenda of the systemic theories of change is unique to the author and his research team. It was originally proposed in two systemic design conferences, leading to the UN-sponsored study and preliminary findings validating the original hypothesis of the underconceptualization of conventional theories of change to high complexity programs. The value of this study is evident in the leading role that a series of advancements can make in changing the models of theories of change for social change and philanthropic projects, and other large-scale complex programs that are now calling on proposals to define clear systems change outcomes. Such programs have relied on linear logical models for decades and now that systems change is demanded of funders, there are few tools commensurate to the requirements to represent a complex transformation program.

Research/ Practical/ Social/ Environment implications – The findings of the UN study have been presented at a sustainability conference and in university discussions, and have been determined as actionable within the SDG program. The implications of the adoption of systemic theories of change are significant, as an effective modelling approach that can address a significant proportion of

complexity variables will be found valuable to the funders, program sponsors, and large-scale programs such as the UN SDG Fund.

Research limitations – Limitations are primarily that the new hypotheses advancing the novelty defined in the enhancements have not been developed to date. However the framework and principles derive directly from current research.

Keywords: Theory of Change, Complexity, Systemic design, Anticipation, Multi-order system

Ecological viability and cybernetic of Ayllu

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The purpose – The goal is to recover the Oikos that reductionist ecology and economics (chrematistics of exchange value) have left out of the culture-nature relationship.

Design/methodology/approach – The methodology of Cognitive Strategies is based on the definition of a Viable Relational System as a configuration of networks of relationships that has achieved a coherent coupling between its -relational configuration relational capacity- and its -sustainability of the material energetic system-, in such a way that it does not put at risk the relationships that generate and sustain the emergence of its organisation. From these definitions, we can homologate the Sacha Runa Yachai with the relational conception of systemic relational viability, the relationship between the Sumak Allpa and the Sumak Kaway would determine the sustainability or patrimonial management of the material energy resources to make the community network viable from the knowledge system or Sacha Kawsai Riksina.

Findings – The Ecosystem and its concepts detached from the culture-nature relational conception must obligatorily migrate to a viable relational system, whose bases are relations of cooperation and reciprocity based on heterarchical structures for finite material energetic resources. The ecotome forces to return to the economy to reduce the production of the Unrequired Variety resulting from the chrematistic vision of the world. In conclusion, the ecotome finds its niche in the Ayllu as a relational conception, this allows changes and transformations from a cosmovision in which the territory of the community itself or Marka Uraqi, with the living well or Sumak Kaway; the sacralized territory or Pacha Uraqi, with the concept Sumak Allpta, fundamental concepts for a decolonized Science.

Originality/value – Sumak Kawsay depends on the current of thought to which it belongs, which have been identified as socialist and statist, indigenist and "Pachamama" or ecologist and post-developmental. This places Sumak Kawsay, according to how it is classified within these currents, in a different cultural frame of reference, which leads to contradictions and operational gaps for decision making. Thus configured, the relationship expresses a character opposed to capitalist chrematisation and the cultural assumptions it entails. Sumak Kawsay is based on another rationality, on a relational vision of the world in which life in plenitude is based on the construction of an OIKOS of relations of reciprocity, solidarity, and cooperation. The basis is the relational viability of the culture-nature community.

Research/ Practical/ Social/ Environment implications – The potential impact is to unveil the Eurocentric conception of this world, which constrains the relation as philosophy, for most of the scientific corpus, this is a given world of objects that demand the observer, who elucidates interactions, transactions, and coercions among other forms of action. Relation as philosophy is intrinsically linked to the conception of experience as temporality and history. The principle of identity and descriptions of the inherent character of objects held in science corresponds to a primary conception in the history of knowledge, i.e., the substance, essence, and autonomous character of the real.

Research limitations – The methodology is under development and is currently automating the process of starting from a cognitive model and ending in a structured strategy to achieve the purpose of the network.

Keywords: Ecological Viability, Ecotomo, Chrematistic, Ayllu, Culture-Nature, Relational Cybernetic.

Understanding the Current Environment and Assisting the Individual in a Sea of Change

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Whenever there has been a massive social change, such as from the agricultural to the industrial economy, benefits have been unevenly distributed and many individuals and families left to scramble to find their place in the new environment. This remains true as we shift to the digital and service economy.

Stafford Beer's most famous quote: "The Purpose of a System is What It Does" (POSWID) invites us to consider the impact of advancing digital technology on those who are most vulnerable. Lags in access including broadband coverage, inability to afford the technology or inadequate education play a part but difficulties persist even when access is available. One differential is scale: the individual has a difficult time correcting a situation where privacy has been violated, errors made or lack of requisite variety has defined their situations out of the framework. Government laws and regulations have not kept pace and late-stage capitalism has few constraints on massive corporations. Individuals, whether they are employees, who may be micro-monitored by algorithms, citizens subjected to surveillance capitalism or users whose attention is 'sold' to advertisers may have little recourse. The internet provides access to information but has little or no protection against misinformation, lies and conspiracy theories that can have real world consequences. Finally, both individuals and organizations are not sufficiently protected against cyber-crime; whether it is identity theft, ransom-ware attacks or on-line scams.

Researchers and practitioners in cybernetics and systems thinking can guide decision-makers in addressing these risks and can inform and encourage elements of civil society including labour unions, political action groups and community agencies to educate and advocate for their constituents. Beer's Viable System Model and Team Syntegrity Process are shown to be valuable tools in this effort.

Keywords: vulnerable individuals, Viable System Model, Team Syntegrity Process

Organizing Society for the 21st Century. The Future of Democracy. Towards a New Social Contract in the Age of Cognitive Machines.

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The rising strength of populist movements across Europe and the United States might be the early manifestation of a broader and more structural long-term transformation taking place within western democracies.

Unprecedented complexity, interconnectivity and uncertainty are impacting the suitability of the current model of social organization. Two major forces seem to be catalyzing this process. On the one hand, the increasing pace of technological development and adoption, including artificial intelligence technologies and widespread adoption of high-speed computing and automation, which are driving a major transformation of the model of economic growth, labour markets and wealth creation. While the overall level of economic prosperity has increased significantly over the last few decades, the level of inequality is reaching record levels in recent human history. On the other hand, the rapid expansion of decentralized communication platforms, such as Facebook, WhatsApp, YouTube and WeChat, are posing significant pressure on the democratic political process and on the diffusion of ideas, with impact on the public perception of science and the debate on human values.

These trends highlight the importance of empowering citizens and enhancing critical thinking, but also the potential reformulation of the models of democratic participation. Both could become the most relevant levers to ensure viable economic growth while preserving social and political stability.

Building upon our debates held in October 2019 at Oxford, we will explore to what extent the current system of western democratic participation is suitable for coping with the aforementioned challenges. Will it require a radical redesign, or could a gradual improvement suffice? Is it possible to moderate extreme aberrations resulting from the perverse use of social power? What fundamental changes are needed to develop more effective systems of governance capable of dealing with the increasing complexity while addressing the aspirations of humanity, maximizing the equity and effectiveness of social institutions and supporting the future evolution of global society?

Section 2.3 Culture and Society, Citizenship and Democracy

Bernard Scott, Tatiana Medvedeva, Matjaz Mulej, Zoraida Mendiwelso Bendek

Community's worldview may perceive culture and society, citizenship and social responsibility, from different perspectives. The West often reduces democracy to voting in elections, whatever are the aspirants' personal attributes. Hence, power-holders are allowed, and even authorized, to be one-sided rather than requisitely holistic; to feel independent rather than interdependent; to be more socially negligent than socially accountable. And this is one of the best models so far, but not good enough for humanity to come close to what L. v. Bertalanffy called 'being the citizens of the world rather than of a country'.

It is hard to see how humankind can cooperate and cope effectively with global ecological, social and economic challenges, if basic beliefs, values and attitudes lack harmony and mutual understanding. Here, citizenship and social responsibility is understood as an interactive process related to social meanings, where we recognize others and ourselves through permanent negotiations, as properties that emerge from the way humans relate to each other. And, by 'culture' is meant the attitudes and values, often tacit, of a particular collective or community as expressed in individual behaviours, social interactions and the production of artefacts in the broadest sense (encompassing spoken and written texts and other symbolic forms, and found or constructed as concrete objects).

Thus, this session invites papers that use cybernetic methodologies and concepts to provide understandings of cultural conflicts, change, transition and transformations. A given society may be monocultural or multicultural. Papers are invited that address questions concerning the relationship between the individual and society, including: (i) citizenship, freedom and inclusion, (ii) empowerment, democracy and social responsibility.

Discussion points

- How can a cybernetic perspective aid understandings of culture?
- How can cybernetics contribute to understandings of the interactions between different cultures, what some authorities refer to as the 'clash of civilisations' and others as 'intercultural conversations'?
- What do we understand by citizenship, freedom and inclusion in modern societies?
- What are the relations between empowerment, democracy and social responsibility?
- How can a cybernetics perspective help Community Based Research and Lifelong Learning strengthen civil societies and democracies?

Cybernetics of large social systems: the example of economics

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Purpose – When attempting to manage a large social system, it is necessary to have an overview of how the society functions at several levels and how economic theories describe this functioning, which methodologies they use. Recent discussions of higher orders of cybernetics are helping to define a multi-disciplinary, multi-level point of view.

Design/methodology/approach – Knowledge from several disciplines is needed – systems science, management, engineering, cognitive studies, and the various social science disciplines all have contributions to make.

Findings – To produce an integrated point of view we can begin with the contemporary view of science and then add additional considerations as needed. The correspondence principle, in philosophy, claims that science grows by adding a new dimension, a consideration that had previously been neglected. Adding new dimensions leads to a more comprehensive view of a traditional field such as economics or a transdisciplinary field such as cybernetics.

The mainstream point of view in modern economics is neoclassical economic theory based on such methodological assumptions as an economic person (consumer, entrepreneur, employee) who seeks to maximize income and minimize costs; the principle of economic liberalism; general equilibrium theory, according to which the mechanism of free competition and market pricing ensures fair distribution of income and full use of economic resources, the law of diminishing returns; the application of the margin principle to all areas of economic analysis.

Market reforms in post-communist countries, which were based on neoclassical assumptions, are increasingly being recognized as a catastrophe by participants and scientists. Many of them consider that it is important (and sometimes decisive) to note the inadequacy of the theoretical foundations of the reforms.

Currently, the so-called unorthodox economy is developing rapidly. A number of schools of thought included in it focus their attention on problems that are ignored in the orthodox economy. More recent work in cybernetics has included descriptions of several “orders” of cybernetics where each order is based in an additional discipline. In this paper, we apply cybernetic ideas to further develop economics.

Specifically, according to the institutions involved, economics can be divided into four levels.

Economics at the first level provides descriptions of how a market economy works. This is the micro level of economics, where firms, individuals and households are the principal actors.

Economics at the second level is usually called macroeconomics. It includes the political and economic institutions and mechanisms used to regulate the economic system – central banks and interest rates, tax policies and the structures and processes of government – political parties, think tanks and elections.

Economics at the third level involves external institutions such as the International Monetary Fund, the World Bank, the World Trade Organization, and the United Nations. Academic institutions such as universities and student exchange programs play an important role in creating mutual understanding. As societies and the international system develop, values and ways of operating have changed and will continue to change.

Economics at the fourth level refers to the environment and the technologies, institutions and procedures used to manage the environment.

A multi-tiered control system has been under development for several decades, largely stimulated by World War II and subsequent efforts at peaceful global development, including current efforts to control climate change.

Originality/value –The paper applies ideas from cybernetics to economics and uses economics to illustrate ideas in cybernetics. Similar thinking can be applied to other disciplines thus advancing the unification of science. The paper illustrates a transdisciplinary approach to knowledge development.

Research/ Practical/ Social/ Environment implications – The implications of the paper are improved understanding among scholars from several disciplines. The intent is to expand the range of conceptual possibilities available for problem-solving.

Key words: history of economics, higher orders of cybernetics.

A participative systems methodology to model pest metapopulation dynamics in agricultural setting

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The purpose of this study was to develop a diagram based on farmers' know-how on how to address Tuta absoluta pest at a local level, to determine how to confront it as a regional problem in the tomato growing region of Sáchica, Colombia. Using the Community-Based Systems Dynamics (CBSD) methodology, we seek to identify the most relevant causal factors of the dynamics between T. absoluta and farmers, the feedback loops that emerge from the relationships between these factors, and their effect on the farmers' productivity and economy.

Design/methodology/approach – Community-Based Systems Dynamics (CBSD) is a participatory research methodology in which a group of stakeholders identifies relevant variables and the cause-effect relations among them in a causal loop diagram. We implemented this methodology described by Peter S. Hovmand, adapted to obtain a causal loop diagram with a metapopulation approach. For this reason, the workshop with farmers had two perspectives of the situation: a local and regional perspective.

Findings – It was evidenced during the causal loop diagram workshop that the relevant factors for the presence of T. absoluta vary regionally and locally. At the local level the pest impacts the tomato production, the well-being of the farmers, and their cash flow, while at the regional level, it affects the market dynamics, environmental factors, and promotes regional coordination among farmers. Farmers propose product safety as a regional objective. A planting calendar and census of greenhouses to control the pest and the tomato supply were proposed. With these results, we expect to frame a metapopulation model in order to simulate diverse pest control scenarios at a regional scale, to design a regional T. absoluta management plan.

Originality/value – As far as we know, there is no work of Participatory Systems Dynamics that has been carried out as a reference framework for a metapopulation model. Furthermore, the present study seeks that the mental model shared by farmers allows designing a regional control program based on characterizing the region as a metapopulation of greenhouses to conduct future simulation models aimed to test and propose coordinated interventions.

Research implications –The presence of T. absoluta is a situation that affects and is affected by the interaction of various actors such as pest behavior, farmer decisions, and crop characteristics. The lack of a systemic approach to managing the pest and harvest in the region generates uncertainty when making collective decisions.

To design a regional control system of pests in the agricultural production of the region, it is important to understand the social, economic, technological, environmental, and political factors associated with the effect that the pest has on the production. This is the first study of a wider project that aims to develop an integrated management model of the tomato production system to improve the safety and sustainability of the crop. The results are intended to be used to inform a series of subsequent complex systems simulation studies that aim to design and implement a methodology that coordinates the farmers to manage the pest.

Research limitations – The results obtained by the shared mental model of the farmers are mostly qualitative and based on their perceptions, which is why the model does not allow simulations of the quantitative effect of the feedback cycles.

Keywords: Causal loop diagram, Community-based system dynamics, Pest management, Metapopulation dynamics, Tuta absoluta.

Disability as a System Model in Social Sciences: Role of a 2-D Visualization

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The purpose – The paper aims at giving a new representation of the different models of disability, making it possible to better understand the question of disability and therefore better work in the field of inclusion of disabled people.

Design/methodology/approach – Modelling is « building in one's mind » [Le Moigne]: it is a necessary condition of intelligibility, an artificial representation, most of the time by a diagram and a system of symbols, of the interactions (flows, causations) between the elements of the system and between the system and its environment.

Modelling often utilizes vizualisation, which completes the narrative part in order to make the study of the system easier.

Disability models, individual ones (charity model, and the so-called “medical” one) and social ones [Patrick Fougeyrollas], are illustrated by diagrams that make it possible to understand the ins and outs of disability. Some are better. All those diagrams are explanatory and essential.

However, in order to better work in the field of inclusion, additional models should be used. After reminding the system dimension of disability, asserted in the February 11 2005 French law on disability, we propose a two-dimensional model: horizontal axis from LIVE to EXIST, vertical axis from PERSON to ENVIRONMENT, in which a virtuous arrow should go from the left to the right.

Findings – That two-dimensional model helps better understand the superiority of the social model to the individual ones.

Originality/value – Some elaborated models do exist (see above); that two-dimensional model is not so widely used [Gerard Donnadiou].

Research/ Practical/ Social/ Environment implications – Better understanding in the disability community (including valid people), and facilitation of education. Possible extension to other fields, such as transhumanism.

Keywords: Disability, Modelling, Visualization.

Technocracy as a cultural imperative: pro and contra

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The purpose – To consider the phenomenon of technocracy associated with trends in the development of modern society. To substantiate that the high demand by society for holders of special knowledge opens up the opportunity for technocrats to occupy leadership positions, both in industrial and scientific spheres. A layer of techno-bureaucracy is being formed, the dominance of which is associated with a number of systemic contradictions and threats. In particular, the use of an accurate scientific approach is increasingly orienting the techno-bureaucracy towards the use of the methodology of cybernetic control, which makes it possible to program citizens for the meanings of activity constructed by administrators and to create a formed image of the surrounding reality. To propose a variant of overcoming the risks of managing the technical bureaucracy on the basis of the ancient concept of "techno".

Design/methodology/approach – The study is based on the principles of dialectical logic, in particular, the principle of the unity of the historical and the logical, which made it possible to consider the transformation of technocracy, highlighting the features of early and late technocracy. Through analytical procedures, the systemic contradictions and threats associated with the dominance of the techno-bureaucracy are revealed.

The principles of post-nonclassical rationality, which take into account the correlation of the knowledge gained about the object not only with the peculiarity of the means and operations of the activity, but also with the value-target structures, made it possible to find a way to overcome the risks of technocratic management based on the antique concept of "techno".

Findings – There is no doubt that in a technogenic society, where technologies construct new objects of the material world with qualitatively different properties that did not previously exist in nature, forcing a person to perceive the surrounding reality through the prism of technological systems, technocracy plays a fundamental role.

But in order for technocracy not to bring society to the point where the future becomes a problem, adherents of the idea of technocracy could use the concept of the antique "techne", that is knowledge that contains the recipe for "how to do it." If "Techne" relies only on practice, it becomes a bare procedure and lacks understanding, it is low-grade techne, craftwork in the worst sense of the word. But there is another feature of techne that allows us to consider it an art, namely the sharpness of techne towards high values. Hopefully, for modern technocrats, ethical and social imperatives will become part of their values.

Originality / value - The scientific novelty of the research is connected with the substantiation of the problem of the research topic. More and more, the development of modern society is determined by technological macro-trends: digitalization, sensorization. Reflection of these trends turns to the theoretical and methodological foundations of technocratic determinism, which focuses on the idea of technical achievements that determine socio-economic and other changes in society. Technocracy is becoming one of the dominant elites of modern society. The separation of technocracy into a fundamentally new social stratum created the preconditions for an even greater stratification of society, only now on the basis of knowledge and information. In the newly created social structure, the so-called technostructure, experts and "effective managers", by virtue of achieving their intellectual domination, suppress the rest of the classes. Not only "new social dead ends" are being produced, but risks and threats associated with the dominance of the technical bureaucracy arise.

Research/ Practical/ Social/ Environment implications – fixing a really existing contradiction in the phenomenon of technocracy makes it possible to reveal that, on the one hand, scientific competence

in making managerial decisions at the stage of project preparation allows technocrats to act as experts on individual problems that need to be weighed against potential environmental, climatic, and sociobiological consequences. On the other hand, technology deforms the deep meanings of human interaction in society, standardizes the life of a person and the whole of society. It is essential that ethical and social imperatives become an integral part of the values of modern technocracy.

Research limitations – Modern social reality is increasingly aggravated by the growing processes of the digitalization of society, which affect the work of the power-management vertical, digital control is becoming a priority.

There is no guarantee that technocrats will always adequately interpret, understand and reflect the interests of society and individual social groups. Increasingly, technocrats are accused of not calculating the social consequences of their decisions and generally ignoring issues of social policy, including, first of all, issues of equitable distribution of benefits.

Keywords: technocratic determinism, technocrats, techno-bureaucracy, socio-technical order, democracy, e-learning, digital control.

Participative action research natural methodology of cybernetics

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The purpose – Social transformations are at the center of our current times. Citizens are not against democracy, they are tired of the democracy that is being applied and they lost confidence in the political class and in the institutions (Castells 2020), meaningful citizens' participation is demanding new multidisciplinary perspective. This paper explores the natural connection between Participatory Action Research and Cybernetics, and its role to transform democratic institutions and anticipating future.

Design/methodology/approach – Design and implementing community based research projects that naturally are immerse in reflective processes anticipating future connected with cybernetic observations, that is focus in system's organisation, are given a fieldwork of coproducing knowledge and practices within community structures and organisations to support communities' capacity building processes for social transformations

Findings – Communities' social transformations are immerse in ongoing reflective processes reconstructing themselves again and again. Processes that are framing: *firstly* people's own reality and meaningful content from citizens own experiences, perceptions, expectations, dreams and nightmares; *secondly* the structures and processes where different agents engage in the frame of power relationships; these are essential connections in the nature of building up active citizenship and sustainable future in different levels of connections:

- *Present building future.* Maturana remind us that from our present concerns we will be built the future, he invites us to start from questioning about our concerns (Maturana 2013). From that concerns citizenship emerged as a property (Mendiwelo-Bendek 2002) where active citizens as agents with the necessary knowledge, skills and abilities to act in decision making processes can engage in situated co-constructing dialogical and *dialectic* process.
- *Hope and citizens' agency.* The agent's disposition to anticipate has a causal power to change as one way the future exists in the present and has effect on transformation. (Fuller 2019). Pedagogy of Hope that has content based on the ethical quality of the struggle of power, knowing how to articulate thought and experience as an ontological necessity to discover the political analysis and the possibilities as a new pedagogy a new society where to acquire knowledge and skills to produce effective strategies for social change. -Pedagogy of Hope This pedagogy seeks to produce change. It is not a dreamer! (Freiri -1993)
- *Inclusive and Epistemic Justice.* Participatory Action Research Popular is based in local people's wisdom sustained in the value of autonomy, human dignity, freedom, solidarity and essentially inclusive and epistemic justice, which is defied by the right to know and to act. Equitable knowledge production- equity Participation (Fals Borda 1981).New forms of learning and research that involve new forms of conversations and enquiries.
- *Active citizenship within knowledge and structures.* Cyberneticians, in a circular causality, presents– a narrative – that reproduces itself as a stable but ever-changing self-conscious self that constantly reproduces and renews itself (Scott 2021). It is in process where Cybernetics, as the science of effective organization (Beer 1975) focus in organizational systems (Espejo 2020) can support better understanding of communities structures of participation by supporting systemic enquiry reframing the system (Ison 2020)
- *Human dignity at the center of sustainable development.* Among all levels the person is at the center. As Cortina and Conill (2020) say Human dignity is an intrinsic and inherent concept of

human nature, the concept of human dignity emerged from historical and cultural horizons of the experience, which it is nurtured by the process of reflection based on the experience. The experience is not only an action, it is an action guided by the logos recognizing our interdependence.

- The processes by which citizens engage in decision making processes for social transformation are defined by community-members realities, there is urgent need to connect with those groups outside our radars, difficult to reach, 'Hidden population' or those outside the lenses or circumstantially marginalized/ vulnerable communities. To regain trust in institutions and strengthen democracy by strengthening citizen participation.

Originality/value — in a transdisciplinary perspective, this paper explore the natural relation between Community Based Research (CBR) and cybernetics by connecting CBR principles and values with Cybernetics processes. Connecting bottom up community processes with community organization embedding democratic community capacity building processes

Research/ Practical/ Social/ Environment implications – Contributes to improve the understanding and expand the communities' capacity building processes' engagement in policy processes and offers mechanisms for HEIs to enable these processes.

The implications of the paper are improved understanding among scholars from several disciplines. The intent is to expand the range of conceptual possibilities available for problem-solving.

Key words: Social Cybernetics, Community Based Research, Participatory Action Research, Experiential Learning

Society structures deformation in the digital age

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The purpose – The paper considers the socio-economic features of the implementation of big data technology. The main attention is paid to the legal regulation of digital technologies and the shifts caused by them in the social life.

Design/methodology/approach – The study revealed three possible mechanisms of influence by the state on the digital ecosystem: prohibitive, regulatory, and infrastructure. The analysis shows two opposing attitudes, most noticeable in PRC (state-centric) and the EU (anthropocentric). Russian policy strives to combine both of these concepts, with efforts to adopt digital technologies as instruments to solve practical issues and to protect national interests.

Findings – The main problem of new technologies is an attempt to “embed” them in the existing structure of society without taking into account possible societal consequences. There is a forced acceleration of digitalization by the state. This approach is explained by the commercial success of digital technologies, but hopes to replicate it in everyday life seem to be overvalued and unrealizable in full in the near future.

Originality/value – Now it’s ere to discuss the shape of digital society, however, a number of trends can be identified.

First, the digital economy, technologies of artificial intelligence, big data, etc. – they all have not instituted as a fundamentally new direction, by now they emphasize existing trends, problems and risks. Their perception as a revolutionary new tool is erroneous; they are in fact only a technical way to solve current challenges. This fact is reflected even in the use of misleading terminology (big data is often not “big”, and artificial intelligence is not “intelligence”, etc.). The thesaurus of digital era has not formed yet, too.

Secondly, there is currently a process of accumulating data (uncontrolled growth of information, methods, approaches). A critical understanding of the emerging “data lakes” is the next step in the development of the digital economy, the expected transition of quantity to quality. This process should be accompanied by the formation of standards for data handling. In the long term, big data will become “smart” and will be an integral part of the Internet of things.

Thirdly, digitalization reflects another manifestation of globalization, since there is no division among countries, there is a high interpenetration of technologies and approaches. In this regard, control over physical entities (such as the policy of localizing data centers on the territory of Russia) can serve as a deterrent preventing the flow of “data lakes” into countries with other legal and political conditions.

Fourth, although a prohibition and restriction policy seems to be the simplest solution to emerging problems, this approach is not effective. It is necessary to look for other methods.

Fifth, such a phenomenon as the “digital twin” is becoming more and more widespread. It is understood as both a universal model of a real system and a set of technological solutions. In the social and educational sphere, a digital twin is often understood as a digital footprint (shadow, trail).

Research/ Practical/ Social/ Environment implications – In general, the continued introduction of digital technology carries a number of risks, seriously changing social practices. It is required to clearly formulate the emerging challenges, and develop answers to them, using both the arsenal of engineering sciences and applying the humanitarian.

Research limitations – In our work, we discuss a few of consequences of the introduction of such technologies. In practice, a new culture of digital society should emerge.

This work was supported by the RFBR grant No. 18-29-16130.

Keywords: Digitalization, Big Data, Legal Regulation, Artificial Intelligence, Digital Twin, Engineering.

System analysis of the strategy of an innovative type of personality formation in the context of new technological revolution

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The purpose of the article is to present the results of the analysis of the main directions, problems and prospects for the formation of an innovative personality as a special social type in the new technological revolution context associated with the convergence and synergy of NBIC technologies. Scientific and technological progress inevitably affects the change of a person, his physical, psychological, moral, ethical and other aspects. At the same time, in the conditions of the global economic and environmental crisis, the society forms its "request" for certain characteristics of an innovative person who is able to function successfully in the society and implement the tasks of the innovative economy. The article focuses on social and humanitarian challenges associated with rapid scientific and technological development, including in Russian realities.

Design/methodology/approach – The logic of research is determined by the movement of theoretical thought from the general to the particular, from macro-sociological analysis to the analysis of the special, regional. The theoretical basis of the macrosociological analysis of innovative civilization is the world-system theory of I. Wallerstein, in which the "semi-periphery" remains the least studied element of the world-system, as well as the theory of multiple modernization of Sh. Eisenstadt. The structure of innovative personality is analyzed on the basis of the V. A. Yadov's dispositional concept of the personality, taking into account the achievements of modern cognitive sciences, and in some sense ahead of them, given that the results of a comprehensive study of the human connectome will be known by 2050, then the world will know the features of the architecture of human neural connections. At the same time, the need to typologize the innovative personality encourages us to turn to the activity approach. A personality is a person who participates in activity interaction, a person as a subject of activity (V.A. Yadov).

The research methods were: historical analysis, comparative analysis, internet survey among young people from 14 to 30 years old (n=1100 in 2018-2019; n = 403 in 2020-2021); expert interviews (n = 15 in 2018-2019; n = 26 in 2020-2021); survey of representatives of the academic community (n = 100); discourse analysis of student essays on the role of education in the value system of modern youth (n = 33); survey of representatives of organizations of various forms of ownership (state and non-state, including commercial structures and NGOs); semi-structured interview of 7 representatives of non-profit organizations providing social services in the Republic of Karelia (total population at the time of the study-7 organizations); semi-structured interview of 7 representatives of municipal and state social service institutions in Petrozavodsk (selected using the method of available arrays; total population – 5 state social service institutions located in Petrozavodsk; survey of 40 representatives of socially oriented NGOs in Petrozavodsk; survey of social entrepreneurs; secondary analysis of sociological research; comparative and historical analysis.

Findings – Each new technological order requires a new type of individual competencies, and an accelerated education system forms the subject of production. However, industrialization in the West formed innovative competencies based on the values of consumer society and alienation (classes), and socialist industrialization (USSR, China, etc.) formed the same competencies (profession, qualification) based on the values of asceticism, collectivism. Thus, the transit of a number of civilizations went and goes through the change of technological structures, but: a) through different economic systems (capitalism, planning and distribution, communal, etc.); b) through almost the opposite mentality (individualism, collectivism). This conclusion should be taken into account when developing strategic documents related to the innovative development of Russia.

Originality/value – The scientific significance of the results is that on the base of the analysis of modern Western macro-sociological concepts, strategy of forming an innovative personality in Russia in the conditions of Russian civilization is determined, taking into account the past experience and peculiarities of the national mentality.

Research/ Practical/ Social/ Environment implications – The study expands the understanding of the characteristics of an innovative personality as a special social type and allows us to formulate a strategy for its formation in the context of innovative development in Russia. For the Russian society, the formation of an innovative personality and its dissemination in all spheres of public life provides a potential opportunity to switch to an innovative path of development.

Research limitations – The study of the innovative personality as a special social type is carried out in the absence of a scientific model of a person in modern science, as well as the crisis of sociological science in the conditions of serious social transformations.

Keywords: innovative personality, innovative personality structure, system, innovative development, Russia, strategy, civilization.

Features of the formation and reproduction of the innovative personality in the Northern and Arctic regions (on the example of the Republic of Karelia)

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The purpose – The article presents the author's analysis on the example of the Karelian case. Karelia is a region including the Far North districts and equated to them, as well as 6 territories belonging to the Arctic zone of the Russian Federation. The purpose of the study is to analyse the factors influencing the process of forming an innovative personality in the conditions of the Karelian region.

Design/methodology/approach – The research methods: the analysis of regional strategic documents, statistical data, internet survey among young people from 14 to 30 years old (n=1100 in 2018-2019; n = 403 in 2020-2021); expert interviews (n = 15 in 2018-2019; n = 26 in 2020-2021); survey of university teachers (n = 100), and the secondary analysis of empirical studies.

Findings – The Republic of Karelia has an internal potential for innovative development, the main elements of which are:

- the presence of large industrial enterprises with serious technological capabilities, personnel with appropriate competencies, and authority in international and Russian markets;
- opportunities for expanding and increasing production volumes, creating new jobs, and developing cooperation with small businesses;
- advantages due to economic and geographical factors;
- historically high civic and entrepreneurial activity of the population;
- the relatively high level of development of information and communication infrastructure in Petrozavodsk and the concentration of professional resources for training specialists in this field;
- high level of development of the scientific and educational complex.

The rich internal potential of innovative development does not exclude serious risks and challenges that the region faces in the transition to the 4.0 technological order:

- climatic conditions: six territories of the Republic of Karelia are included in the Arctic zone. In the conditions of the Arctic and northern territories, the development of a market economy is significantly hindered;
- territorial unevenness of development, differences in the level and quality of life in cities and rural areas;
- the concentration of the population and labour force in Petrozavodsk, combined with the acceleration of depopulation processes in remote parts of the republic;
- growing competition for young professionals and qualified personnel from Moscow, St. Petersburg;
- an imbalance between the structure of the regional labor market and the profiles of training specialists in educational institutions (the industrial model of training specialists), as well as between the requirements of employers for the content of professional training and the capabilities of educational institutions;
- an imbalance in terms of the high level of development of science and education and insufficient interaction between educational, scientific organizations and real sector of the economy;
- digital inequality.

On the background of low population density, negative indicators of natural and migration growth of the population of the Republic of Karelia, these risks and challenges entail the main one – not innovative human reproduction and, as a result, the fate of “catching up” in the conditions of serious technological, economic and social transformations. It is possible to overcome these risks by analyzing and radically revising the relations in the “Nature – Society – Human” system, accelerated training of a new generation of personnel, as well as creating favorable conditions for the preservation of human and intellectual resources in the region, and the demand for innovative competencies being formed. It is also important to understand the need for a special policy on the part of the federal center in relation to the northern and Arctic regions, aimed at supporting competitive advantages and mitigating risks.

Originality/value – The research is carried out on the basis of the author's approach to the study of an innovative personality and with the help of the author's tools that have been approved.

Research/ Practical/ Social/ Environment implications. The processes of innovative development and the formation of an innovative person in Russia are extremely heterogeneous, they have pronounced regional features due to climatic, cultural, historical, economic and other factors. Taking into account this diversity of Russian regions, all the above-mentioned circumstances constitute a research problem – the lack of knowledge about the main factors influencing the process of forming an innovative personality in specific regional conditions. By filling this cognitive gap, it is likely that it will be possible to develop a strategy to overcome negative trends, risks and challenges. Based on the obtained results, there is a potential opportunity to develop a strategy to overcome the identified risks and challenges.

Research limitations – For the augmented typologization of Russian regions by the level of innovative development, it is necessary to analyze the potential and risks of an innovative person formation in all regions. To date, such scientific information is not available.

Keywords: innovative development, region, innovative personality, formation of innovative personality, reproduction of innovative personality.

Sociocybernetic Understandings of Cultural Transmissions and Transformations

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The purpose – This paper uses concepts from sociocybernetics in order to unify and bring order to topics and issues in the social sciences, in particular issues concerning cultural transformations and transmissions. Here, by “culture” is meant the attitudes and values, often tacit, of a particular collective or community as expressed in individual behaviours, interactions and productions of “artefacts” in the broadest sense (for example, encompassing spoken and written texts and other symbolic forms and found or constructed concrete objects) It is intended to be distinguished from “social institutions” that are explicitly constructed to guide and control said behaviours and interactions.

Design/methodology/approach – The approach is to use concepts from sociocybernetics, in particular, Gordon Pask’s conversation and interaction of actors theories, to critically examine topics and issues in the social sciences and to look for similarities and differences in order to provide a unifying conceptual framework. Topics addressed include: using second order cybernetics to characterise “the social”; conceptions and definitions of “culture”; relations between culture and “personality” and other individual differences; interactions between different cultures, including studies and commentaries on what some authorities refer to as the “clash of civilisations” and others as “intercultural conversations”; attempts by self and others to change culturally transmitted attitudes and behaviour (for example: counterterrorism, rehabilitation of criminals, alienation and problems of mental health).

Findings – The paper shows how concepts from sociocybernetics, in particular, Gordon Pask’s conversation and interaction of actors theories, can bring order and unity to the social sciences. Relevant Pask concepts are: a “concept” defined as a rule or procedure that recognises, recalls, constructs or maintains a relation, where the relation may be other rules and procedures; a social actor as a “psychological (P) individual” (a psychosocial unity, an organisationally closed, self-reproducing system of concepts), embodied in one or more “mechanical (M) individuals” (a biomechanical unity). P and M individuals are not necessarily in one to one correspondence. Thus, the observer (including the self-observer) can apply the concepts to both single actors and collectives, different orders of recursively nested, embodied psychosocial unities.

Originality/value – The paper shows originality in its use of cybernetics to unify and bring order to the domains in question.

Research/ Practical/ Social/ Environment implications – Globally, we need better understandings of how cultures are transmitted and transformed in order to pursue peace and harmony as sustainable societal goals, together with how to identify and combat pathological ways of thinking and behaving.

Research limitations – The research is limited in that it only outlines a possible research programme. Large scale empirical studies are required that address both the global issues and local issues of identifying and combating pathological ways of thinking and behaving.

Keywords: Cybernetics, culture, cultural transmission and transformation, personality

Democracy: the ascent of participation and creativity

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Background – Upsurges in social participation and creativity are neither frequent nor cyclical. Still, such sudden and usually large increase in ingenuity, flair and aim to improve living conditions, although limited in time, remain in our mind as a joy forever. Nowadays the world witnesses a contrary motion towards sterile art patterns and restrained behaviour. Hence it becomes even more important to better understand the basic roots of cultural, social and political blooming.

Objective – This paper presents a study of a remarkable chain of events in science, art, mathematics and planning that took place in South America in the 1970s to evaluate the links between democracy and uncaging processes for freedom and creativity.

Method – The study is based on an in-depth case study of five outstanding steps in attempting to settle the issue in real societies: Mario Pedrosa, creation of the Museum of Solidarity in Chile; Stafford Beer, Cybersyn project for cybernetics and self-management in Chile; Humberto Maturana, concepts of autopoiesis, cognition, language and multiverse; Oscar Varsavsky, national projects, styles of development, scientific and technological autonomy; Stefano Varese, cultural and political autonomy of indigenous people. The study counts with the author direct participation in all cases.

Results – The paper sets a similarity worthy of being noticed between Allende's Unidad Popular in Chile and Pericles' Golden Age in Greece and outlines why these historic realms albeit far apart have lasting importance and similar historical momentum.

Conclusions – From this concludes that democracy is the necessary condition for participation and creativity. Based on the findings the paper also highlights the essential and seminal features of each stream.

Keywords: Democracy and creativity, Chile Museum of Solidarity, Cybersyn, cybernetics and self-management, Autopoiesis, language and cognition, National projects, Indigenous people autonomy.

History as a critique of boundary conditions in community organizations. A case study in Venezuela.

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The purpose – The unfolding of the meaning of community organizations has been a critical task for those addressing these organizations from a systemic perspective. It has been so as it became clear that the role of these organizations is seriously conditioned by the interaction with other sectors of society. In particular, the role played by the state and laws are very relevant for them as they are usually associated with weak sectors of society. It is argued that by considering the historical development of the organization as a way of exploring the taken for granted assumptions on which the organizations usually performs their actions, it could provide possible courses of action when social and political transformations appears to gather possible changes in which the community organizations will be affected.

By considering the last twenty years of political changes in Venezuela, it is explored how a historical addressing on the development of community organizations helped to reveal possible courses of action for processes carried out in a neighbourhood in a medium size city in Venezuela. The findings helped the members to build possible scenarios for the practice of a critical citizenship precisely on the grounds of revealing the historical constraints upon which the organizations were built and how they condition the current practices of the community organization. The paper unveils a transit from a territorial ground towards a cultural and more intangible good as the source for their practice.

The paper concludes on the challenges of historical accounting as a factor in the boundary critique of the social organizations that are compelled to deal with changing social structures.

Design/methodology/approach – The basis of this research is the interpretive-systemic study of organizations based on interpretive systemology as stated in Fuenmayor (1990) and Ochoa- Arias (1998)

Findings – The unfolding of historical accounts of community organizations plays a critical part in the current practice of the organization as it is usually held to be considered as a linear process when it unveils a rather complex web of changes in time. The patterns upon which critics were laid in the past seems to be still in place even when the discourse and the law structure could change.

Originality/value – The unveiling of the historical knowledge and their impact on their current practice could provide a path for further research on the dominance of historical conditioning in organizations that usually plea for transformations and emancipatory roles in societies. By unveiling these restrictions, the process of critically addressing the current status quo requires a more specific and detailed unveiling of the historical building of the organizations.

Research/ Practical/ Social/ Environment implications – It incorporates in systems thinking the historical research as a key dimension upon which current practice could be comprehended and criticised. In doing so, it could play a role for the understanding of their self-imposed restrictions in identifying the role of the organizations.

Research limitations – It is a still going on project based on a new grounds for the researcher.

Keywords: Boundary critique; systems thinking; democracy; citizenship; community organizations

Theme 3. On digital technologies and human interactions: the co-development of a hybrid reality

Igor Perko

Hybrid reality (HyR) is about the close interconnection of technology and people, addressing every instance of their behaviour individually or as parts of groups or organisations. From a cybernetic perspective, this theme is addressing the convergence and integration of our digital and physical realities. It offers a debate about the amplification of individual capabilities, through organisation and technology, and the attenuation of digital representations and constructions of digital systems, actively affecting our lives. Hybrid reality refers to the dynamics of the gradual integration of the Artificial intelligence (AI) technology in the real life and its perception.

Thereby, HyR can be time-limited, setting a timeframe in which AI technology gradually develops its abilities to actively participate in the complete loop of observing/deciding/acting/learning processes with its elements and services (Perko, 2020).

In this theme special attention is posted to the gradual development of hybrid reality elements. Regarding AI technology, these combine the development of capacities, enabling AI to interact in the real world:

- capacity to sense;
- capacity to reason and understand
- capacity to act in the real world.

The examination of gradual development of these capacities may provide a deeper understanding of the dynamics of interactions between the stakeholders in the systems encompassing people, organisations, regulators, natural environment and AI technology and provide the means for sustainable governance.

In the age of human-machine interdependence, the boundaries between individual and group intelligence are constantly being redefined, putting information technology in everything we do and experience. Reasoning on group consciousness and clarification of these boundaries pose a challenge for WOSC 2021.

In WOSC 2021, we are inviting contributions elaborating on the development path of technological research and its applications through new tools, computing and computation in its design and architecture, focused especially on their implications for people, organizations, societies and the environment.

Contributions can focus on concepts and implications of big data analytics and sharing, AI technology developments, situation centres, energy and transport related issues, health, blockchains, autonomous devices, and the convergence of technologies and similar.

Reasoning on smart devices and intelligent environments should be advanced with implications for people, organisations, society and the environment. Known positive implications (communication, upgrade of capacities, international connections etc.) and negative implications (cyber threats, data monopolies, truth adjustment, surveillance and lack of privacy) as well as paths for identifying not yet recognised consequences should be considered.

We consider that CyberSystemic approaches should be invoked in governing the development of complexity of interactions in hybrid reality to maximize its synergetic potentials on people and organizations, to avoid misuse, and to mitigate undesired consequences.

Section 3.1 Digital transition and smart self-organisation

Boris Slavin, Igor Perko, Francesco Caputo, Peter Ototsky

Digitalization is changing managerial approaches, organisational architectures and personal interactions. Strong innovation rates are questioning the validity of highly hierarchical structures requiring for new approaches able to increase actors' engagement, participation, and contribution. New organizational assets are emerging in which digital technologies define the new rules for accessing and participating, leading a path into what we may refer as a hybrid reality. Large-scale automation of routine-based work processes is requiring high intellectual effort and collaboration abilities to human resources. New competencies and skills are required to human resources, engaged in the challenging human-machine interactions.

Accordingly, new horizons appear for social and economic studies related to the need for discovering how a digital transition is affecting business and social behaviours and how (and if) it is possible to manage the emerging bottom up and self-organized digital platforms. New questions seem to emerge about the 'Ethics by Design' and its multiple dimensions and processes.

The COVID-19 pandemic is accelerating the above mentioned transition towards a digital world showing us multiple advantages related to the definition of an engaging community supporting faster reactions to unexpected changes. Despite this, several doubts exist with reference to an unclear spreading of smart self-organizations, as their composition, structure, dynamics, and codification implications are not really known.

Discussion points

- Risks and opportunities of digital transition for socioeconomic entities.
- Business models and managerial approaches for promoting smart participation in collective digital ecosystems.
- Emerging values, consciousness, augmented and distributed thinking in the new hybrid reality.
- Functioning, dynamics, examples, ethical considerations and directions for network communication platforms.
- Accordingly, the section aims at investigating the following research questions:
- Digital transition: are we really going towards a smart society?
- How to manage and regulate digital platforms? Is it a challenge for policy makers?
- Self-organization in digital transition: What about data management and privacy issues?
- How to invoke "Ethic by design" in the development of a smart society?
- Are network communication platforms the new society's infrastructures?

Towards a Sustainable Smart Society (SSS). Insights from Plastic free movement

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The purpose – Increasing pollution, scarcity of resources, and evident inequalities in social society are only few of the multiple topics that are magnetising the attention of researchers and practitioner interested in defining models and instruments able to ensure a better harmonization among society, economy, and environment. Sustainability issues are progressively becoming a central debate in multiple fora and all disciplines are invited to provide their contributions for building a Sustainable Society. Consolidated approaches are fading under the strong pressure of Information and Communication Technologies as new ways for better understanding and managing variables on which sustainability debate is founded. A new effort is then required for catching opportunities and risks of an emerging Sustainable Smart Society in which both individual and collective behaviours emerge as a consequence of joint influences and co-evolution of algorithms, technologies, and platforms. Plastic free movement is also analysed as an example of collaborations among society, economy, and environment affected by new emerging rules.

Design/methodology/approach – A literature review is proposed for depicting the main contact points between the increasing attention in sustainability and the pervasive nature of new technologies. Elements derived from the managerial literature are analysed and organized in the light of systems thinking for providing a conceptual model able to explain the emerging nature of Sustainable Smart Society as an ecosystem in which technology becomes the shared floor trough which actors can combine their recourses using shared platforms in as a consequence of dynamic algorithms. Finally, the Plastic free movement is analysed as a tangible example of collaboration among society, economy, and environment supported by the new technologies.

Findings – The paper provides a sharable conceptual model able to support a better understanding of variables and dynamics engaged in the challenging debate related to the role of smart technology for organizations' survival in a knowledge-based economy. Focusing the attention on the ways in which rules evolve as a consequence of actors' interactions within a dynamic environment, the paper shows the relevance of algorithms, technologies, and platforms in affecting emerging and survival of a possible Sustainable Smart Society

Originality/value – The paper underlines the relevant role of new technologies in supporting the needed collaboration among multiple actors for ensuring the achievement of shared aims. Proposed model about Sustainable Smart Society contributes to the ongoing debate about Smartness and Sustainability highlighting the key interpretative role provided by systems thinking.

Research/ Practical/ Social/ Environment implications – Thanks to a multi-disciplinary contamination, the paper highlights key paths through which build a wider interpretative framework able to explain logics and dynamics on which should be founded a collaborative model for an effective use of technologies and knowledge.

Research limitations – The paper only proposes conceptual reflections about premises and foundations of Sustainable Smart Society. The exploitation of proposed conceptual model with reference to the Plastic free movement requires to be extended through quantitative data and case studies.

Keywords: Sustainability, Smartness, New Technologies, Plastic free movement, Shared knowledge, Systems thinking.

Linking platforms to systems theories: a conceptual framework

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The purpose – The purpose of this paper is to link the conceptual core developed under recent branches of systems research to the recent seminal literature on platforms as a new emerging configuration of modern organizations. Today much of the technological innovation is done within digital platforms that configure ever more ecosystems, evolving and taking shape from modularity trade-offs. Platforms convey new technologies and act as interfaces between business, developers and users. Systems thinking and the viable system approach (VSA) can provide a better specification to this role they have, thanks to the notions of process, interaction, and context.

Design/methodology/approach – This paper is a conceptual analysis based on recent developments in systems theory, platforms and ecosystems. Multiple case studies and examples will be provided to support the theoretical assumptions.

Findings – Recent seminal contributions have focused on the analysis of platforms, their configuration, and the mechanisms that lead to the emergence of leadership. However, little investigation seems to exist about the nexus between current systems research and platforms core concepts. Aiming to fill this gap, this paper focuses on the different configurations of platforms reinterpreted according to a systems perspective. Expected results will return a conceptual framework that, connecting the core concepts of systems thinking, will represent the main configurations of platform ecosystems.

Originality/value – This is believed to be the only paper to apply systems theories and the VSA perspective to platforms.

Research/ Practical/ Social/ Environment implications – In the current organizational landscape, more and more the opportunity to create value emerges not only inside the extant organizational boundaries, rather by absorbing and exploiting the opportunities developed outside the same organizational boundaries and between different platforms configurations. By drawing on the core concepts of systems thinking, the research provides a conceptual framework for the understanding of platforms. Second, it fosters future research on how platform configuration and leadership can be defined and designed under a systems perspective. Moreover, the paper helps practitioners to better understand platforms through the proposed conceptual framework to strategize about modularization and configure accordingly their ecosystem boundaries. A further set of contributions concerns the understanding of the different configurations of platforms. Lastly, the understanding of the link between their configurations and core systems concepts could allow decision-makers to better shape their boundaries and define their configurations.

Research limitations – The paper is conceptual in nature and the interpretative framework proposed is a general scheme. Further research could address the application of the framework to the analysis of platforms according to the proposed framework. By providing a first framework of the main dimensions that can define different platforms configurations according to a systems perspective, this paper provides preliminary insights for future empirical inquiry that is required for a deeper understanding of the proposed issue.

Keywords: systems; networks; ecosystems; platforms; vsa

Information and Cognition. Emerging new foundations for knowledge society

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The purpose – For a long-time data, information, and knowledge have been considered as a sort of ‘raw materials’ in the industrial world. As a consequence of the increasing attention toward service economy and digital platforms, a new era is emerging based on a disruptive role of knowledge domains. Social and economic dynamics are radically changing and more effort is required for explaining how knowledge emerge, evolve, and ‘infect’ multiple actors influencing our everyday live. Accordingly, the paper aims at providing an overview about the key elements of emerging knowledge economy for supporting both researchers and practitioners in better understanding ongoing dynamics thanks to the interpretative contribution of systems thinking.

Design/methodology/approach – The paper builds upon a conceptual framework defined within system thinking and oriented to support a shift from reductionist to holistic view of knowledge. Digging in the managerial literature about knowledge and information management, the key constructs of information asymmetry and cognitive distance are derived and analysed for depicting an interpretative model able to support current understanding about knowledge era.

Findings – Thanks to the adoption of a multidisciplinary approach, the paper combine the key concepts of systems thinking and service logic for providing a renovate view of information asymmetry and cognitive distance. Proposed conceptual model overcomes consolidated view of social and market relationships inspired by transactional and win-to-lose logics for highlighting a new possible scenario where data, information, and knowledge are the pillars for ensuring direct interactions, reciprocal understanding, and shared willingness to collaborate in common paths.

Originality/value – The paper combines multiple research contributions in the light of knowledge contamination. Systems thinking and Service logic are mixed and a renovate view of ‘knowledge world’ is provided through the focus on information asymmetry and cognitive distance. A conceptual model is provided for exploiting key constructs able to influence actors’ reciprocal understanding and their willingness to be active parts in collaborative path in contrast to consolidated transactional and speculative relations.

Research/ Practical/ Social/ Environment implications – Recognizing the increasing attention toward the intangible world, the paper calls the attention of both researchers and practitioners on the multiple dimensions of knowledge scenario able to affect our way to see and perceive the world. The shift from a reductionist to a holistic view of knowledge highlights the relevant role of subjectivity in building the world and the relationships on which it is founded.

Research limitations – As a result of a subjective observation and analysis of ongoing dynamics, the paper is affected by the incapability to summarize all the dimensions engaged in the analysed dimensions. Future effort is required for extending reflections herein trough a wider knowledge contamination.

Keywords: Knowledge, Information asymmetry, Cognitive distance, Systems Thinking, Service Logic, Sharing approach, Understandability, Collaboration.

The holographic strategy of the industry platforms: a way to compete in complex environments

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The Purpose – The aim of this paper is to shed light on the holographic capabilities exploited by the industry platforms to survive in complex environments.

Eisenmann, Parker and Van Alstyne (2006, 2011) highlight that large platform companies compete in complex environments and frequently they attempt to enter each other's market in order to grow and protect their revenues. Industry platforms can decide to enter in a new market by leveraging their holographic capabilities and developing a second platform in which they combine their functionality with the features required by the new market to be conquered. Thanks to this strategy from an industry platform an ecosystem of holographic industry platforms can be born.

Design/methodology/approach – Routing in the complexity perspective this paper uses hologram concept to explain a strategic path of the industry platform. After a pervasive literature review and aiming to prevent the ecosystem of holographic industry platforms from becoming an empty concept, the study critically discusses phenomenon by relevant case studies.

Findings – The paper throws light upon industry platform's holographic capabilities. The holographic metaphor describes systems as made of components that possess the attributes of the system itself as a whole. Therefore, these systems have the ability to self-organize and regenerate themselves on a continuous basis (Morgan, 2006).

These regenerative capabilities can naturally allow industry platforms to create and recreate themselves to put into practice different diversification strategies in order to survive in complex systems.

In particular, this paper aims to explain the industry platform holographic strategic option by highlighting the possible advantages that this entails in terms of economies of variety.

Originality/value – Over the past twenty years, numerous scholars in management fields have studied the roles and key processes which characterize industry platforms.

However, a focus on platforms' holographic capabilities is still missing.

Specifically, literature does not explain the way through which one industry platform flourishes from another one giving rise a holographic industry platform ecosystem.

This work aims to fill this gap.

Research/ Practical/ Social/ Environment implications – Although the phenomenon of industry platform has been under the spotlight of managerial studies for the last twenty years a general framework that highlights industry platform's holographic properties is still missing. The holographic reading highlights the possibility for industry platform to diversify its business and compete in complex environments by economies of variety and through dominant logics.

Practical implications: the paper proposes a conceptual framework to face on the challenge of the emerging multipoint competition.

Research limitations – This research is based on a pervasive literature review on industry platforms and the analysis of relevant case studies on the subject.

Therefore, the main limitation attains to the need to sustain this study with further empirical evidences.

Keywords: industry platforms; ecosystem; holographic strategies, complex environments.

Philosophical and methodological foundations of post-Turing intelligent robotics

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Can the machines that can play board games or recognize images only in their cozy virtual world be intelligent? To become reliable and convenient assistants for humans, machines need to learn how to act and communicate in physical reality like people. The authors propose two novel ways of designing and building Artificial General Intelligence (AGI). The first one seeks to unify all participants in any instance of the Turing test – judge, machine, human-subject and mean of observance of their interactions instead of building separation wall. The second one needs to design AGI programs in such a way, that they can move in various environments. Authors thoroughly discuss four areas of interaction for robots with AGI with introducing a new idea of techno-umwelt bridging artificial intelligence with biology in a novel way.

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Digital transformation: complexity, trends, risks and opportunities

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The purpose – the paper provides a reflection of the digitalization processes as a social phenomenon using of cybernetics, psychology and complexity management approaches. Usually digitalization is considered from the point of view of information technologies and tools. However, the authors propose to consider indirect changes from ongoing digitalization – the transformation of human consciousness, models of social relations, models of social structures such as business, monetary system, legal system and state.

Design/methodology/approach – the authors interpret their practical experience in digital projects using such concepts as Umwelt, Second-order Cybernetics, the Laws of Requisite Variety and Requisite Holism, Viable System Model and Innovative/Cognitive communication methodology of V. Dudchenko.

Findings – digitalization process consists in exporting an Umwelt (a model of the world) from a person's head to a digital medium (to the cloud), digital tools are a cognitive amplifiers (exoskeletons), different people have united collective Umwelt, which is not just a projection/model of reality, but has a significant impact on processes in physical reality indirectly (for example, navigation apps affect real road traffic). Therefore, mass digital services are a collective Umwelts and the observers of the second order.

Originality/value – the article has originality, because it synthesizes the methods of cybernetics and psychology when considering the processes of digitalization.

Research/ Practical/ Social/ Environment implications – the practical usefulness of the work is in the opportunity to look beyond the horizon, because digitalization has a significant impact on the development of societies and human consciousness. We are on the threshold of large-scale changes related to the digitalization of money (the system of trust), legal system and the state itself (the public platform).

Research limitations – the work is a framework and there are great opportunities for further development of each thesis.

Keywords: Digitalization, Umwelt, Collective Consciousness, Digital Ecosystems, Legal Tech, Digital State

Hybrid Reality Data sharing concepts

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The purpose – The Hybrid reality (HyR) AI reasoning is fuelled by high quality detailed behavioural data. These can usually be obtained by the biometrical sensors embedded in smart devices. The currently used data collecting approach, where data ownership is taken by the designers of device or the related application delivers multiple ethical, sociological and governance concerns. In this paper, we are proposing a data sharing concept, in which data producers keep the data ownership rights.

Design/methodology/approach – Since the data sharing concept delivers a substantially different alternative, it needs to be thoroughly examined from multiple perspectives, among them: the ethical, social and feasibility. At this stage, theoretical examination modes in the form of literature analysis and mental models development is being performed.

Findings – we expect to deliver models that will direct future ethical, social sciences and data science research in the field of HyR data sharing concepts.

Originality/value the paper opens new research directions of HyR data sharing concepts.

Research limitations – Since the research proposal is theoretical in its nature, the proposed may not provide direct applicative value, but are largely focused in fuelling the research directions.

Research/ Practical/ Social/ Environment implications – For the researchers the data sharing concepts will provide an alternative approach and help resolving multiple ethical considerations related to IoT data collecting approach. For the practitioners in the data science, it will provide numerous new challenges, such as distributed data storing, distributed data analysis, and intelligent data sharing protocols.

Keywords: Hybrid reality, Data sharing, Systems thinking, Cybernetics, Artificial intelligence

Socio-cyber ecosystems during the Covid-19 pandemic: processes performance analysis

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The purpose – Our paper entails a critical analysis of the main literature contributions dealing with the digital transformation of social subsystems in COVID-19 pandemics and focuses on digital innovations in government systems. According to the current research, the following research questions have been prepared: What state-of-the-art approaches and solutions emerged in the COVID-19 period (or increase the digitalisation) and will be a key socio-technological factor in future development digitalisation of urban (smart) ecosystems?

Design/methodology/approach – The automated content analysis was provided with the software Leximancer 5.0. Authors prepared a topic analysis function with Leximancer software to determine the most frequent topics and contents and use automated content analysis's extract statistically manipulative information about the presence, intensity, and/or frequency of thematic and/or stylistic features of texts.

Findings – It is expected that the emergence of a cyber-physical ecosystem will soon happen, and smart communities will have an important impact on changing existing approaches in, e.g., learning, medical treatment, and smart governance.

Originality/value – The paper presents the possible changes in the post-COVID-19 world, which will cause faster processes for the emergence of the technological advanced urban environment and will be based on the interactions between the physical and cyber world. Furthermore, the paper aims to present new knowledge based on the current findings of the future possible interaction between the citizens and governance (from communication to decision making and self-governance tools). In our paper, we also addressed citizens' trust in sharing their data with public infrastructure.

Research/ Practical/ Social/ Environment implications – The ACA results can be useful for academics, decision-makers, civil society and urban centre stakeholders. Moreover, the paper delves into a topic that could drastically increase the actualisation of all urban centre stakeholders' needs and wishes.

Research limitations – The particular research limitation of the conference paper is that the authors used a mixed-method for literature content research

Social features of digital media transformation

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The purpose – the media industry was the first to go under the digital transformation, as its main product is information. However, digital transformation has led to a change in the formats for transmitting media information and has also become a catalyst for social change. The variety of media broadcasters has become the essential tool for forming human relations in society. Users have the opportunity to develop their unique information environment.

Design/methodology/approach – the study was conducted on the digital media users' trust in informational content. The study looked for the correlation between the type, format, other features of the content, and the level of trust in the information and content by the audience.

Findings – research has shown that personal digital media holds more credibility than those created by major news and media agencies. The involvement of digital content consumers in its assessment, on the one hand, increases the degree of trust in the media environment but, on the other hand, increases subjectivity and manipulateness in the information exchange.

Originality/value – this work brings out the fantastic paradox that accompanies the digitalization of the media environment in the world. An interesting connection has been established, which is not a straightforward logical conclusion formed from a cursory glance at this topic.

Research/ Practical/ Social/ Environment implications – the media environment is becoming practically the main instrument of political activity and is also increasingly penetrating business. Apparently, we are witnessing a severe reformation of the media industry, which, thanks to digital technologies, is becoming an integral part of human social life.

Research limitations – the research was conducted on just one digital media branch - blogs, video blogs, and multimedia content. Any media market research is complicated by the significant differences in different types of media. Therefore, much more profound and extensive research is needed to understand the correlation between different media types and trust for content and information.

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Analysing the social aspects of Industrial Symbiosis through the Viable Systems Approach

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The purpose – Conceived as a mean of making industrial production more sustainable, Industrial Symbiosis has emerged as a set of exchange structures to advance to a more eco-efficient industrial system, whose inter-organizational characters can be well interpreted through the lens of the Viable Systems Approach (vSa), the necessity of which arises from the lack of a comprehensive framework for the analysis of the social components of IS networks. This paper proposes a general model that can be used both for diagnostic purposes on existing IS cases both for design purposes for future initiatives.

Methodology – Selected cases from the Italian scenery were studied, consistently with the principles of multiple case study, using the lens of vSa to discover the premises and conditions for the surviving of Industrial Symbioses initiatives.

Findings – The model built based on the methodological lens of vSa allowed to discover the premises and conditions for the surviving of the studied Industrial Symbioses initiatives, linking the notion of systemic viability to Industrial Symbiosis and detecting the relational and interactional aspects that oversee the birth and development of the initiatives of Industrial Symbiosis.

Originality/value – This is the first study that analyses Industrial Symbiosis through the methodological lens of vSa and provides some of the very first insights into the viable systems key concepts that favour the emergence and development of IS networks.

Research/ Practical/ Social/ Environment implications – The paper highlights the applicative potential of the vSa in the areas of systemic industrial activities and encourages its application to other areas of economic activity / provides general guidelines for the governing bodies and managers for the diagnosis and planning of IS initiatives / contributes to increasing the chances of success and survival of IS initiatives, in themselves, aimed at producing social and environmental benefits.

Research limitations – The multiple case study aimed at the construction of general models provides results influenced by the extent and characteristics of the selected cases (age, size, territorial location and many other aspects); however, they provide the boundaries within which to frame existing cases and initiatives in other contexts.

A Revolution in Systems Thinking?

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The purpose – This paper presents the approach of Human-Centric Functional Modelling, and explores why it is hypothesized to be a groundbreaking approach to understanding and navigating systems complexity that introduces the potential to achieve an exponential increase in impact on any collective outcomes where predicted to not reliably be achievable otherwise, including on all the themes of the World Organisation of Systems and Cybernetics (WOSC) Congress 2021.

Design/methodology/approach – The technique of Human-Centric Functional Modelling is hypothesized to provide a methodology that enables first person observations of systems to be represented as forming mathematical spaces that in turn enable complex properties of the systems to be deduced where not possible before. As an example, when applied to cognition HCFM is hypothesized to enable properties of the cognitive system such as "intelligence" and properties of reasoning such as "complexity" to be computed. Here HCFM was used to define a metric for complexity that might be applied in the cognitive domain to determine the complexity of the reasoning involved in defining or solving any problem, as well as potentially being applicable to every other system in determining the complexity of defining or solving problems in those systems as well.

Findings – A hypothetical metric for complexity in conceptual space was defined to be some constant multiplied by the product of distance in conceptual space and the linear density of concepts in that space.

Originality/value – The importance of defining a human-centric metric for complexity that can be validated within one's awareness of one's own experience is that functional state spaces, and therefore potentially the same metric for complexity, can be applied in many other systems. For example, a functional state space has been proposed for the entire physical universe. Another functional state space has been proposed to represent the state of the human system (the human state space) so that the complexity of medical interventions required to solve particular ailments might be predicted. Many other functional state spaces have been proposed for systems ranging from the future Internet, to the Internet of Things, to blockchain platforms.

Research/ Practical/ Social/ Environment implications – The general model of intelligence developed using this approach predicts either an exponential increase in artificial intelligence that will drive unprecedented centralization and acceleration in the unsustainable consumption of resources, or alternatively an exponential increase in collective intelligence that will drive an unprecedented increase in collective well-being and sustainability. These paths are predicted to be mutually exclusive and therefore to represent a fork in the road. If at this fork in the road civilization takes the direction of collective intelligence, for the first time in human history this General Collective Intelligence is predicted to create the opportunity to exponentially increase positive impact on climate change, poverty, and other collective outcomes such as the other sustainable development goals so they might be reliably solvable where today evidence suggests they are reliably unsolvable. The goal of this paper is to encourage other researchers to independently confirm or refute the potential of Human-Centric Functional Modelling to exponentially increase impact on such collective challenges per dollar spent.

Research limitations – Since distances in conceptual space have only been approximated at this time, the relationship between complexity and distance in conceptual space remains to be elaborated. Once the conceptual space has been mapped out and distances established, relative complexity might be measured empirically based on this model for ability to navigate complexity, and based on the time taken to complete a standard IQ test (assuming that the intelligence quotient is proportional to the

product of the volume density of concepts and the volume in conceptual space as predicted by this model). This ability might be compared to the predictions for complexity made by this model.

Global-networked Synergy of Large Distributed Systems with Control

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The purpose – The global computer environment (GCE) has become the basis for increasing the scales of large distributed systems with control, which include technical, economic, organizational, and social systems. Motives for their growth are determined by the positive synergy of the network effect, the upper estimate of which is given by Metcalfe's law: "Network's impact is the square of the number of nodes in the network."

The largest systems cover billions of users. Their cost is close to the budgets of the largest countries.

Why does the cost overly depend on the size? Are there any reserves of global network synergy for increasing the system's usefulness?

Enormous cost means that the growing scales of systems have exceeded the existing GCE's system-forming capabilities. The outstripping cost proves that inside GCE, there are sources of negative synergy that radically devalue Metcalfe's effect.

The purposes of the paper are:

- identification/analysis intrasystem's reasons activation of sources negative's synergy in the GCE
- system-holistic upgrading the GCE's formation principles directed at neutralization identified sources and maximization useful synergy effect of large systems and GCE as a whole.

Design/methodology/approach – The heterogeneity of networks is the reason for the unbalanced development of GCE. Of the three possible actions with information – storage, transmission, and transformation – only the first two are globalized. The universal programmability inherent in each node, in such a case, cannot be seamlessly extended to the GCE as a whole. To acquire the emergent property of seamless programmability of distributed computing in arbitrary networks, the system-holistic globalization of these actions is necessary.

Findings – Heterogeneity is the main source of negative GCE synergy. Excessive growth in the cost of systems is associated with the combinatorial complexity of the functional integration of heterogeneous resources.

Heterogeneity and systemic imbalance of GCE activate secondary sources of negative synergy:

- the exponential growth of globally distributed poorly formalized information - texts and multimedia that poorly suited suitable for computer-semantic processing for control sustainable functioning/development of systems;
- impossibility of ensuring cyber-security with growing heterogeneity of GCE.

The concept of eliminating/neutralizing negative synergy is based on the results:

- the reasons for heterogeneity GCE, hidden in postulates of model universal computers von Neumann, are revealed;
- elimination of reasons heterogeneity was achieved by mathematical generalization the von Neumann's model using of Calculus of Tree-Like Structures (CTLs);
- principles of building the new – non-micro-processor-architecture for network computers that connect to GCE nodes to provide seamlessly programmable distributed computing is proposed;
- hardware implementation of key functions OS and control of distributed computing in new network computers eliminates the negative synergy of heterogeneity of systemic software and drastically increases cybersecurity.

Originality/value – The original approach to research the fundamental regularities of the development of GCE as a system-holistic object is presented.

Research/ Practical/ Social/ Environment implications – For the first time, the ways to eliminate the intrasystem's negative synergy of GCE, opening opportunities to minimize the cost of arbitrarily large systems, are shown.

Research limitations – The obtained results show the ways of further development of research aimed at developing methods, computer-network architectures, and technologies of new generations, aimed at eliminating the causes of continuous reproduction of heterogeneity of GCE. This is necessary to neutralize the negative synergy that is becoming the main barrier to further scaling up the scale of digital transformation.

Keywords: Global computer environment, heterogeneity, negative synergy, seamless programming, non-microprocessor architecture

Collaborative Robotics: the Dawn of Human-Machine Interaction

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The purpose – Collaborative robotics is an extremely promising and fast developing branch of robotics, which covers environments, where robots and humans have to interact and collaborate in a shared workspace, work on the same workpieces in different or sometimes overlapping time slots.

We are going to investigate how the robots silently became a part of a modern household on one side and how (with a delay) they charge on to do the same in the industrial applications. We will check the current directions of the collaborative robotics is developing in and use a practical example of a collaborative robotics environment to present restraints, which humans and robots have to follow so they can interact safely and efficiently.

Design/methodology/approach – At the beginning we have analysed the scientific and applied publications using VOSviewer software package – a bibliometric analysis tool to outline the reach of collaborative robotics. Our focus was on the following online resources: IEEE Explorer, Web of Science, SCOPUS and PROQUEST. The results were represented as either a graph or a table of areas and keywords, where connections are weighted according to the frequencies of common appearances in the analysed documents.

The second part of the approach was to set up the requirements for a shared environment, which will be capable of hosting a robot and a human. Such environment will, from a technical point of view, use advances in robotics and artificial intelligence to provide a safety level high enough to avoid any potential hazard. We will outline the main constraints the collaborative robotic systems will face in the future.

Findings – The most terms revealed during the bibliometric research were expected: ‘system’, ‘environment’, ‘application’, ‘control’, ‘problem’ and ‘industrial’ were some the most often terms correlated to the ‘collaborative robotics’ search term. Household robots, like vacuum cleaner and mower robots did not appear in the results and are not considered as collaborative robots. The main constraints addressed safety features, like SEAs - Series Elastic Actuators that are able to flex and absorb energy, without harming the human; Safety zones (fixed or variable) to impact the speed of robot’s movements; Hand guiding as a substitute for manual programming.

Originality/value – Using bibliometric mapping for bibliometric and thematic analysis is an approach, which gained it’s reputation in the last few years. We used it to assess the width of the scientific field, identify the sub-fields in which the collaborative robotics has the most influence and predict the fields to which the collaborative robotics will spread in the following years. Set of constraints and requirements for a shared environment, which will, from a technical point of view, use advances in robotics and artificial intelligence to provide a safety level high enough to avoid any potential hazard.

Research/ Practical/ Social/ Environment implications – The sub-fields in which the collaborative robotics has the most influence and the fields to which the collaborative robotics will spread in the following years will have to adapt: industries will change, new job roles will emerge and some job roles will become obsolete.

Research limitations – We will limit our bibliometric analysis to publicly available publications, emerged in the last ten years. Constraints and predictions will follow the current state of the art in collaborative robotics and artificial intelligence.

Keywords: collaborative robots, cobots, human-machine interaction, safety, industrial robots, artificial intelligence

Section 3.2 Socio-humanitarian artificial intelligence

Alexander Raikov, Massimiliano Pirani, Aleksander Ageev, Timofei Nestik

A Socio-humanitarian environment and a collective intelligence phenomenon make new demands on artificial intelligence (AI). Traditional AI can only recognize, predict, and answer relatively simple questions. However, thinking, understanding, explaining and dealing with complex problems is not available to current AI, which cannot harness the meaning of what this relationship implies. Only humans can understand ideas of the universe and possess consciousness of the holistic micro- and macro-worlds. Collective intelligence is immersed into an unconscious space. A person is able to make correct and at the same time uncaused decisions. Humans have intuition, can meditate and fall into a trance. The events depend on the observer and AI behaviour has to take into account the collective human observers. These events integrating human and AI become a part of a hybrid reality with fuzzy boundaries.

Interactions between socio-humanitarian environment and AI create caused and uncaused complete loops of observing/deciding/acting/ learning processes with its elements and services. Non-formalizable cognitive functions begin to play an important role. The collective behaviour of people and AI systems activities, by conciliating both technological and cognitive approaches, may proceed in opposite directions. The first one proceeds top-down from non-formalizable uncaused and chaotic human consciousness towards purposeful and sustainable human-machine interactions. The second is based on logical-formalizable and multi-agent architectures that are carried out bottom-up from tiny, intelligent machines towards high-end computing. It results in a framework for coping with dualities of different models in Hybrid Strong Artificial Intelligence (HSAI).

Traditional AI helps to perform routine operations. Only a few researchers are arguing that AI can copy emotions and thinking processes by logical means. The general and strong AI moves further into the areas previously inaccessible for understanding people's capabilities: the collective unconscious, the transcendental state of mind. Unlike traditional AI, HSAI enables acting in the unlimited real world. It possesses capacities to sense, reason and understanding. It can set the purposes and are being monitored themselves through time-space limitation to the benefit of humans with continuous revision of goals and even stay an actor when goals are absent.

To build HSAI the paradigm of AI development has to undergo changes. It is necessary to include an observer into the system of AI, i.e., a person who actively, reflexively and cognitively influences a socio-humanitarian situation. This inclusion can make the problem-solving inverse, unsustainable, non-logical. Instead of a traditional logical or neuro-network AI, apparently, it is necessary to dive down to the atomic or rise onto relativistic levels, to achieve adequate semantic interpretation of AI models. The power of HSAI maybe 30-50 orders of magnitude higher than the traditional AI.

Advanced AI technologies are useful for group strategic formation for self-organising social networks, rising social responsibility, and creating effective plans for government, non-government, regional, national, municipal, and other bodies. But there is a high risk of societal development with limited attention to people's emotions, lacking soul. All of this can lead to a sharp reduction in jobs, and as a consequence, social unrest. Due to HSAI development, the malicious use of AI can be dangerous on local and on an international scale.

This session aims to discuss such ideas and propose disruptive AI development solutions in the present and future.

Discussion points

- AI implementation issues in the social and humanitarian sphere
- AI-accelerating advanced and networked democracy processes

- AI-powered social responsibility in Hybrid Reality
- The issue of integrity in collective and artificial intelligence
- Time-, space-, boundary-limitations of HSAI
- Architectures and frameworks of HSAI
- Ethical approaches to counteract malicious use of AI

«Red lines» in Co-evolution Artificial and Natural Intelligence

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The purpose – Formation of the problem field of the co-evolution of AI and NI.

Metodology/approach System analysis – Development of the conceptual apparatus of standards in the field of AI. Empirical research.

Findings – 1. At present, “intelligence” is understood as “general cognitive ability, which manifests itself in how a person perceives, understands, explains and predicts what is happening, what decisions he makes and how effectively he acts (primarily in new, complex and unusual situations)”. It is believed, in particular, that the speed of data processing acts as a criterion for the development of intelligence as a system of mental operations (analysis, synthesis and generalization) and that there are mechanisms of mental self-management, forms of organization of mental experience, etc. G. Gardner in the 1980s put forward the idea of the existence of seven aspects of intelligence inherent in man. In fact the key difference between artificial (AI) and natural intelligence (NI) today can be interpreted as the difference between a point (one domain) and many points (domains) in space with the differences in the structural and dynamic organization of such systems. The NI's ability to operate on a variety of concepts from different domains, combine them and create new knowledge so far surpasses the capabilities of AIS. However, the question of the co-evolution of FIS and NI has already grown from a theoretical to a practice.

2. Algorithms as a kind of conceptual watershed have become the epicenter of the modern discussion about the essence and boundaries of FIS. The growth of culture can be described as the accumulation of a stock of algorithms (stereotypes, routines) for solving certain problems. Problems for the solution of which an algorithm has not yet been found and requires effort, ingenuity and insight of the human mind are classified as intellectual and referred to as AI. The second key issue in modern AI research is the ability of computers to think and be aware of themselves as a separate person. The third urgent problem can be attributed to the formation of a complex of possibilities (Internet, search engines, databases, social networks, etc), which allows artificial systems to think, understand and act as an organized aggregate. This directly concerns the problems of subjectivity of thinking, motivation, behavior, trusted environment, reliability, interoperability, etc.

3. The “red lines”, beyond which the risk of the evolution of AIS, autonomous from the human, occurs, is determined by many factors. Among them: (1) the energy needs of the functioning of the AIS, by orders of magnitude higher than the NI of a person, (2) the properties of human consciousness that are not yet amenable to reproduction in the AIS, (3) social constraints, (4) model (mathematical) limits to effective the functioning of the AIS.

4. In our empirical study in 2018–21, we identified the most and least likely digital changes. It is currently recognized that it is practically powerless in the face of such a high-ranking risk as the degradation of NI. This leads to the formation of persistently inadequate ideas about the world among the broad masses of people, with their strong infantilization.

5. All work to accelerate digital transformation may turn into a rather dangerous “patchwork” process in the absence of a single conceptual field, an agreed management language of communication and, as a consequence, a single semantic space for creating new standards and, in fact, management systems. In fact, this is the problem of ontologies for AIS, in part it is considered and solved in the concept of cognitive architectures.

Originality/value – The current and prospective problems of the development of AI are presented, taking into account developments in the field of AI standards and empirical research. The importance

of studying the problems of the degradation of the NI and the co-evolution of the AI and the NI is emphasized.

Research / Practical / Social / Environment implications – The problem of “degradation of natural intelligence” is defined. The question is raised about the “red lines” of the evolution of AIS. The promising areas of research and development are formulated.

Research limitations – The formation of significant volumes of structured data and the speed of emergence of new information requires the development of scientific activities using AIS.

Keywords Artificial Intelligence. Natural intelligence. Standards. Evolution. Control.

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Artificial Intelligence and Smart Systems

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The purpose – what is the components of artificial intelligence (AI) of smart systems (SmS)?

Design/methodology/approach – like natural intelligence, two conditions should be distinguished in AI:

- 1) the necessary condition is the presence of the first signal system as an elementary sensorium associated with reflexes, sensations, terminal sensors and performers;
- 2) a sufficient condition is the presence of a second signal system as a language associated with words, texts, and speech.

Findings – the thesis about the necessary and sufficient requirement for artificial intelligence of SmS consists of two requirements:

- 1) the existence of an information-system redundant reflexive model of SmS and its theater of action. This model is presented in the form of an “environment of radicals” (ER). That is, the presence of an ER-based reflexive model of SmS, and its theater of action (elementary sensorium);
- 2) the existence of a language of SmS as a semantic sensory superstructure of a ER-based reflexive model of SmS. That is the presence of semantic sensory structure of ER-based model of SmS with the sensory operation system of ER-based reflective model of SmS (the linguistic sensorium of SmS).

Originality/value – Redundancy of the ER-based reflexive model of an SmS and its semantic sensory superstructure (a structure with the operating system as the language of SmS).

Research/ Practical/ Social/ Environment implications – creating a unified information and system space artificial general intelligence of smart systems and natural human intelligence.

Research limitations – the existing element base of computer science.

Keywords: Smart system, artificial intelligence, redundancy

Money and robots: the two shadows of humanity that will destroy it

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The purpose – The goal is to set a preliminary task of studying the interaction of monetary circulation systems and artificial intelligence, and the impact of this interaction on humanity.

Design/methodology/approach – The approach is a system analysis, including the analysis of the logic of systems (A.A. Zinoviev). The main ideas of a system analysis (St. Beer) are well known to the academic community. Systemic impacts of risk asymmetry, which are close to the Chebyshev criterion, should be considered (N. Taleb). It is important to envision the future of financial systems (B. King, 2018). It is also important to understand the ideas about the happiness of mankind as well as the methods and criteria for measuring this key characteristic (D. Gilbert). The author usually uses the methodology of reflexive control (V. Lefebvre), as well as his own “4Co” approach (collective, cognitive, configuratory, convergent) and cross-technologies of situation center (V. Filimonov 2018). In our case, the use of a simple system analysis (R. Ackoff) seems to be quite sufficient.

Findings – Replacing the original term “artificial intelligence” (that is an artificially organized ability to reason) with the term “artificial intellect” led to the situation like the crisis of the Tower of Babel. This means that builders have a complete illusion of understanding each other in the absence of that understanding in real life. The existence of “simulacrum” i.e. systems of signs that do not have the objects in real life, is natural for humanity. However, the lack of understanding of the global nature of the mankind interaction does not allow us to suggest a favorable perspective for this interaction. We should note that robots, like other tools, also participate in this interaction.

The hypothesis is that the financial system, extended to the system of artificial personalities, will lead to a “soft” destruction of humanity.

The deontologization of robots will lead to the creation of social systems that will be the source of numerous conflicts. It can be assumed that there will be laws prohibiting thought experiments in which living beings can die. Famous participants in such experiments are Buridan’s donkey and Schrödinger’s cat.

Originality/value – The originality of the result lies in the consideration of the synergistic interaction of humanity as a whole and the systems of monetary circulation and artificial intelligence created by it.

Research/ Practical/ Social/ Environment implications – The presented perspective allows for each human being to create strategy and tactics of existence. The perspective is similar to the situation when somebody can boil a frog, gradually increasing the temperature of the water in the vessel in which it is located; with a sharp change in temperature, the frog can jump out of the vessel. Society responds well enough to a sharp increase in the threat, such as an epidemic caused by a coronavirus. A gradual increase in the threat may not cause an adequate response.

As a consequence of our hypothesis, a sharp increase in the scale of legal activity related to the protection of the rights of robots and systems equated to them is predicted over the next 5 to 10 years. An experimental verification of this statement can be made on the basis of statistics from relevant lawsuits and the amount of money associated with them.

Research limitations – The limitations are that communities that counteract the trend noted here either consciously or for other reasons, have not been studied.

Keywords: money, robots, humanity, global goals

AI as a social regulator of innovation activity

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The purpose of the work is to specify the objects of management in relation to the tasks of regulating innovation activities, to demonstrate the vector of application of AI technologies in the area of development and implementation of innovative ecosystems, to formulate and emphasize the functions of humanities in the processes of generating economically significant ideas. Methodology of the research is determined by the reflexive theory of management, general semiotic mechanisms of modelling and is built on the critical interpretation of the classical theory of knowledge and the "triact" of P. K. Engelmeyer, the Stevens-Burley formula, the idea of the "innovation rocket" of the Agency for Strategic Initiatives.

A community becomes a society when it forms the institutions of self-government. In the situation of the digital revolution as a transitional stage leading to life within the environment of the third artificial nature, managers become hybrids that combine natural decision-making skills and machine output algorithms. The question of specific objects of management becomes extremely important, which entails unresolved problems of the systematic view of the world, the place and role of a person in it, and the goals of management.

We proceed from the idea of a reflexive spiral of receptive cognition and projective activity, which sets the boundaries of the activity of a subject taken as an individual, community or society. The subject acts by solving problems, imagining and setting goals, expressing them in constructs or language patterns, and embodying them by processing matter manually or with the help of a machine. And the same subject perceives the sensory world available to his receptors, designating it within the schemes of known languages and interpreting it within the framework of a particular set of reasonable models. Innovation management in its current form takes into account the environment of design and implementation as objects of management, that is, the second and third acts of creativity in the Engelmeyer's system. The act of imagination and desire – the act of invention in the narrow sense - is not taken into account, and therefore falls out of the control system. In addition, the conditions for generating new ideas in receptive cognition procedures are ignored.

In a number of articles since 2017, we have formulated a model for the development of a technical and economic balance that includes AI systems: from the "Funnel" defined by the Stevens-Burley formula to the "Grail", which implies the destruction of ideas about the market as a system of social exchange and about the product as a way of existence of inventions. The basic conclusion was that in the conditions of the third artificial nature, the focus of management shifts from the environment that regulates the interaction of knowledge (inventions) and needs (desires) to the person itself. In this study, we emphasize that human management through AI technologies needs a serious analysis of the functions of traditional humanitarian knowledge in the context of digital transformation, the transition to a "society of imagination". 'With the digitization of activity "innovative" vector of public life should be accompanied by the digitization of the receptive, "humanitarian" vector. The objects of management are the processes of individual perception, the processes of taking language into account, and the processes of rational interpretation. These objects are combined into a system of technical and economic balance, modeled by means of AI as a "reflector of ideas". If the current models of the technical and economic balance in innovation set the processes of turning an idea into an artifact, then the "idea reflector" system complements them with models of the emergence of ideas based on artifacts. From the viewpoint of history of systemic philosophy, this is a natural state of affairs, the originality of the "reflector of ideas" is associated with the task of introducing a system model of cognition and activity into the practice of digital management as a tool of social reflection that

consolidates society. This kind of technical solution is able to prevent the regression of society to a disparate set of communities, which is observed today.

The significance of the research is determined by the task of overcoming the crisis of systemic thinking in the management of social processes based on the example of innovation activity or, in the context of the theory of invention of I. I. Lapshin, the task of transition from system modelling to environmental modelling.

The limitations and content aspects of the applied methods are highlighted in the publications of the authors' team in relation to problems of innovation, the philosophy of technology, and the theory of invention.

Co-evolutionary hybrid intelligence is a key concept toward the world intellectualization

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The purpose – To show the inconsistency of the approach to the development of artificial intelligence as an independent tool (just one more tool that human developed). To describe the logic and concept of the intelligence development regardless of its substrate: a human or a machine. To prove that the co-evolutionary hybridization of machine and human intelligences will make it possible to reach the solution for the problems inaccessible to the humanity so far (global climate monitoring and control, pandemics, and so on)

Design/methodology/approach – The global trend for artificial intelligence development has been set during Dartmudt seminar in 1956 (M. Minsky, R. Solomonoff, J. McCarthy, C. Shannon et al.). The main goal was to define characteristics and research directions for artificial intelligent comparable or even overperformed than human intelligence. It should be able to acquire and create new knowledges in highly uncertain dynamic environment (the real-world environment is an example) and apply those knowledges for solving practical problems. Nowadays we have many cases when artificial intelligence overperform human abilities (playing games, speech recognition, search, art generation, extract patterns from data and many other) but all these examples show that developers came to a dead end. Narrow artificial intelligence has no connection to the real human intelligence and even cannot be successfully used in many cases due to lack of transparency, explainability, computational ineffectiveness and many other limits.

A strong artificial intelligence development model can be discussed unrelated of the substrate development of the intelligence and its general properties in general that are inherent in this development, and only then clarify which part of the cognitive functions can be transferred to an artificial medium. The process of the development of intelligence (as a mutual development of natural and artificial intelligence) should correspond to the property of increasing cognitive interoperability. The degree of cognitive interoperability is arranged in the same way as the method of measuring the strength of intelligence. It is stronger if knowledge can be transferred between different domains on the higher level of the abstraction (F. Chollet)

Findings – The key factors behind the development of hybrid intelligence are:

- interoperability -- the ability to create a common ontology in the context of the problem being solved, plan and carry out joint activities;
- co-evolution - ensuring the growth of the aggregate intellectual ability without the loss of subjectness by each of the substrates (Human, machine)

The rate of co-evolution depends on the rate of knowledge interchange and the manufacturability of this process).

Originality/value – The novelty of the research is connected to a new look at the principles of the development of machine and human intelligence in the of co-evolution style. Also new is the statement that the development of intelligence should take place within the framework of the integration of the following 4 domains: global challenges and tasks, concepts (general hybrid intelligence), technologies, and products (specific applications that satisfy the need in the market)

Research/ Practical/ Social/ Environment implications – Revision of the approach to the intellectualization through the development of hybrid intelligence methods will help bridge the gap between the developers of specific solutions and those who apply them. Co-evolution of machine

intelligence and human intelligence will ensure the seamless integration of smart new solutions into the global division of labor and social institutions

Research limitations – Resistance to the idea of developing co-evolutionary hybrid intelligence can be expected from agents and developers who have bet and invest in data-driven artificial intelligence and machine learning.

Keywords: artificial intelligence concepts, human machine hybridization, co-evolution

Ethical implications of artificial intelligence development

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The purpose – Artificial intelligence is now increasingly pervading areas that were traditionally considered the ultimate prerogative of human thinking. This presents us with a number of new questions, not only technical, but also socio-humanitarian. The problem that we would like to draw attention to is ethical: namely, is it even possible nowadays to talk about ethics and responsibility in relation to artificial intelligence?

Design/methodology/approach – We consider the possibility of using ethical normative complexes in machine learning and artificial neural networks to be the most interesting. It is known that attempts to "train" neural networks to choose the best solutions based on available information in recruitment and some other areas have shown that a lot of social stereotypes and bias embedded in the source data and analyzed by the neural network have had a strong and undesirable impact on the results obtained. It makes us turn both to the analysis of the culture of modern societies, where this data came from, and to philosophical and psychological questions about what human systems of values and goal-setting principles are.

Findings – We tend to attribute to artificial intelligence the anthropomorphic traits that it does not possess. Artificial intelligence is still an instrument, albeit a very good one, for a number of practical tasks. It does not act completely autonomously and independently for its own survival, as do living organisms, and does not set itself any goals. Goal setting is still a task for developers. They, in turn, use the source materials and ethical standards provided by their culture. Thus, at the moment, in matters of ethical implications of artificial intelligence, the focus inevitably shifts to its creator – human, and forces us to explore how ethical systems work and why we actually need them.

Originality/value – Researchers and developers of artificial intelligence face the challenges of not only identifying and removing bias from their models, but also of predicting what sets of ethical standards might be necessary to regulate new forms of social relations inspired by these scientific and technical achievements. We agree with V. E. Lepskiy's point of view that the new, post-nonclassical type of rationality will require developers and users to have a much higher level of understanding, acceptance and social responsibility than perhaps in all previous eras.

Research/ Practical/ Social/ Environment implications– Despite the complexity of the question of the origins and meaning of ethics, we should recognize its powerful adaptive potential. An important role in the development of ethical norms regulating human behavior was played by the need for survival and effective functioning of human communities who passed on these norms further through learning. However, nowadays, because of extremely rapid scientific and technological progress, the norms do not always adapt at the same time with changing social relations, which creates the effect of a cultural lag that affects further artificial intelligence development.

Research limitations – In our opinion, the regarded issue involves not only the task of "teaching" artificial intelligence to use any norms, but also their search and selection, which goes far beyond the scope of one work.

Keywords: Artificial intelligence, anthropomorphism, ethics, values, goals

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Intelligence as the Individual Abilities and Civilizational Capabilities Interaction

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The purpose – To study any complex system, it is useful to decompose it into simpler components. The biological and social components extraction of human intelligence makes it possible to improve understanding of its development process as civilization is built. And to predict more reliably the consequences of choosing further ways of intelligence self-improvement in the context of the creation of AI and AGI.

Design/methodology/approach – M. Tegmark (Tegmark, 2017) ideas about three life development stages (Life 1.0 - 3.0) and their consequences are considered. Life 2.0 evolution leads to thinking formation and its properties development – mind, and Intelligence. Mind (according to the proposed definitions) is a biological object's facility to plan complex actions. And intelligence is the ability to set and solve problems not directly related to the satisfaction of the physiological needs is a civilization development product. Man advantages over other animals make it possible to create multilevel hierarchical communities and material culture. These are the conditions for the civilization formation beginning. An important milestone in intelligence level growth will be the Life 3.0 creation In the next 3-10 years.

Findings – The Life 3.0 creation will dramatically accelerate the production of the intelligent product and reduce their cost. That can serve to the civilization development and the level of intelligence of its members. Provided that the created AGI (Life 3.0) will be compatible with the existing civilization. S. Russell (Russell, 2019, believes that the main AGI agent's property should be the ability to guess their owners (living men) desires. In our study we draw other conclusions: the preference of creating a large number of AGI agents, possessing their own desires, capable of forming goals that correspond to civilizational norms. And not having the ability to resist the entire civilization community (of people and AGI agents).

Originality/value – Our approach helps to understand the civilization's role in intelligence formation, demonstrates the society development trend to Life 3.0 creation, and indicates an affirmative development path. The main AI progress goals should be the AGI agents' participation in deepening the labor division, competition. "Reasonable" properties of AI: abilities to highlight concepts, simulate complex scenes, form civilization compatible goals and desires. These properties will provide AGI agents with access to the developed by civilization capabilities and their improvement. It's important to focus efforts on planning the use of the reasonable abilities of both living people and AGI agents for the creation of intellectual products and the development of civilization.

Research/ Practical/ Social/ Environment implications – In the civilization development process all aspects of progress matter. The transition from Life 2a.0 to Life 3.0 will require the growth of civilizational capabilities. Which will allow us to create artificial life with abilities superior to humans. The process has been going on for a long time, but the milestone in the transition to Life 3.0 will be the development of "reasonable" properties of AI to a level that will allow us to include AGI agents in community life. The individual AGI agents' capabilities limitation is important. It's useful for maintaining control over their actions and also for ensuring the participation of a large agents number in all (or many) civilization's progress aspects to maintain its harmonious development.

Research limitations – Research of the life development evolution stages classification proposed by M. Tegmark makes it possible to understand better the problems facing the creators of AGI and the positive goals that can be achieved with a balanced AGI agents' construction. Preference should be given to neural network algorithms, promising ones are highlighted and development directions are indicated, but the study contains only sketches of plans for such design. Ensuring civilization

sustainable self-organization in new technological conditions will require social structures modernization and countries able to carry out effectively such transformation will be the progress leaders. But the political support achieving issues for the Life 3.0 creation development plans that are positive for civilization has not been analyzed in this work.

Social Implications of Implementing Artificial Intelligence in the Russian Agriculture

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The purpose – the purpose of this study is to analyze the social transformation of human resources when using artificial intelligence (AI) methods in the digitalization of agriculture. On the example of the list of the most significant AI developments offered by the market in the industry, we should analyze the prerequisites and challenges of their successful launch, because the intensity and coverage of the technology development areas and AI methods turned out to be so great that introducing these technologies can radically change not only the economic, but also the social situation. The most important resource for AI is data. Thus, among the development problems of these methods, experts in this field prioritized the lack of structured and reliable data. Therefore, the aim of this study is to search for methods of creating such a structured unified information space.

Design/methodology/approach – since AI methods are currently used in almost all known precision technologies in agriculture, which are evolving from the digitalization of individual operations to the digitalization of their interconnected system based on integrating all operations, including those of related industries, AI applications must also undergo integration transformations into standards of the suggested unified digital platform for managing the agricultural economy built on the basis of mathematical and ontological modelling. However, there are some interdependencies between the ways in which technologies penetrate these areas. Thus, it is now generally admitted that the deployment of AI applications in manufacturing enterprises is impossible without automation and robotization of production processes. Moreover, the theory of complementarity by Milgrom and Roberts has confirmed in practice that, among other things, investments in the digital economy (DE) are more effective when the level of two other complementary assets – organizational and human capital – is high. That is, investments in the DE are AI are associated with significant costs of changing managerial and human capital. Currently, the transition of the industry to such a unified platform is complicated by the patchwork and insular informatization that dominates in our country; however, there is a trend for demand to shift towards standard solutions that require a fundamental change in technologies of designing, developing, and maintaining such solutions. Accordingly, there should be some changes in the composition of executors' staff. One of the results of mathematical and ontological modelling of the suggested unified digital platform for managing the agricultural economy should be a scientifically sound calculation of the need for specialists for the digital transformation of the industry.

Findings – we have to admit that the country is not ready for a full-scale digital transformation of agriculture. This is evidenced both by the lack of integration processes in the DE program towards creating a digital platform for managing industries and the absence of the DE general designer with its own scientific and experimental industrial infrastructure, as well as a kind of digital feudalism as a result of transferring the program events executors' functions to several sectoral state-owned companies. This is also evidenced by the weak social demand for comprehensive digitalization due to insufficient use of traditional factors to increase the production efficiency and the product quality in the industry. Finally, this is evidenced by the complementarity theory findings about the insufficient development of other assets for the massive introduction of perfect digital technologies in the form of a material and engineering infrastructure and human capital. So far, most of the enterprises today use solutions independently developed within a company. Agricultural companies are facing a severe shortage of experts in data science and in the AI development and implementation. AI technologies are developing so rapidly that it is difficult for potential users to stop when choosing a time point to start using them, being confident in the appearance of more advanced and cheaper technologies in the near future.

Originality/value – the study uses an original approach to mathematical and ontological modelling of a unified digital platform for managing the agricultural economy, based on the positive practical experience with comprehensive informatization of large agro-industrial entities in the Kuban and Stavropol regions with introducing expert systems, which are the prototype of modern AI methods, for growing tomatoes and sugar beets.

Research/ Practical/ Social/ Environment implications – the transition to a unified digital platform for managing the agricultural economy should be accompanied by a change of both managerial structure for the development, implementation, and operation of digitalization systems, systems for retraining farm specialists involved in the operation of AI applications and other tasks in the field of the DE, and the nomenclature of IT specialists, which needs restructuring the education in universities.

Research limitations – as stated above, the most important resource for AI is data, and domestic agricultural enterprises have yet to learn how to acquire the same. Currently, about 90% of all data is acquired by people; it is recorded on paper or manually entered into Excel sheets. It is virtually impossible to use such data. The comprehensive application of AI is a way to obtain real data on each individual process operation, person, mechanism, animal, and sometimes even a plant. Therefore, there are almost no successful cases of an integrated approach to applying AI methods in business. Accordingly, this imposes some restrictions on the scientific research of this process.

Keywords: artificial intelligence, digital platform, agriculture, social implications, human capital, mathematical modelling.

Contradiction of modern and social-humanitarian artificial intelligence.

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The purpose – To find out an effective approach of using artificial intelligence (AI) methods and tools for modelling and forecasting social-humanitarian objects and events, which do not have traditional formalized way of representation. Wherein, the purpose of humanitarian action has to protect life and ensure respect for human beings. The new task of the paper is to describe processes of integration of AI and human beings in the united, or hybrid system in which traditional AI typically misses capabilities of making good decisions when it fails to take into consideration the special rules of human impact on decision processes.

Design/methodology/approach – The phenomenon of social-humanitarian dynamics contradicts the traditional logical and neuron-logical characteristics of AI. The suggested methodology embraces formalized and non-formalized parts. For the former part, holonic approach is used, for the latter an indirect one. Author's convergent approach, which ensures purposefulness and sustainability of collective decision-making, integrates these parts. The methods of inverse problem-solving on topology spaces, control thermodynamic, and creating quantum and relativistic semantics compound this approach. Wherefore, the hybrid AI system includes an observer who reflexively and cognitively influences reality taken as eigenform.

Findings – Collective decision-making cannot be represented by formal means. Any attempt of formalization distorts the integrity of the social-humanitarian phenomenon with its emotional and transcendental peculiarities, which include points such as: hidden thoughts, emotions and intentions; lack of similarity between the AI models and consciousness; the ability of explosive mental activity; the capturing of consciousness by the behaviour of neighbours, etc.. The paper suggests the idea and framework of building and materializing the equation of artificial life, which solution consists of formalizable and non-formalizable parts at the same time. The holonic approach, thermodynamic theory, cognitive modelling with genetic algorithms for inverse problem-solving help to do it by considering all the parts. The author's special convergent approach makes the process of solution of this equation purposeful and sustainable.

Originality/value – Traditional AI can recognize, predict, and answer manageable questions. However, thinking, meaning, understanding, explaining and posing problems is not available to current AI. A person is able of making correct and at the same time uncaused decisions, which depends on observer's behaviours. This research is beyond state of the art by aiming to ensure new possibilities, in order to make social-humanitarian subjects achieve their goals purposefully and sustainably when these goals are not clear; there are many ways to get it, but assets are limited. Therefore, the special convergent way of structuring information during collective decision-making creates the necessary condition to ensure such goals.

Research/ Practical/ Social/ Environment implications – Social-humanitarian objects and events embrace all phenomena connected with individual and collective human behaviour. The paper will impact deeply networked experts, groups of crowds, rescue teams, researchers, professional communities, society, and environment. Examples of such impacted subjects, object, and events are social responsibility, advanced and networked democracy, strategic development of state and mega-police tourism, and creating scientific cities strategies. The convergent approach has confirmed its effectiveness in the real economy, in the design of decision support systems, and in creating development strategies for government departments or business companies. It helps accelerating problem-solving and quickly reaching a collective agreement among the participants. For example, a draft strategy of the development of industrial enterprise can be elaborated via a parallel series of

brainstorming sessions, with the participation of top managers and invited experts during several days or even hours.

Research limitations – the suggested approach is far-reaching with respect of current technological state of the art, and its methodology has expected limitations in practice, when it comes to considering the creation of cognitive semantics based on large-volume evolutionary algorithms and non-local quantum effects.

Keywords: Artificial intelligence, convergent methodology, holonic approach, hybrid reality, eigenform, 3rd-order cybernetics

Artificial intelligence and ethical paradox of hybrid reality

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Purpose – The aim of this article is to explore the ethical issues surrounding artificial intelligence (AI). In today's world, AI is undergoing extremely widespread integration into all facets of human life, inevitably generating paradoxes and conflicts between the natural subjectivity of humans as sentient beings and the hybrid reality they create. One of the most disturbing trends in this process is that AI is increasingly being used as a mechanism to limit and alienate the freedom and agency of individuals and communities. With the boundaries between physical and digital reality effectively levelled, humans no longer have the means to distinguish between artificial digital entities and natural ones, if only because in the hybrid reality, humans themselves acquire the properties of artificial agents (constructed by themselves), while AI acquires a certain degree of agency alienated from humans. The author argues that in the face of a hybrid reality, we should not discuss just the ethics of artificial intelligence as a technological system, but rather the ethics of a hybrid subject – a complex humanitarian, psycho-social, biological and technological construct, embedded in the broad context of contemporary human society while changing its landscape. Based on certain philosophical and ethical concepts, the author of this paper proposes the foundational principles of this ethics.

Design/methodology/approach – The author considers the ethics of artificial intelligence from both a systems science and a philosophical perspective. The author focuses on the methodological gaps of systems science and proposes to fill them by a comprehensive understanding of AI as a metaphysical system

Findings – The paper offers a hypothesis about the mutual mimicry and quasi-merging of natural and artificial subjects in a hybrid environment, which requires a fundamentally different approach to ethics.

Originality/value – Traditional approaches to digital ethics view artificial intelligence as a technological engineering and, less frequently, an organisational system in which ethical issues are reduced to a list of operating guidelines. On the contrary, this paper proposes to view the ethics of artificial intelligence as the ethics of a hybrid entity, inherently embedded in the broad context of human biological, psychological, social and political life.

Research/ Practical/ Social/ Environment implications – This paper offers a theoretical study, however, after further research and validation, hypothetical implications of this paper can be used for the study of AI and hybrid reality as a complex organizational phenomenon, as well as offering potentially valuable insight on how ethical, legal and political systems can better anticipate change and manage emergent challenges of broad AI integration.

Research limitations – The paper explores theoretical aspects, which exact applicability and relevance, as well as the scale of impact, remain to be defined. Theoretical study, provided in the paper, offers limited scope by default and requires more evidence and experimentation.

Keywords: artificial intelligence, hybrid reality, ethics, social responsibility

Intergenerational representations of egalitarianism and hierarchy in social interactions online and offline

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The purpose – The paper is devoted to the research of adolescents' and parents' representations of the peculiarities of social interaction (in particular, issues of hierarchy and egalitarianism in social relations, as well as strategies for achieving success) in the era of digitalization. Digital space transforms familiar sociocultural practices and creates another mixed reality in which different values can coexist. This transformation may affect the rising generation and adults in different ways, reinforcing or smoothing the existing digital divide between generations.

Design and methodology – The study was conducted on the basis of the EU Kids Online 2017-2019 survey methodology, but some questions were developed by the Russian team for the Russian sample only. Different aspects of social interaction in the digital space will be considered in the context of the concept of digital socialization based on the cultural-activity approach (Vygotsky L.S., Luria A.R., Leontief A.N., Asmolov A.G., M.Cole and etc.) and U. Bronfenbrenner's ecological systems theory. The study sample consisted of 1553 school children aged 12-17 and 1219 parents of the same age adolescents from 8 federal districts (15 cities) of the Russian Federation. In this paper, a number of categories of social interaction are analyzed by comparing groups of respondents with different user activity, with different features of social online capital and the level of psychological well-being.

Findings – The following hypotheses are supposed to be examined as part of the work: 1) user activity, size of social capital online, psychological well-being indicators act as preferences for representations of vertical or horizontal social interactions both online and offline; 2) adolescents consider the online space as more egalitarian in comparison with parents' ideas; 3) parents and children will appreciate the offline space as more hierarchically arranged in comparison with the online one.

Originality – Modern research is just beginning to focus on the digital transformation of the world image and its implications for the personality. This study is the first comparative intergenerational analysis of perceptions of such coordinates of social interaction as "vertical" and "horizontal" social interactions online and offline.

Research and practical implications – Research contributes to the study of digital socialization processes and may be relevant to both psychologists and IT industry representatives involved in developing technologies for online social interactions.

Research limitations – This study is based on self-assessment reports of respondents. Some data, including self-assessment of time online, number of friends, etc., may be relative and subjective.

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Keywords: social interactions, egalitarianism, hierarchy, digital transformation, intergenerational analysis

Ergatic system as a model of organizational psychology integration

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Purpose – The crisis in the human Sciences, in particular in psychology, manifests among other signs as the fragmentation of scientific field: the facts accumulated are divided into separate, unrelated areas of knowledge. So, there are psychology of leadership, psychology of justice, organizational culture psychology, etc. as the separate facets of organizational psychology. The sense of the crisis is that the lack of meaningful links between the facts of different areas does not allow them to be used for explanation of real practice. It is the semantic connections between established facts are the foundation for interpreting what has happened and predicting what might happen. The facts accumulation without their integration into explanatory scheme (a model) has no practical sense. The integration of separate scientific disciplines subjects into a single model is a classic system problem. A possible solution to this problem is suggested.

Methodology – The functional approach is able to provide ordering as well as to predict and explain the evidence. When studying the past meanings of the function, one understands why something has happened. Analyzing future function's meanings, one predicts what may happen. The functional approach reveals itself as a system approach at the same time, since any function includes interrelations with other functions within the whole to get the common purpose. The principle of the unity (oneness) of the historical and the logical, first formulated by Hegel lets to reveal function meanings of main organizational psychology phenomena above mentioned and integrate them in the whole. It states that the process of the emergence and development of the system corresponds to the mechanism of its actual functioning. The functions appeared in response to conditions a system operates under then are saved as its parts. Therefore, a reconstruction of system's functions arising sequence (its history) is able to understand how the system operates (its logic).

Approach – The bipolar structure S – O first described by Hegel is a starting point of the reconstruction. It shows systemic properties which are described by “objectification – disobjectification”.formula. Namely, a Subject (an actor) and an Object (a thing) mutually determine and generate each other as it takes place in any system. The S–O system is the simplest unit of purposeful activity, it is a prototype of all types of labor; so it can be defined as the simplest ergatic system.

Admitting a Subject as well as an Object may be divided one may reconstruct a reverse function of the integration of the divided. A divided Object is beyond the consideration, its main topic is divided Subject (collective Subject).

A formal role-based structure of the team is the first and basic mechanism for integrating the collective (divided) Subject. It integrates the collective by prescriptions what to do and how to interact. Its main deficiency is inability to prescribe any activity under all conditions of its realization. Thus, a set of non-formal compensating activities is arise as response to this deficiency. The second negative feature of the set of formal roles is their destructive impact on performers, suppressing performers' natural psychological needs. The appearance of extra-formal psychologically full-fledged activities is the immediate consequence of this negative condition. So, a lot of simultaneously relevant activities (formal, non-formal and extra-formal) and a lot of their corresponding goals cause another function – of ordering them to achieve the main goal. Leadership is just such a function. The leader sets priorities among all topical goals and thereby forms the organizational culture. Then, the justice function motivates performers to participate (or not participate) in common activities and make (or not make) their efforts to achieve a common goal.

All functions mentioned integrate an ergatic system under different conditions and form together its operating mechanism.

Findings – The principle of the unity (oneness) of the historical and the logical has demonstrated its heuristic and methodological value. The separate scientific areas are integrated into a holistic system model, and functional meanings of their phenomena are revealed at the same time. So, the fragmentation of organizational psychology field is overcoming to some degree.

Keywords: ergatic system, organizational psychology, unity of a historical and a logical, divided labor integration

Section 3.3 Systems Modelling, Analysis, and Decision Making under uncertainty

Sifeng Liu, Yingjie Yang, Stefano Armenia, Jerzy Jozefczyk, Alexander Ryjov

Nature and human society are full of uncertainties. Just as Professor Robert Vallée, former president of WOSC, said that “Greyness is the field we live in”. Uncertainty plays a significant role in the world. The interactions between technology and people in society are indeed complicated and traditional mathematical systems have no capacity to model them. Alternative systems are necessary to model such interactions, among them, data-driven models are gaining momentum.

With the increased availability of data from Internet and the Internet of things (IOT), big data technology is the current focus for such developments. However, uncertainty in systems means that the historical data cannot reflect recent changes of policy or other environment factors, and the only reliable data is likely to be real time data rather than historical big data. And, of course unexpected uncertainty can always surprise us in modelling.

Therefore, effective modelling, maximizing the use of available meaningful, albeit limited data, recognizing uncertainties is essential in our big data age. Among others, the theory of grey systems does provide exactly such a facility (Sifeng Liu, Yingjie Yang). Here, this session, wants to highlight the role of grey systems; this debate will focus mainly on the two extremes: big data and limited data, certainty and uncertainty.

Discussion points

- Data Mining and Processing
- Systems Modelling and Simulation
- Forecasting and Decision Making
- Uncertainty Control
- Relation Analysis Model
- Clustering Evaluation
- Complex Equipment Development Management
- Technical Innovation and Emerging Industry Development
- Computational Intelligence
- Uncertainty Analysis and Applications

The science of interdependence for autonomous human-machine teams and systems (A-HMT-Ss)

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The purpose –Interdependence exists in all social interactions. When interdependence exists, states are not independent, the primary assumption underwriting social science and a reason why social science is ill-equipped to contribute to the science of autonomous human-machine teams and systems. In contrast to the assumption of independence, states of interdependence transmit positive (constructive) or negative (destructive) effects in every social interaction. In this paper, we review the theory of interdependence, and its effects when positive (e.g., innovation) or negative (e.g., divorce, business spinoff, etc.). We apply the theory to human-machine teams to predict the structure and performance of the best and worst teams. And with the theory of interdependence, we review our newest discovery of mathematically characterizing vulnerability in an opposing team or in our own team. We consider vulnerability to be a fundamental principle of organization during a competition between teams or organizations. For future research, we consider combining the contributions of Shannon and Von Neumann information theory to advance the theory of autonomous human-machine teams and systems.

Design/methodology/approach – Guided by theory, we explore the world for evidence from social, economic, political and military disciplines to support predictions with case studies, statistics and Kullback–Leibler divergence.

Findings – Redundancy in social systems impedes performance; a lack of national emphasis on education impedes the production of a nation's patent production; and vulnerability can be mathematically determined in a team or system.

Originality/value – Theory directed discoveries that validate a mathematical-physics based approach to the design and performance of autonomous human-machine teams and systems.

Research/ Practical/ Social/ Environment implications – We offer the first mathematical physics model of interdependence in autonomous human-machine teams and systems.

Research limitations – No known limitations at this time.

Keywords: Interdependence; autonomy; human-machine teams; systems engineering; vulnerability.

Depopulation trends modelling in a community with different levels of economic development

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The purpose – Today, there is a huge variety of foreign and Russian studies that develop issues of analysis and modelling of economic growth. Numerous attempts by various scientific teams to create mathematical models and forecasts focus mainly on an economic nature. As a rule, they take into account linear processes and provide passive analysis of already established development trends.

Approach – In this work, an attempt is made to develop a mathematical model of population growth, taking into account socio-economic factors. The paper presents the intermediate results of the study of the economic community, which consists of unequally economically developed regions. A mathematical model distinguishing conditional “center” and “periphery” (“world city” and “world village”) is proposed. As control variables the population and a number of generalized economic parameters were chosen.

From an analysis of the existing socio-economic conditions for development, it follows that the “periphery” acts as a demographic donor for the “center”. In the case of birth rate decrease in the “village”, the outflow of the population leads to its socio-economic decline, and, ultimately, to depopulation. Examples of such systems are, in particular, the EU-Baltic relations, EU-Ukraine, and also Russia-EAEU countries, with the difference that in the EAEU countries the birth rate is still at a high level and the migration process does not lead to depopulation.

Findings – The analysis shows that in this case the “institutional trap” occurs, when in the system “center – periphery” the population of the periphery will constantly decrease and the population of the center will increase, with the difference in the living standards of the center and the periphery also gapping. This trend is cemented by existing legal norms and regulation, biased to the interests of the “center”. In the language of the mathematical model, this means rigidly fixed coupling coefficients between system elements that implement one-way communication (towards the “center”).

Originality – The results of mathematical modelling of this system with reference to the existing relationships within the EU are presented. The obtained results allow us to better understand the mechanisms of interaction between the center and the periphery in such large communities as the EU, and to evaluate the role of similar phenomena within the EAEU. In particular, the following features were identified related to the population of countries with different levels of economic development. The system is “rigid” and, with given parameters, weakly reacts to changes in the initial conditions. Without a sharp change in the parameters of the system (periphery gaining subjectivity), it is not possible to reverse demographic trends. By historical standards, the degradation of the system occurs quite quickly: for example, by the middle of the 21 century, the population of the Baltic states will decrease by more than 40% compared to 1990.

Practical/ Social/ implications – The results obtained show the importance of mathematical models that allow modelling macro trends and cycles of economic, demographic, social, cultural and technological dynamics at the global, regional and national levels in order to optimize the strategic management of society.

Studying similar processes with the participation of Russia (both as a “center” for the EAEU countries and as a “periphery” for the USA or the EU) allows us to formulate ideas and suggestions to correct the situation in favor of our country, as well as to predict in advance the challenges associated with depopulation of regions near the borders of Russia.

The authors suggest that the developed approach will allow considering complex systems where simplified approaches do not work. In terms of the institutional trap, this is tantamount to breaking the trap in the course of institutional restructuring (reform). The results of computer modelling should make it possible to assess the characteristic times of development of unfavorable dynamics ("half-life" of the Periphery countries). The authors also hope that the study of this model will make it possible to formulate recipes for getting out of the emerging institutional traps (by controlling the parameters of the system).

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Key words: Mathematical modelling, depopulation, economic development, foresight, institutional trap

On selected models and methods of robust decision-making and their applications

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The purpose – Uncertainty is a fundamental paradigm constituting analysis and decision-making problems more challenging on the one hand but closer to real-world systems on the other hand. The scope of the paper is limited to the decision-making regarded as a vital activity for the input-output decision-making plant. Different types and aspects of robust decision-making are exemplified using job scheduling problems. The paper has two crucial aims: a brief survey on various robust decision-making concepts and the presentation of new results on the selected worst-case job scheduling on parallel machines with uncertain release dates obtained recently in the Division of Intelligent Decision Support Systems Wrocław University of Science and Technology. The encountered uncertainty in decision-making problems can be represented in different forms. Selected possibilities like probabilistic, fuzzy, and a set of possible values are briefly characterized. The uncertainty makes it impossible to directly use the evaluations of made decisions taken from deterministic counterparts. Therefore basic operators of substantiation/determinization are presented. Moreover, the usefulness of systems thinking is pointed out while considering the latter aim.

Design/methodology/approach – The uncertainty can be interpreted, described, handled, and investigated differently for particular applications. A representation of uncertainty and an evaluation of an optimization variable, i.e., a criterion, must be chosen from various possibilities. The considerations in the paper are limited to parametric uncertainty. They constitute specific uncertain optimization problems or, in general, uncertain decision-making problems. Different aspects of robust decision-making are briefly summarized in the first part, including worst-case, adjustable, and recoverable robust optimization. A lexicographic-robustness as an example of non-optimal approaches is also given. The crucial (second) part of the paper is devoted to investigating a specific minmax regret job scheduling of non-preemptive, independent jobs with different release dates on unrelated parallel machines to minimize the makespan. The parametric uncertainty deals with the assumption that values of release dates are not given, but the finite set of their possible values are only known. The substantiation based on absolute regret is applied. In consequence, we have a challenging optimization problem.

Findings – It turned out that the complexity of investigated minmax regret job scheduling problem with release dates belonging to the finite set of possible values can be substantially limited. Namely, it is enough to consider only so-called extreme scenarios, i.e., the minimum or maximum values for every release date. The conducted numerical experiments showed the usefulness of the proposed heuristic constructive solution algorithm.

Originality/value – The results presented in the second part of the paper are wholly original. Such a robust optimal decision-making problem has not been yet considered in the literature to the authors' best knowledge. The first part of the paper can be regarded as a survey.

Research/ Practical/ Social/ Environment implications – Optimization decision-making problems with parametric uncertainty have undisputed meaning and significance in various real-world applications as we are very frequently faced with inaccurate, unknown, or noised data. The solutions of considered particular problem of job scheduling can be used while elaborating plans of people evacuation from dangerous zones.

Research limitations – More comprehensive experimental studies are required to evaluate the proposed constructive algorithm adequately.

Keywords:

decision-making, uncertain systems, parametric uncertainty, minmax regret

Modelling of the strategic development of socio-economic systems based on hybrid simulation and ontologies

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The purpose of this research is to demonstrate model designs and approaches based on using modern paradigms and technological solutions in the field of simulation modelling of socio-economic processes and social forecasting that allow us to study complex dynamic occurrences in the development of socio-economic systems.

Strategic management of socio-economic system involves the analysis of structural changes and dynamic aspects of its development. The socio-economic system can be a specific dynamic behavior in terms of development. The search for an effective modelling constructs developing socio-economic systems due to several reasons, among which:

- necessity of choice and analysis of the trajectory of development in the conditions of formation of the strategy;
- structural changes and dynamic complexity of socio-economic systems;
- the need to consider behavioral aspects of individual social behavior and the activity of individual elements of a complex social system;
- the presence of self-organization in social systems where the dynamic behavior can occur spontaneously, depending on the internal structure and the influences from the external environment.

Design/methodology/approach – Observed in society and the socio-economic phenomena, the processes are similar to the processes studied in the area of systemological sciences, as synergetics. The article discusses the methodology and general technological approach to building simulation models describing such phenomena in socio-economic systems. Model design public system should link the micro level, where individuals (organization) decide and act and macro-level, describing the state, the basic structure and development of the system. All model variables are constantly changing for a long time under the influence of external factors and internal, in transforming the system of structures and properties of the socio-economic system. At the macro level model designs are produced by means of the aggregated system dynamics models describing the main elements and processes of development, the evolution of social systems: population, economy, production and social infrastructure, environment and other factors of social life. Through the description of microprocesses aggregated system dynamics model of socio-economic systems are complemented by agent-based models of individual social and economic behavior of decision makers, as well as describing the interaction of many social groups. The agent-based model allows to investigate the individual behaviour of different groups of agents, the specificity of their adaptation to the changing environment, and how the processes of self-organization influence the evolution and development of socio-economic system as a whole

Findings – This approach in building a multi-model complexes based composite system dynamics and agent-based simulation models allows to investigate the dynamics and development of socio-economic processes through cyclical relationship of micro- and macro- levels in this socio-economic system.

Originality/value – As an integration base for creating a model set, the paper uses a suite of ontological models, whose framework is based on the conceptual approaches to the model set stratification proposed in the paper.

Research/ Practical/ Social/ Environment implications – A simulation model of the socio-economic system acts as the core of the procedure of strategic decision making in the information-analytical centers, along with the monitoring system, data analysis, methods of generating scenarios, the technology of the scenario studies and analyzing their results. Procedures expert of audit and expertise-cognitive analysis is used for stratification, ontological design simulated socio-economic systems, the formation of possible scenarios, playable on simulation models, and modelling "balance of interests".

Research limitations – Considered model construction by the socio-economic systems are considered and applied by the author of this article in the construction of dynamic models in the social sphere (health, housing, pension system), a regional system, the collaborative supply chain.

Keywords: sinergetics; socio-economic system; stratification; simulation modelling; system dynamics; agent-based modelling; ontologies

Utilizing Enterprise Historical Data in Strategic Scenario Planning for a Power Plant

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IT-infrastructure of a modern enterprise usually includes a number of very powerful automation and control systems. Such functionality as real-time data collection, aggregation and storing do not belong to outstanding or extraordinary activities since last couple of decades. The main focus is now moving away from accumulating data to its 'intellectual' processing and analysis. IT (information technology), BI (business intelligence) and other managing and analytical departments are trying to bring additional insights and value to their enterprises by inventing new data-driven control approaches. This paper describes one approach how the real-time historical data may be utilized during so called "what-if" enterprise scenario forecast. In our research we conduct the "what-if" research on a power plant and the problem setting with the scenario modelling stages look as follows:

- a. Based on the available historical trends from SCADA (supervisory control and data acquisition system) approximate the output power characteristics of the power generating units with a piecewise linear dependencies for different ambient conditions. The approximation is conducted with a least squares (LSQ) method and the resulting model strongly depends on the data captured into the LSQ scope.
- b. Calculate cross-correlation for all output powers with all available measurements collected by power station SCADA system. The influencing factors belong to several major reasons: ambient conditions change, operators accuracy when following the generating plan, assets basic state characteristics.
- c. Create several scenarios for research – for this purpose we take a random historical day with known power generating plan and calculated level of power plant margin. Alternative scenarios contain certain plan modifications and the modelling session objective is to define whether each plan deviation could provide additional margin to the power plant (define the better possible generating plan).
- d. For each possible approximation generated in p.a and all combinations of influencing parameters of p.b recalculate the day margin with the new plan. Considering all the possible variants we get the Monte-Carlo alike procedure of calculations. The resulting effect of each scenario is estimated by comparison of mean values of distribution sets obtained after Monte-Carlo modelling session.

The number of data points used to create a power plant model for this experiment is calculate as the number of parameters multiplied by observation timeframe duration and frequency of the SCADA trending in events per minute. As it is done in the paper, considering 100 parameters during 10 years with the frequency of 1 measurement per 1 minute leads to a 500 million points analysis at the model generation stage. During scenario modelling stage the typical number of Monte-Carlo iterations is usually around 1 million. Both stages assume massive computations and may be considered as big data problems when conducted on a standard server platform. On the whole the paper targets to show a real practical case of such buzz notions of modern industrial IT as 'digitalization' and 'big data'.

Free-Rider Problem: Markov Model of System Self-Regulation by Means of Economic Levers

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The paper presents a novel way to solve a classic economic problem – “the problem of free - rider”. This well – known problem is specified in economic scientific literature and is usually considered as unsolvable one. The problem deals with a process of unrequited consumption of collective goods, and it can be considered as a problem of unfailing interest for economy of each frame of a society. The economic theory considers as a “free-rider” a person who uses advantages of some object or situation, product or service without covering of expenses. Traditional approach to this problem includes game theory schemes of different kinds, in efforts to find a solution internally, staying inside the system of free - riding. Now the authors proposed an unusual manner of exteriorly free-riding regulation, suggesting a possible solution of this “unsolvable” problem by means of economic levers. These levers can be found if the problem is solved with due account of external factors of free - rider surrounding. Moreover, the authors have used as a mathematical tool for problem modelling not a traditional game theory, but applied the Markov chain concept for system self-regulation simulation and analysis.

Authors put forward an idea of description of free-riding phenomenon by means of Markov random process, which gives an opportunity to sort out a problem and find the conditions for spontaneous process self-regulation by means of economic instruments. A mathematical model reflecting authors’ view is based on Markov chains with absorbing states, created on the base of graph depicting an interaction of “free-rider” with his neighborhood. The concept of graph description for free – rider and interaction with his surrounding for different possible system states is developed for demonstration of an opportunity to deactivate free—rider activity without direct state regulation. The simulation represents system convergence from arbitrary initial state to a stable final distribution for Markov chain, demonstrating an opportunity of system self-adjustment. The state participation in this case is came down to an arrangement of necessary institutional conditions.

The research demonstrated clearly, that, in spite of non-rivalry in consumption, the case, when “free-rider” disserves the interests of his nearest surrounding, would result in increasing antagonism and suppression of free – rider activity spread. The methodology suggested includes arrangement of institutional conditions for the control of “free-rider” activity by economic and social agents directly interacting with him. So, the generally “unsolvable” problem could have a possible successful solution for an important special case of frequent occurrence. The opportunities and perspectives of Markov chain models for phenomena description, simulation and investigation were for illustration presented for two typical cases of free - riding. These cases are counterfeiting and paying under-the-table wages. Issue of counterfeit banknotes and implementing them into money turnover disrupts the state monetary system, but essentially greater damage is inflicted on individuals with these counterfeit banknotes in the wallets. Payment off-the-book wages decreases pension funding, but essentially more strongly endamages the individuals who receive such salaries, depress their opportunities. In both cases we deal with low public and high private harm, so it is easy to find persons who are primary stakeholders, that stimulate such economic agents interacting with free - rider to keep this negative phenomenon under their control.

The approach and mathematical model suggested can be applied for “free-riding” analysis in different spheres, from ecology problems to public health care. Manifestations of this problem may be found in the following spheres: politico-military strategy (a choice in favor of defensive warfare or aggression), social revolution in the present-day Ibero America, cribbing during exams in institutes of higher education, realization of medical insurance reforms carried out by the President of the US Barack

Obama, ecological activity of international institutions, free blood donation. It also can be applied to problem of whether the person is free in wearing the mask, preventing surrounding from Covid-19 infection, which becomes of great importance for the situation of current pandemic disease.

Research limitations – The both approach suggested and mathematical model developed can be applied in a situation of free – riding with high private detriment, in which it is not difficult to create an institutional conditions for free-riding suppression.

Keywords: free - rider problem, public good consumption, Markov chain model, self-adjusting system.

Hybrid Intelligence. Main concepts and application scenarios

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The purpose – Hybrid Intelligence is a cooperative collaboration between Human and Artificial Intelligence in the process of solving intelligence tasks. The concept of Hybrid Intelligence originates from ideas of William Ross Ashby, Joseph Carl Robnett Licklider, and Douglas Carl Engelbart. Fuzzy set theory, introduced by Lofti Zadeh, is a natural tool for describing and modelling Hybrid Intelligence. Basic problems of Hybrid Intelligence – modelling of human perception and operating with perception-based information have been discussing in the report. Two application scenarios – personalization of human interaction with the digital world and evaluation and monitoring of complex processes have been discussing and illustrating, too.

Design/methodology/approach. The results are based on system analysis, fuzzy logic, some mathematical and psychology theories and facts.

Findings – Hybrid Intelligence is a pragmatism aspect of intelligence technologies, and this concept could be a reply to the crisis of modern Artificial Intelligence.

Originality/value. Hybrid Intelligence is a new formal model which could be a formalization of concepts “automation of knowledge work” (McKinney), “augmenting human performance” (NSF), “human-machine symbiosis” (DARPA) and have broad areas of applications.

Research/ Practical/ Social/ Environment implications. Hybrid Intelligence can help people in comfortable and effective interaction with the digital world and can be a base for developing systems for evaluation and monitoring complex processes in society and the environment.

Research limitations. Hybrid Intelligence approach can augment an ordinary human performance in solving routine intelligence tasks but cannot substitute a genius.

Keywords: hybrid intelligence, perception modelling, personalization, evaluation and monitoring complex processes.

Section 3.4 Cybernetics and Control Science for Information Society

Mikhail Goubko, Alexander Kuznetsov, Andrei Khrennikov, Yuri Slovokhotov

‘Information’ is the new paradigm reflecting the main character of modern human society as an information society. The tremendous development of information technologies of the last 20 years has dramatically changed our lifestyle through the world-wide web of the Internet and the mobile-connectivity web that have led to the creation of virtual social networks. Recent information technologies caused the digital transformation of human communications and, consequently, of the whole society. Unavoidably, challenges of the new information culture become the focus of intensive studies and a meeting point for researchers from social sciences, physics, and engineering. The aim of this section is to invite leading experts in Cybernetics, Control Science, Sociophysics, and Social sciences to the talk on the role of information and the informational issues in their theories and applications to the problems of the society

Discussion points

- Control problems in complex cyber-physical, economic and social systems
- Models of complex networks and their applications
- Non-linear and stochastic modelling in economic and social sciences
- Collaboration and conflicts in social and technical systems
- Artificial intelligence and data-driven control
- Computer sciences in interdisciplinary studies
- Econophysics and models of behavioural economy
- Quantum-like modelling of cognition, decision making, and social processes
- Physical modelling in political sciences
- Distributed intelligence of multi-agent Systems

About nonlinearity in social evolution

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The purpose of the report is to use the methods of mathematical modelling of macrosocial processes to investigate the phenomenon of "singularity" in human history. The singularity phenomenon refers to the fact that over the past few hundred years, a number of important global demographic and economic characteristics have been growing according to a hyperbolic law that should reach the point of singularity in the coming decades.

The methodological approach is based on the use of mathematical modelling to analyze global phase transitions in human history and compare them with similar processes in biological evolution. The conclusions obtained as a result of mathematical modelling are the following: 1) the phenomenon of singularity, which is expressed in the accelerating growth of a number of basic characteristics observed both in biological evolution and in human history, has both common and different features; 2) the acceleration of biological speciation is due to the fact that the earlier species with their vital activity change the habitat, making it more diverse, saturating with organic matter, creating new biological niches, thereby creating favorable conditions for the emergence of new species. Mathematical modelling and the available empirical data show that, to date, the dynamics of biota diversity are fairly well described by the hyperbolic trend, which goes to infinity after about 30 million years; 3) acceleration is also characteristic of social evolution, but the widely discussed phenomena of technological, demographic, social singularity are in many ways speculative. As shown by mathematical modelling, the hyperbolic growth of some demographic, economic and other indicators observed in recent centuries is a consequence of the transitional processes that began as a result of the industrial revolution (replacing manual labor with machine labor) and anticipating the transition of society to a new stage of its development. The point of singularity of the hyperbolic trend characterizes the end of the initial stage of this process and the transition to its final stage. A direct analogue of the current situation in this sense is the "axial time" (from 8th century BC to the beginning of our era).

The presence of such an analogy allows you to look into the future, studying the past. The mathematical model and the conclusions derived from it are original. Simulation results that allow you to make a long-term forecast can be used in practical strategic planning. The obtained results of calculations are preliminary and will be refined in the course of further research.

Keywords: social evolution, hyperbolic growth, transient processes.

A higher-dimensional dynamic representation for complex systems

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Purpose – Visualization allows certification of rules and effects, especially when structures exceed a certain degree of complexity. This means that structures of high complexity can be more easily perceived visually than by pure power of imagination. The proposed article & presentation is motivated by the aim for delivering higher dimensional representation forms for complex dynamic systems. This requires a concept that allows composite structures in movement, for which we developed a digital 3D animated dynamic hyper-Euclidean geometry.

Design/methodology/approach – The newly developed higher-dimensional model derived from quasicrystallography uses 5-simplices for the formation of complex interconnected spacial compounds up to higher order. It is based on the finding of the 3D representation of the Penrose Kites & Darts tiling, unit cells of 5-dimensional space. References to cybernetic concepts and Gregory Bateson's *Pattern that connects* will be discussed.

This visualisation method based on this 5-dimensional geometry enables to compose structures up to higher order. For the definition of dimensions we rely on Henri Poincaré's ideas as implemented by Luitzen E. J. Brouwer's "lawless sequences". We may present some examples of this method such as a model for quantum bi-partite systems — in a hyper-Euclidean 8-dimensional representation form, as well a model for atoms — a 26-dimensional space model in regard to String theory-- up to our galaxy and the S^3 Universe.

Findings – Moreover the presented dynamic representation form enables to model dynamic systems from microscopic to cosmological levels on a morphological basis. In this context newly developed dynamic geometrical representation forms such as the hypersphere (S^3) and the Poincaré homology sphere as models e.g. for the earth shall be introduced. The visualization of the Poincaré Homology sphere in a dynamic hyper-Euclidean depiction form is based on a dynamic composite system of the 3D representation of the Penrose Kites & Darts forming a 4-dimensional dodecahedron that acts upon descriptions of Threlfall & Seifert (1933). The result conforms with the infinite 5-dimensional space which acts like a machine that Poincaré found appropriate for Group Theory.

Originality/value – This digital visualization concept can be applied to conceptualize dimensions as manifolds of three-dimensional spaces instead of degrees of freedom of a random vector.

Research/ Practical/ Social/ Environment implications – Hence, it can be applied in visualization of different kinds of complex systems in nature such as planet earth for which a complex higher-dimensional model of the biosphere shall be presented. We take a 2-sphere (S^2) and attach hemispheres assigned to the 4th dimension (on imaginary axis i) on each point of its surface. This construction of a 3-sphere (S^3) leads to the hyper-Euclidean representation of the 4-dimensional space similar to description of the projection of a hypercube. The resulting space is a dynamic 6-dimensional hyper-sphere where inherent symmetries are conforming to Noether's theorem. Finally the same model of a self sustainable dynamic systems shall be proposed as image of ideal social systems in the state of equilibrium. We hope that our methods will flow

Research limitations - We hope that our visualization method will gain broad acceptance and find many applications.

Keywords: visualization, complex systems modelling, Pattern that connects, hypersphere S^3 , 3D representation of the Penrose Kites & Darts, Poincaré homology sphere.

Voting is not [good] for heaven or hell, which are symmetric

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In this study, the voting efficiency of economically rational agents in favourable environment conditions is investigated in the model of Voting in Stochastic Environment (ViSE). An analogue of “pit of losses” in positive conditions is analyzed. It is found that voting mechanism is less efficient for egoists, under certain conditions, than the strategy, in which all proposals are accepted without voting.

MNM-methodology of Developing Microfluidics

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The purpose – Depending on the design, the performances of the microfluidic units may vary within a wide range, even if the operational geometry being fixed. In order to obtain the most effective results of the designing, it is reasonable to use the formal procedures of systematizing possible variants of the design, analyzing these variants, and selecting the best design variant on the basis of the criteria preset. In this context, the problem of creating the effective formal methods of designing the microfluidics is topical. Therefore, the main purpose of this paper is to propose a decision of this problem.

Design/methodology/approach – To solve the above mentioned problem, the authors devised the method of analyzing and synthesizing the designs on the basis of the multidimensional network models (MNM-method).

Findings – The MNM-method provides the possibility of generating and in-computable-form-analyzing qualitatively different variants of the design on the principle of the unity of the geometrical, structural-hierarchical, and functional characteristics, as well as the possibility of selecting the best design variant on the basis of the preset criteria by means of analyzing both the structure and features of the multidimensional networks.

Originality/value – The MNM-method of designing the microfluidics is a new formal method of the design analysis and synthesis, with the effectiveness proved by practice. The method uses a new kind of the generalized models – the multidimensional network models – that are based on the ‘structure class’ entity. In order to design the microfluidics, the formal definitions of the geometrical, structural-hierarchical, and functional structure classes have been developed.

Research/ Practical/ Social/ Environment implications – In this paper, the key stages of applying the MNM-method are represented by the example of designing the microfluidic generator of the 100- μm feature size. This is very important from the view point of the practical application, because the microfluidics is increasingly used to create high-technology products. For instance, the microfluidics provides potential to create promising non-electric reserve control systems (RCS). The prospectivity of RCS is mainly determined by the resistance of the microfluidics to multiple destabilizing factors resulting in failures of electronics (for instance, radioactive and corpuscular emissions, electromagnetic emission, high temperatures, etc.). The microfluidics has its own approaches to generating, saving, transforming, and transmitting the data. Therefore, the microfluidics allows new original cybernetic systems to be developed by means of the non-electronic element base. At the present time, the fields taking advantage of the microfluidics also are microanalytics, micromechanics, biotechnology, bioengineering and other complex scientific areas.

Research limitations – This paper represents one of the possible applications of the MNM-method – designing the microfluidics. In general, the field of application is wider than the above one. However, not to disturb the monographic composition of the paper, no alternative was considered within the research undertaken. Therefore, the authors do not declare the universality of the MNM-method, despite its large potential to be used as a development tool.

Keywords:

Multidimensional network model, design analysis and synthesis, microfluidics, reserve control system.

On the Differential Neural Network Toolbox Design for Identification, Estimation and Control

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The purpose – Concerning the control design, there is often a problem of identifying the mathematical model of an unknown system for constructing control laws, non-parametric approximation, and state estimation. There are many concepts for solving problems: statistical, genetic algorithms, neural network systems. Differential neural network (DNN) system approximation can simplify the analysis of the system under study for developing observation and control problems. A neural network is represented by a system of differential equations defined by a vector field in the space of vector activation functions with weights and offsets functionally associated with the input data. Hence, choosing the structure and determining the neural network parameters is not a trivial task for an inexperienced user.

Approach – This study shows the first version of the developed toolbox to reduce the threshold for entering this area. Potential toolbox users include researchers (control science, electrical, aerospace, chemical, biology, etc.), students (engineering, control science), engineers.

The main scenarios of toolbox usage: DNN implemented as an identifier, composing an identifier for solving forecast problems (DNN predictor), static and dynamic functional relationships (nonlinear regressions using weights as parameters), non-parametric modelling of input-output data relationships, software sensors based on differential neural networks and state observers, adaptive automatic control of systems with uncertain dynamics.

Findings – The toolbox consists of 3 main components - user layer, DNN manager, and DNN logic. The user layer is the only element the user has direct access to. It provides high-level controls and monitoring of the system.

DNN manager serves as an intermediary between the user layer and the neural network manager. That means it should allow the user layer to start and stop learning, provide an interface to indirectly access internal data of the DNN (current weights, input and output data, estimation error at the current step).

DNN logic is a component that includes a concrete mathematical model of the DNN and performs operations on it. It needs to be able to perform one integration step at a time.

Originality – At the moment, there is no open universal toolkit for working with differential neural networks. The key feature of the toolbox is the possibility of developing an algorithmic semi-automated selection of activation functions parameters. The problem of selecting the parameters of activation functions is often solved by trial and error, which is considered one of the weaknesses of the DNN approximation theory. An additional capability of the neural network manager is controlling the optimization of activation functions' parameters.

Practical implications – Toolbox could identify the dynamics of the "black box," restoring the laws underlying an available system at a known input and output. It is aimed to simplify the workflow (identification, estimation, control) for various kinds of controlled systems in aerospace, chemistry, economics, etc. Depending on the completeness of the information about the system, a flexible toolbox allows users to change the neural network structure efficiently for fitting under a specific task. The current tests of the proposed toolbox have shown the workability of all the considered scenarios, which seems to be a promising scheme for expanding the application of the DNN theoretical contributions.

Research limitations – Control capability is limited to adjusting a small number of numerical parameters and selecting exact functional parameters from a predefined list. The exact implementation of the user interface depends on the exact usage.

Keywords: Toolbox; Non-parametric model; Artificial neural networks; Learning laws.

Fine structure of Human spectrum according to the Fractaquantum hypothesis

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The purpose – In this contribution, we consider a new aspect of the fractaquantum hypothesis. We know that atoms are described, in quantum theory, by their energy spectrum. According to the transfer of knowledge authorized by the fractaquantum framework, we consider a human being as a macroscopic Atom with an intrinsic spectrum. We study various aspects of the spectrum, including the fundamental state, the loving state and the mystical state. The perturbations of the spectrum due to internal and external fields induce a specific spectrum for each individual human being.

Design/methodology/approach – When determining the spectrum of an atomic structure, a background is associated to the main part of the interaction. In the presence of a perturbation, the energy levels are modified and a lifting of degeneracy can occur for degenerate energy levels.

Findings – A important question concerning the lack of indiscernability for macroscopic Atoms has a beginning of resolution.

Originality/value – The fractaquantum hypothesis is a non-reducing epistemology that treat all scales in Nature with the approach of quantum mechanics.

Research/ Practical/ Social/ Environment implications – The fractaquantum hypothesis proposes a new representation of knowledge for the macroscopic world.

Research limitations – We made a large use of analogy in the development of this new epistemology. An important question concerns the quantification of internal and external fields that induces various perturbations of the spectrum.

Keywords: Atoms, stationary perturbation, discernability, degeneracy.

Agent-based Model of scientific results development

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The Agent-based model focused on formation and evolution of scientific groups under different funding strategies is presented.

The agents in model are representing individual scientists which can form scientific groups.

The agents do not have strategy behavior but perform definite algorithms of actions.

The model do not pretend to describe any kind of process of scientific knowledge formation itself but consider evolution of some aggregate parameters which reflect results of the scientific and teaching activities of groups and individuals.

The realistic input of model is provided by the scientists interaction graph derived from scientific publication database (Web of Science) for Russian Federation and by researcher age distribution and total funding information of the RAS Institutes.

The development of region: the background and the activity of regional authorities.

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The development of any region – a self-developing socio-economic system (SES) – is a multi-level process with a goal-setting to increase the real incomes for the inhabitants. And to ensure the successful development of the region the top-level of regional authorities must realize the transition of the region's economy to a more suitable type of self-regulation (see, for example, [1]). Only by counting on reliable authorities activity can be achieved the required increase in the specific regional gross domestic product – $GDP_{reg}/person$ and sufficiently attractive specific disposable income – $DI_{reg}/person$. So, the main task of the region's authorities should be directed to identify the adequacy of the undertaken activity on the process of forming the desired "channel" of development.

The complexity of a purely theoretical study of intra-regional dynamics under the influence of self-regulation factors makes it preferable to study region's self-development based on the method of "passive experiment". The necessary structuring of the data of the "passive experiment" can be realized by using the modernized method of the transversal cutting Poincare surface (see, for example, [2]). The proposed modified Poincaré method allows one to obtain (according to the data of the "passive experiment") a well-defined two-dimensional dependence of the dynamic parameters determined by the selected coordinates of the transversal cutting Poincare plane. The selection of various combinations of the argument and ordinate as the coordinates of the cutting plane makes it possible to clarify the features of development of the SES-region.

To carry out "passive experiment" were selected regions France. Both politically and economically, France is the leading socio-economic system of the European Union. The values of the $GDP_{reg}/person$, the values of the $DI_{reg}/person$ achieved by the France regions were obtained for 2018. The ratio of the resulting difference $\Delta reg/people = GDP_{reg}/p - DI_{reg}/p$ to $GDP_{reg}/person$ gives an estimate of the funds that the region can use for investment in development).

The study was made of the dynamics of the development of the regions France by studying changes in the value of the $GDP_{reg}/person$ under the influence of changes in population density and the adequacy of the activity of regional authorities. The results of the study made it possible to identify for France the presence of two groups of regions. The first group can include fairly prosperous regions, namely: the metropolitan region of Ile de France, Auvergne-Rhone-Alpes, Provence-Alpes-Cote d'Azur and the region of Pays de la Loire. All other regions of France can be classified as backward. The prosperous regions of the first group are able, having sufficiently high $GDP_{reg}/person$ and $DI_{reg}/person$ values, to provide a sufficiently high value of the resulting difference $\Delta reg/people = GDP_{reg}/p - DI_{reg}/p$. This allows the prosperous regions of the first group to obtain a share of the resulting difference $\Delta reg/people$ to GDP_{reg}/p equal to or greater than 0.30. And this achievement allowed for four regions (Ile de France (point 2 in Fig. 1), Auvergne-Rhone-Alpes (10), Provence-Alpes-Cote d'Azur (12) and Pays de la Loire (point 6)), as the graphs in Figure 1 show, to fall into the group of prosperous regions. For the rest of the regions of France, the consequences of deindustrialization are still having an effect.

Keywords: development dynamics, region, gross domestic product, population density, authorities' activity.

Spoiler equilibrium as a macroeconomic self-regulation mechanism and overcoming of its failures.

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The purpose – We consider a financialisation problem, that is key problem in microeconomic that prevents extension of Arrow-Debrew model to explain a purely macroeconomic phenomena connected with money and finance. According to our interpretation all the financial state variables can be explained as an optimal response to volatility. We explain mutually its origin as a direct stability constraint violation consequence.

Design/methodology/approach – We model volatility as a spoiler price or a quasi-price that leads to an attractiveness diminishing for a common pool resource (or a common good) that is identified as a macroeconomic stability constraint. Since the leverage of an asset (the asset to own capital ratio) is a linear term of this constraint (leverages along with the physical capital are a bilinear terms in the responsible for stability matrix operator) the rising of it moves elder eigen value real part up to zero. So we have a Pareto-like constraint when rising of one leverage is impossible without diminishing of some others (or their capital weights at least - as we consider leverage to capital product sum with operator coefficients).

Findings – we demonstrate how one can potentially built an economic theory without splitting it to separate macro and microeconomic parts.

Originality/value – We introduce a stability constraint (depending on financial leverages) and volatility as a price, getting the (Nash) equilibrium explanation for both.

Research/ Practical/ Social/ Environment implications – We demonstrate a way at that one can regularly describe financial variables and it's a way of economic dynamic understanding through the investment decisions according to financial optimisation problem.

Research limitations – Our approach in calculation of spoiler equilibrium based on some approximations that omit stock market and bank sector degrees of freedom that can either affect stability (instability) of the overall system. Still this is not crucial for the basic idea, that independent of over factors there are forces (motivations) in economic system that turn the whole economic system at the close vicinity of stability constraint.

Keywords: volatility, general equilibrium, macroeconomics, financialisation, common pool resource, stabilisation policy.

Social dynamics determined by voting: Median consideration of stochastic environment features

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Under the assumptions of the ViSE (Voting in Stochastic Environment) simulation model, homogeneous societies are considered whose participants adhere to an egoistic or altruistic strategy. The success of the whole society is evaluated based on two criteria: an average increment of the capital of the participant and the number of non-bankrupt participants after 500 steps. Two classes of distributions used to generate offers are studied: normal distributions and symmetric Pareto distributions.

In the present work, we study in detail the symmetrized Pareto distributions (SP distributions) with “superheavy” tails. In previous works, distributions were standardized by dispersion, which excessively focuses the “heavy” Pareto distributions near the mode. The problem is that in the concentration zone of the greater part of the probability, these distributions differ many times in density from the normal distributions and SP distributions with lighter tails. And in this work, it was decided to use a substantially more correct way of standardization, which is equalization of the positions of three quartiles of compared infinite symmetric distributions (in other words, equalization of middle and one-sided medians).

According to the results obtained through simulation modelling, the heaviness of the distribution tails contributes to an increase the average increment of capital (AIC) in one step of the participants. At the same time heaviness of the tails influences altruists more than egoists. For societies with the elimination of bankrupt participants («extinction»), this difference is even more clear. Despite the fact that superheavy tails make it easier to build up capital in society of altruists, they are worse at maintaining size of society.

For a society of egoists, the pattern is more complicated: in an unfavorable environment, the severity of the distribution tails increases the values of both criteria; with a slightly unfavorable and favorable environment, increasing the AIC, it simultaneously intensifies the process of extinction. In cases where the welfare of participants is higher in societies with more intense extinction, this is explained by the fact that stratification of society with the ruin and disposal of poor participants increases the average capital of those remaining.

Keywords: Voting in Stochastic Environment, simulation model, egoistic or altruistic strategy, symmetrized Pareto distributions, elimination of bankrupt participants, average increment of capital

Medieval global warming and feudal fragmentation

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The purpose – A novel understanding of feudal fragmentation in medieval Europe of X-XII AD as a consequence of medieval warm period, is presented.

Design/methodology/approach – Analysis of historic data, agent modelling, computer simulation

Findings – Earth climate change in the historical past and its possible impact to ancient agricultural societies were a subject of intense research during last decades. In particular, variations of concentration of cosmogenic isotopes like ^{18}O , ^{10}Be and ^{14}C in the Earth sources (sea and glacial deposits, tree growth rings) are used as proxy data of solar activity in reconstructions of average global temperature dynamics (see A. Moberg, et al., *Nature*, 2005, 433, 613). Such a dynamics possibly included secular variations of average temperature in Northern hemisphere within the range of ca. 1 K with (partially documented) local fluctuations of weather and humidity that strongly affected pre-industrial economics influencing social and political dynamics.

The main features of the reconstructed climate dynamics in the last millenium include Medieval Warm Period (MWP) of X-XII AD, followed by decrease of average temperature through Spoerer (mid-XVIth) and Maunder minima (late XVIIth centuries) known as Little Ice Age in Europe, to the contemporary global warming from XXth century. Similar centennial variations of average temperature and humidity were recorded in other regions of Earth, e.g. China.

We suggest that the Medieval Warm Period of X-XIIth centuries, accompanied by rise of agricultural production and population growths, caused the political and economical decentralization in early medieval states in the number of regions (Western Europe, Kievan Rus' , Song Empire in China) with only weak or no relation in the meantime. A period of 'feudal fragmentation', coincident with MWP (named 'Feudal Revolution' or 'encastellation' in European historical science, see R.Fossier, *Enfance de l'Europe. Aspects économiques et sociaux*. ft. 1-2. Paris: 1982) occurred during MWP together with a decline of central state's power and the rise of local military authorities.

The elements of feudal economics and organization originated from ancient time, existed in all traditional societies at different levels. However, their proliferation independently occurred in various Earth regions during X-XII centuries AD (see China: Five Thousand Years of History and Civilization. City University of HK Press. 2007), not necessary with a positive impact on their dynamics. Specifically, the political fragmentation in early medieval Kievan Rus' facilitated the Mongol invasion of mid-XIIIth, whereas the full-scale local feudal formation matured only later in Moscovian period (S. Franklin, J. Shepard, *The Emergence of Rus, 750–1200*. Longman, London, 1996.).

Agent modelling of distribution of a product between the population, local authorities and the state, has been carried out. In agreement with the historical knowledge, a delayed withdrawal of the extra product by state under a fast growth of population (and so production) boosted the income of local authorities up to the level sufficient for an independent support of their local domains, causing fragmentation. The growth is limited by a finite supporting area.

Originality/value – The economical and political impact of climate variations to pre-industrial states is widely discussed in historical science. However, a linkage of MWP with encastellation of X-XII centuries AD was not yet discussed in the literature. It may bring a new insight into the important period of the medieval history of Europe.

Research/ Practical/ Social/ Environment implications – We believe that our new interpretation may have an impact on the related historical studies. On the other hand, computer agent modelling is a

novel tool relatively scarce in contemporary historical science, so its implementation may bring new possibilities. The main idea of our paper is a linkage of political and economical reality with environmental issues, mandatory for modern humanitarian science.

Research limitations – Our material does not yet include statistical data for medieval demography and economical output; it is rather a declaration of the new pathway. The development of this approach is our task for the nearest future.

Keywords: Medieval warm period, encastellation, agent modelling

Optimal Enterprise: Complex Activity and Mathematics of Knowledge and Human Capital

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The concept and term Enterprise is widespread and has a long, centuries-old history, accompanying almost all the contemporary development of humankind. Enterprises, being, on the one hand, complex, and, on the other hand, widespread systems, are the subject matter of various knowledge domains, such as cybernetics, system theory, systems engineering, operations research, game theory, sociology, economics, business and management sciences, and many others fields of fundamental and applied science. However, the formalization of the Enterprise has not yet been advanced to the development of a harmonized system of mathematical models of the Enterprise as a managed object or its control process.

As a system of systems and as a cyber-physical system, an Enterprise is not created merely to exist in and of itself. The value of any system does not lie in the system itself: the system itself only consumes resources to be supported and maintained. But valuable output is produced exactly by functions, operations, and the activity of the system. If nontrivial, complex output is needed (which is always or nearly always the case), it is necessary that, in turn, complex activity (CA) be carried out. An Enterprise is modeled and studied based on the concepts of the methodology of complex activity (CA is an activity with a non-trivial internal structure and with multiple and/or changing actors/players, methods, and roles of the subject matter of the activity in its relevant context). So, precisely complex activity is a primary source of value in general, while an Enterprise is secondary, executing CA as an actor.

The logical structure of CA is a finite acyclic graph, which represents the fact that each structural element of activity (and CA as a whole) is decomposed into a finite number of lower-level elements and elementary operations. The causal structure of CA reflects the technological relations among the elements of complex activity, being actually a general system technology, while the elementary operations (their content) and the cause-effect relationships themselves represent a specific domain of the CA. The implementation of the lifecycle of CA is described in an algorithmic form by universal process model of CA in BPMN format.

The proposed representation of embraces the following key aspects of an Enterprise:

- Humans and their active choices as key elements of an Enterprise – Human Capital;
- Nontrivial structure of the subject matter of the control, which is defined by the goal/logical structure;
- Implementation of CA during all phases of its lifecycle;
- Technology of CA – the system of conditions, criteria, forms, methods, and means to successfully achieve a stated goal . Technology is incorporated in the Knowledge of the Enterprise.

We make an attempt to pose and solve the Enterprise control problem as an aggregate of mathematical optimization problems. As a result, a harmonized set of mathematical models and methods is proposed that not only models the essential features of the Enterprise as a complex system of systems but also allows solving Enterprise control problems as formal mathematical optimization problems.

Development of electronic money turnover control systems by means of simulation techniques

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The purpose – This paper deals with a concept of stability control system for electronic payment by means of graph analytics. The contemporary distributed system of electronic money turnover can be represented by means of complex network, mapped by a graph, nodes of which represent the participants of the system, and links of which represent connections and communications between interacting economic agents. Such system can be considered as complex network, because it has a typical specific feature: it includes several significant nodes, so-called hubs – the nodes with vast number of links, which influence to the whole systems is constitutive. In systems of electronic money turnover such hubs are presented by banks and interbank processing centers. The purpose of this work was to find the graph characteristics which numerical value can be considered as an benchmark or indicator of functional failure of electronic payment system.

Design/methodology/approach – An investigation was carried out in two steps (stages). During the first stage the graph, simulating the system of electronic money turnover, was generated by means of Gephi program and various numerical graph metrics were analyzed; on the base of these metrics values an integrated metric of system stability was developed. During the second stage the validity and applicability of this integrated metric was tested by means of so-called crash-test. These tests include consecutive destruction of the graph, which simulates the system of electronic money turnover, and keeping track of proportion of successive payments throw this “broken” system. The simulation is carried out by means of random deleting of some nodes and considering a chance of financial transaction to be carried out successfully. The interest was to catch the critical degree of destruction, for which the proportion of successive payments becomes rather low, and to monitor the value of integrated graph metric for this critical situation. Such approach gives an opportunity to verify the graph model suggested and effectiveness of integrated metric developed.

Findings – It was demonstrated that the most effective for system stability analysis are graph centrality metrics, on the base of which an integrated metric of centrality was developed. The values of this metric for various graph nodes determine the stability of the whole system. The proportion of graph nodes with metric values in different quartiles determine so-called green, yellow and red zones for stability. As a result of this consideration the matrix of system stability control was created, that give a chance to see the dangerous situation before it results in system failure and breakdown.

Originality/value – The approach presented in this paper is completely original, developing the earlier research carried out by authors and presented in their previous publication. The system of electronic money turnover control is also considered in comparison with cloud storage information system and content exchange between users of cloud systems.

Research/ Practical/ Social/ Environment implications – An important way for such system research development is an applications to different type graph analytic systems. The system may include all the payments within the single city or country or can be constructed as a combination of a few countries systems jointed together.

Research limitations – It should be mentioned that there were no any reality check for approach presented in this paper. The collection a complete set of data for such check is a very complicated problem and require the production potentialities which are not available for authors.

Keywords: graph analytics, crash-tests, electronic money turnover system

The political picture of the world and risks of a digital society

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The purpose – To show that in Russia the digitalization process radically changes the functioning and reproduction of the culture that underlies the national-state identity. These changes involve significant risks of destabilizing the state and its main institutions.

This requires:

1. To reveal the dynamics of changes in the political picture of the world of the Russian networked youth;
2. To determine the factors of the crisis of the national identity of networked youth by analyzing the system of images and symbols associated in their minds with the concept of “Russia”.
3. Justify that the transforming political picture of the digital society is a factor in the crisis of national identity and forms long-term systemic risks.

Methodology– The research is based on the genetic approach (K. Popper, N.D. Kondratyev, V.A. Yadov V.A.), the principle of immanent changes (P. Sorokin); models of cultural dynamics (V. Buhl, K. De Green); synergistic model of social processes (Lotman Yu.M.).

To explain psychological and social processes in the digital environment, a socio-psychological approach to the study of social (Tajfel H.) and national-state identity (Drobizheva L.M.) is important.

The theory of social representations (S. Moscovichi), his interpretation of the specific role and logic of “cyber representations” in social networks and virtual reality are applied. The analysis of the structure of social representations was carried out within the framework of the structural approach (J.-C. Abric and K. Flaman).

Findings – 1. The results showed negative dynamics of social well-being and trust in political institutions, ideologies and leaders of Russia. The values of the main indicators of the political picture of the world are concentrated near the origin of coordinates, which indicates the weak stability of assessments of the existing political system. Such localization of numerical value is capable of becoming a bifurcation point under these conditions.

2. The urgency of the problem of the crisis of national-state identity in the historical and cultural context is shown. The growing polarization of young people in the perception of their country reinforces the problem of weakening the identification mechanisms of citizens with their country.

Originality – The political picture of the world is presented as a projection of a subjective semantic space, explicated into political consciousness, containing a set of features organized in a certain way that describe and differentiate attitudes towards a country, institutions, leaders, ideologies.

The analysis of associative images, values, social ideas about Russia of young users of social networks using projective techniques is carried out.

The dependence of national-state identity on social ideas about one's country, which are being transformed in the context of digitalization of all spheres of life, has been substantiated.

The deformation of social representations of networked youth towards their simplification and internal inconsistency was revealed, which indicates the delayed risks of instability of social systems.

Research implications – Taking into account the ongoing crisis of the national identity of young people, manifested in the weakening of the attractiveness of the values of the Russian statehood, the results of the study may reveal the process of virtualization of state sovereignty, its shift towards segmentation. They will also help to clarify the understanding of the mechanism of social thinking, which is responsible for the choice of identification images, and predetermines the strength and direction of political attitudes that affect the political stability of not only Russian, but also other modern states.

Research limitations – To continue the study, the toolkit needs to be improved:

- 1.determination of the criteria for creating a hierarchy of systemic socio-political risks of a digital society, which are deferred;
- 2.construction of indicators to identify the still unmanifest consequences of the deformation of the political picture of the world;
- 3.selection, using determinant analysis, of the characteristics that determine the belonging of groups of respondents to a particular picture of the world.

The array of data needs to be replenished to identify the dependence of various risks of a digital society on the dominant groups - carriers of certain pictures of the world.

Keywords: picture of the world, social representations, identity, risks.

Social Variety and the Crisis of Management in the Modern World

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The purpose – To reveal the contradiction between the development of social systems and management capabilities in the context of global changes, as well as the associated risks of instability of the nation state. To show the trends of ongoing changes using the example of social representations of the Russian networked youth. To substantiate the conditions for resolving this contradiction.

Methodology – The authors draw on the basic principles of cybernetics (St. Beer, C. Shannon, W. Ashby), including “the law of requisite variety”; “diverse” concept of information (B.V. Biryukov, A.D. Ursul); conclusions of the theory of catastrophes and functional analysis on the relationship between stability and complexity – “the principle of fragility of the good” (V.I. Arnold and L.V. Levantovsky). For an empirical study of the characteristics of youth perception of their state, the theoretical model of political perception (E.B. Shestopal) and the theory of social representations (S. Moskovici) were used.

Findings –

The growth of the degree of diversity of social systems gave rise to a contradiction between the need for management and the “the law of requisite variety”, and attempts to solve it by increasing the degree of diversity of governing subsystems came into conflict with the “principle of fragility of the good”. In turn, attempts at global governance came into conflict with the development of social systems.

There are two ways to exit:

1. simplification of managed objects while expanding the scope of management, which is tantamount to their degradation;
2. reduction of the sphere of management due to the transfer of a wider range of issues to the sphere of self-organization.

The modern world is moving along the first path.

Originality – The concepts of development and degradation of social systems are divorced. The danger of attempts to expand the sphere of management, which creates risks of degradation of modern states and humanity as a whole, with possible catastrophic consequences is shown. The conditions are formulated under which it is possible to resolve the existing contradictions and reduce risks. The conclusion is made that development is possible only in conditions of increasing the degree of diversity by transferring responsibility for solving growing problems from the sphere of management to the sphere of self-organization. The deformation of social representations of networked youth in the direction of their simplification and internal inconsistency is revealed, which indicates the postponed risks of instability of social systems.

Implications – The approaches and conclusions formulated in the work will serve as the basis for further research in the management of social systems and the natural environment, the choice of ways to ensure their development and keep them from degradation. The results obtained will also stimulate further research on the techno-humanitarian imbalance, the gap between technological optimism and social pessimism, which is increasing in the context of digitalization of life and social constraints that determine the transformation of the national-state identification of citizens and generate socio-political risks of a delayed nature.

Research limitations – The conclusions drawn require further development and substantiation. This is especially true for the problems of deformation of social representations, identity and their connection

with the tendency to expand the sphere of control at the expense of social unification. The study of the risks associated with the displacement of real social relations into the virtual space and new possibilities of manipulation, including transboundary ones, by the public consciousness is largely pilot and requires expanding the sample and obtaining the dynamics of the changes taking place.

Keywords: Information, diversity, management, development, social perception, identity.

Improvement of Traffic Control on a Complex Crossroads via Sending Randomized Recommendations to Drivers

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The purpose – Complex crossroads, especially intersections of multi-lane highways play a great role in urban traffic and their inefficient usage they may almost block the traffic in vast segments of road networks. Analysis of real intersections and traffic organization on them shows that traces for some lanes within an intersection split and even may merge with other traces on some phases; besides, typical traffic organization around an intersection includes changes of lane counts on entrance and exit roads. For efficient use of an intersection capacity it is necessary both to work out the adequate control by traffic lights regulation and achieve rational adaptation of the drivers' totality to current traffic organization and control.

Design/methodology/approach – The paper proposes a way to organize a feedback between monitoring of the current traffic flow through an intersection and drivers' behavior in the aspect of route choice in the vicinity of the intersection. The monitoring data treatment reveals the average fractions of passage directions for vehicles entering the intersection.

The aim of the control system is to provide the distribution of drivers between lanes according to their desired directions of passage; it is proposed to achieve this distribution by sending impersonal recommendations to drivers of approaching vehicles depending on their desired passage directions; these recommendations must randomly change in time according to the determined distribution.

Findings – The proposed control method can significantly reduce improper lane choice by drivers, including their principal errors not allowing them to reach the needed road. As a result, it must increase the intersection capacity utilization and reduce traffic delays. To substantiate this assertion in some possible cases and to find reasonable values of control variables, numerical experiments were performed thereof based on traffic simulation via its representation as a hybrid system; this model type that was recently proposed and tested by the author and his colleagues.

Originality/value – The proposed approach and its substantiation includes three ideas. The first is the detailed graph-theoretical representation of an intersection and its surroundings and traffic organization on them, including traffic separation schemes by phases of traffic lights cycle. The second is the original microscopic model of traffic flow through the intersection area in the form of stochastically perturbed hybrid system. The proposed way of traffic control by sending impersonal recommendations to drivers is an original idea too based on the first ones as well as on specific treatment of monitoring data; its value consists in affecting behaviour of the drivers' totality to improve the local traffic situation.

Research/ Practical/ Social/ Environment implications – Practical implications of the introduced approach is that it proposes an instrument for traffic control systems that can increase the positive effect of other control methods for a current traffic situation. Potentially, by calculations of its possible effect for typical traffic situations via computer simulation, it may yield arguments for changes of local traffic organization. Both social and environmental implications result from the expected impact of the method implementation on time waste and comfort of drivers and passengers and reducing air pollution.

Research limitations – The approach demands enough high level of monitoring. It assumes that traffic is the flow of independent vehicles. It is not applicable if traffic mainly consists of coordinated movement of vehicles' successions or contains a great share of public transport means.

Keywords:

Road traffic control. Traffic organization. Multi-lane highway. Road intersection. Driver behaviour. Simulation.

Notional models based on primary mental abstractions

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The purpose – The purpose of the article is to research a semantically invariant method of modelling subject domains based on the use of primary mental abstractions of identification, generalization, and association. The modelling process does not depend on any subject area, but is determined only by human abstraction abilities.

Design/methodology/approach – Notions are modeled, but not concepts. A notion is an abstract objective concept, and a concept is a concrete subjective notion. There are different notions belonging to the same concept. A notional model consists of a notional structure and descriptions of notions included in it. The notional structure is defined as a set of notions formed by mental abstractions of identification, generalization, and association. A description of a notion is a set of other previously defined notions.

Findings – Using the primary mental abstractions allows increasing the level of model abstraction, improving the scalability of information systems and developing an information system, which requires a small number of common algorithms with a small computational complexity. These algorithms do not depend on the subject domain as they are formulated in universal operations on notions.

Originality/value – The refusal to describe associations as relations with different semantic meanings makes the conceptual model semantically invariant (independent of subject areas). This effect is because an association between notions in notional models is a notion that can be used to define other notions.

Research/ Practical/ Social/ Environment implications – The semantic invariance of the modelling method increases the efficiency of describing complex subject areas, as well as the updatability and usability of the notional models. The use of an information system with a notional model increases the transparency of the company's business processes and reduces the risks of ownership of the information system.

Research limitations – The main difficulty in using the notional models is the need to master the new methodology and technology of modelling, knowledge representation and knowledge inference.

Keywords: subject domain, mental abstractions, identification, association, generalization, notional structure, notional model, information

Application of deformed entropy concept to the problems of topic modelling.

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Purpose – The Internet generates a huge amount of data of different types. Analysis of big data became one of the most relevant scientific directions to date while the amount of collected data becomes comparable to physical mesoscopic systems. Correspondingly, it becomes possible to use machine learning methods developed in the framework of statistical physics to analyse such data. Topic modelling is one of such methods. The purpose of topic modelling is to determine the set of hidden distributions in big data. However, in practice, application of topic modelling is limited due to several open issues.

Design/methodology/approach – In this work, an entropic concept for analysis of the results of topic modelling is proposed, which based on application of deformed entropies. The proposed approach seeks for minimum deformed entropy under variation of model hyper-parameters, regularization coefficients and the number of topics. Even though this approach is a grid search method and iterates through many parameter combinations, the problem of computational and time costs can be solved partially by means of renormalization technique.

Findings – It was shown that the principle of searching for the minimum deformed entropy allows tune all hyper-parameters of a topic model simultaneously. Moreover, it was shown that the general shape of Renyi entropy curve can be derived by successive coarsening of a topic model, i.e. by renormalization. In addition, the minimum point of Renyi entropy which was obtained by successive topic modelling is almost identical to that obtained by means of renormalization. It is notable that renormalization procedure provides significant gain in time that is essential when dealing with big data.

Originality/value – Note that the existing approaches for model parameters tuning are mostly based on log-likelihood maximization and allow tune only certain parameters. Moreover, such a tuning demands grid searching which is extremely computationally expensive. Therefore, tuning of topic models on big data is impossible in practice. However, our approach allows to solve partially this problem and tune topic models on big data in a reasonable amount of time.

Research/ Practical/ Social/ Environment implications – Since one of the major problems of topic modelling usability is the necessity to set several parameters, users who might come from social science or commercial text analytics need a method that is able to automatically select parameters. This work proposes such a method.

Research limitations – First, topic models can detect topics that are represented in many documents and poorly identify topics with a small number of documents. Therefore, Renyi entropy allows determining the number of those large topics only. Second, Renyi entropy and renormalization technique were tested only for three European languages, while there are papers on the application of topic models for the Chinese, Japanese, and Arabic languages. Correspondingly, our research should be extended and tested on non-European languages.

Theme 4. Transdisciplinarity of systems sciences and cybernetics: developing areas of knowledge

Alfonso Reyes, Igor Perko, Raul Espejo, Vladimir Lepskiy

In the world we know, a structural and long-term transformation is taking place. Centralization of communication platforms, rapid expansion and the use of artificial intelligence along with major environmental, demographic, sociopolitical and economic shifts are impinging on a major change in our society. This situation demands empowering of citizens to promote economic growth, sustainability, social justice, and political stability. In particular, youth should develop capacities to think and act differently, which requires a major transformation of our education systems.

Decision-takers all around the world in public institutions and private organizations are recognizing the complexity of issues (ecological, social, health, economic, energy, transport, migratory, etc.) and their interrelations. The underlying systems are intricately and intimately intertwined. The current narrative goes around economic competitiveness and focuses on supporting people to act in a digital and virtual economy leaving aside the enormous challenges humankind is facing, some of them existential.

In the last four decades events like Chernobyl, the Global Financial Crisis, the Gulf Oil spilt, Fukushima's tsunami and current pandemic have shown the danger of this lack of consciousness of the potential planetary effects of man-made decisions. Decision-takers need to use systemic approaches to cope with the complexity of these issues and ameliorate their impact in impending global crises. Crisis, in ancient Greek, refers to the breaking of connections.

Within the systems movement, a wealth of conceptual and methodological knowledge has been created that should help in these tasks. The challenge for researchers and practitioners is to make everybody, especially young people aware and knowledgeable of these foundations and proficient in their application. Cultivating cyber-systemic approaches, with their related ontologies, epistemologies, methodologies, methods, tools, and concepts provide ways of thinking and acting that allow developing such a collective consciousness.

The aim of this theme is the cyber-systemic exploration of distinct social areas, and at the same time the search for connections, relations and transverse knowledge. What is that makes education unique in society? What is special to education that requires receiving both holistic attention and the development of particular communication mechanisms? What makes it different to the economic or the transportation systems?

What can be said about the commonalities of these systems in different regions of the world? What can be said about their cross cultural nature? How are they producing their unique hybrid realities? In all areas it is necessary to avoid fragmentation by facilitating the alignment of people's purposes. What is unique about levels of self-organisation and self-regulation in each case? How are they addressing their interactions with their environments? What do their unique perspectives have in common? How to develop trans-disciplinary learning processes?

In a world increasingly requiring interactions, one of the challenges is facilitating self-organization processes for the emergence of desirable values in societies and for the creation and production of related policies from the most local to the most global levels. These are processes, aimed at individual innovation as well as making more meaningful coexistence.

In this theme the invitation is to open debates to explore in specific areas people's wide variety of possible interactions, communications and relationships to make them more effective. Through the investigation of specific institutions and evolving technologies for each of these areas, we foster discussions that guide, enable and facilitate interactions among existing, necessary and available resources to increase society's requisite variety to deal with challenges to areas at different structural levels in different cultural contexts

It seems important to go beyond interdisciplinary approaches to develop a new transdisciplinary way of thinking and acting; a kind of indidscipline in which we must recover Aristotle's practical wisdom. The WOSC Congress is offering a platform for cyber-systemic contributions of group discussions for collective synergy supported by state-of-the-art individual research.

Section 4.1 Redesigning the Education System

Jose Perez-Rios, Clive Holtham, Alfonso Reyes, Aleksandr Kovriga, Nadezhda G. Bagdasaryan

A structural and long-term transformation is taking place in the world. The decentralized communication platforms, the rapid expansion and use of artificial intelligence along with major environmental, demographic, sociopolitical and economic shifts are impinging on a major change in our society. This situation demands empowering citizens to promote economic growth, sustainability, social justice, and political stability. In particular, youth must develop a capacity to think and act differently which requires a major transformation of our education systems.

Decision-takers all around the world in public institutions and private organizations are facing issues (ecological, social, economic, energy, transport, migratory, etc.) of an ever-increasing complexity. The economic and education systems are intricately and intimately intertwined. The education narrative goes around economic competitiveness and focuses on preparing people for the knowledge society in a digital economy leaving aside the enormous challenges humankind is facing, some of them existential.

In the last four decades events like Chernobyl, the Global Financial Crisis, the Gulf Oil split, Fukushima's tsunami and current pandemic have shown the danger of this lack of consciousness of the potential planetary effects of man-made decisions. Hence, decision-takers need to use systemic approaches to cope with the complexity of these issues to avoid global crisis. Crisis, in ancient Greek, refers to the breaking of connections.

Within the systems movement, a wealth of conceptual and methodological knowledge has been created that is adequate for this task. Both researchers and practitioners now have the challenge of making young people aware and knowledgeable of these foundations and proficient in their application.

Today's education system is fragmented and has become very ineffective and inefficient. Redesigning the education system means overcoming disciplinary barriers, intellectual constraints of particular ideologies, promoting new ways of knowledge production and learning approaches, to move from a human-center rationalism towards a planetary-center awareness of the interconnectedness of all human cognitions, what Vladimir Vernadsky has called the noosphere.

Cultivating cyber-systemic approaches, with their related ontologies, epistemological roots, their methodologies, methods, tools, and concepts provides a way of thinking and acting that allows developing such a collective consciousness.

On the other hand, the substantial development of Cognitive and Neural Sciences (CNS) during the last decades has provided crucial empirical evidence regarding human learning. As the CNS fields grow and mature, our knowledge regarding how learning is modulated by contextual and pedagogic interventions tends to expand at an ever-faster pace. A large body of behavioral, genetic, anatomical, neurophysiological, and computational data has accumulated over the past decade alone. The extraordinary development of the CNS is certainly leading to a deeper understanding of the mechanisms underlying successful and failed learning, with great potential to transform the way education is implemented by schoolteachers. This advance in knowledge is expected to impact cultural and economic aspects of the modern society, debunking myths and promoting a science-based transference of knowledge to educational practice.

The changes taking place in technology, market, etc. are affecting the match between the skills that employers (and society) need and those that the persons developed through the education system (what it is "demanded" does not fit with what it is "supplied"). This implies that people should take the responsibility for keeping their skills up to date all lifelong. The conscience about this should be developed through their education process.

Also, the tendency, accelerated by the pandemic, to transform the working modes (ie. working from home, temporary, short duration of specific jobs, etc.) will require a capacity for quick adaptation to this new changing situation. Again, the education systems should prepare people for this new working reality.

Therefore, a holistic approach to this new broad and fast changing landscape is necessary. If stakeholders (employees, employers, teachers, and decision-takers) share this vision, a whole redesign of the education system is mandatory.

It seems important to go beyond multy and interdisciplinary approaches to develop a new transdisciplinary way of thinking and acting; a kind of indiscipline in which we must recover Aristotle's practical wisdom.

We will distinguish between systemic education and the educational system. The first concept refers to the learning and teaching processes as well as the contents needed to embody systems thinking and holistic behavior in our daily living. The second focuses in setting the organizational capacity needed to have an effective educational system.

Both dimensions can be observed along a life spam of a person. We can recognize four stages for learning: childhood, primary and secondary education (k12), higher education and life-long-learning (adulthood).

Of course, there are additional questions that cross all dimensions, such as: How can we articulate every stage of learning? How innovation, information technology (MOOC, Kahn Academy, etc.) and the use of artificial intelligence permeates all stages of learning? How can we develop the ability of learning to learn in a complex changing environment? What is the purpose of education in each of these dimensions? What is the systemic nature of educational relations that allows the emergence of new learning ecosystems?

The main goal of this section is to define key problems and an agenda for a cyber-systemic research and development for reshaping the future of education.

We invite contributors who may want to present innovative ideas, conceptual frameworks, methodologies or case studies (experiences) that may illuminate alternatives to address these or similar issues from a cyber-systemic perspective to send their proposals to WOSC 2021.

Discussion points

- How to introduce Systems thinking in education? Elementary and High School; Undergraduate (universities, colleges); Post-graduate (Master and doctoral); Life-long learning; Consulting companies, etc.
- How to handle inter and trans-disciplinarity.
- How can people be prepared for the huge impact of artificial intelligence? How can artificial intelligence (AI) help teachers in their tasks?
- Development of a global ethics for citizens of the future
- How to develop an adaptation capacity for the education system (Formal, Informal, Free open courses etc.)?
- What could be the strategies to permeate diffuse Systems Thinking in society? How can systemic education be present in: Education; the Press; Media (TV, etc.); Social networks?
- Experiences. Success stories of systemic learning in academic and non-academic institutions.
- How can holistic visionary and responsible future-thinking in planetary scale may become an organic part of universities curriculum?
- What kind of knowledge, research projects and institutional building initiatives for promotion of that issues can be developed within communities of systems movement?

Systems Engineering in the Modus of Cybernetics: the concept of educational organization

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The purpose – an attempt to answer the question: how should the education system respond to the challenge of modern technological development? Moreover, what managerial paradigms are capable of forming a fundamentally new system of engineering education?

Design / methodology / approach – This research task can be solved by resorting to the methodology of interdisciplinarity and a systematic approach based on modern ideas about managerial cybernetic influences. The world of modern technologies can be adequately described in the terminology of cybernetics (second-order cybernetics) as a universal interdisciplinary field of research, combining control systems with various technological processes, including social processes

Findings – It seems extremely problematic organization of engineering education, which is based on the subject diversification of technical knowledge, forming a discrete view of technological objects. The transition to a systemological representation of objects with the properties of emergence, or super-additivity, that is, the irreducibility of complex systems to simple ones, requires a fundamental transformation of the organization of education. The conceptual novelty of this process - in changing the professional role and pool of competencies of engineering specialists - from instrumental rationality to activities in the interests of the social system.

Originality / value – The question of the future of human civilization is related to the prospects of technological innovations included in the discourse on their consequences. These consequences should be foreseen both for humanity as a whole and for forecasting the socio-cultural and institutional aspects of development. The 21st century, weighed down not only by fantastic technological achievements, but also by the problems created by people on their basis, has put mankind before the main question: what changes in the geopolitical structure, in science and education, in the organization of social life at the state and private levels can lead to new technology?

Research / Practical / Social / Environment implications – People for whom engineering is the essence of their profession create the technological equipment of the modern world in the process of engineering. With the formation of this profession, the dominant aspect of technical rationality has developed, which involves the use of all means available to a professional leading to success. Utilitarian thinking does not even raise the question of the boundaries of the use of these funds, of their admissibility in the aspect of the interests of society. The leading motive for the engineer is the demand for the technical product he created on the market. Just as a criterion for the success of a university is the demand for its graduates in the labor market. That is, universities are institutionally market oriented. But not a society that is interested in environmental, technological and other safety. Such a disproportion of values and motives requires consideration through the prism of modern requirements for creators and carriers of technological ideas of a new model of engineering education as a key institution that forms the image of a future society.

Keywords: engineering education model, emergence, consequences of technological advances, Cybernetics

Systemic Design: teaching systems thinking to engineers

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The purpose – The purpose of this paper is to share the design of an undergraduate industrial engineering course whose goal is to introduce students to the use of systems thinking for designing solutions in real life problems.

Design/methodology/approach – The “Systemic Design” course was conceived during a curriculum redesign process based on the CDIO framework, which “provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating (CDIO) real-world systems and products” (CDIO, s.f). It specifies learning outcomes; this is “what students should know and be able to do at the conclusion of their engineering programs, which include knowledge, skills, and attitudes intended as a result of engineering education” (CDIO). From the CDIO framework, this course aims to develop, among others, the system thinking skill.

The course was designed using the DSRP framework (Cabrera et al., 2008) as a guide to explain what we consider are the basic elements of system thinking. Thus, each DSRP element is related to a system thinking methodology that is reflected upon on the course syllabus. We use case-based learning with current real issues (not just fictional cases), so students can see the useful nature of systems thinking in their environment. The theory and the application of each methodology are interspersed, so that students get to make use of the concepts as soon as they learn them.

Findings – The design of the course promotes, at least in some basic level, the habits of a systems thinker described by the Waters Center of Systems Thinking (2020), as shown in the following table.

Meadows (1999) considers paradigm changes as the second most powerful leverage point to intervene a system, because she believes people have shape the way any system works. Therefore, helping our students see things in a different light (i.e. in a systemic way) can have such an impact in the way they identify, formulate and solve problems as engineers.

An example of this is the final exam, where students get an unstructured case and must identify a specific problem, define a design objective, choose a systems thinking methodology that best suits the situation and problem, and explain how they would apply it, in a justified manner. According to the final exam grades, most of the students (82% and 62% in the two course versions, respectively) achieved proficiency in approaching problem solving from a systems perspective.

Originality/Value – The combination of methodologies promotes cognitive skills and habits that enhance a better understanding and application of existing systems thinking tools focused on the design of practical solutions, and therefore we believe most of our students show a shift in perspective towards a more holistic approach.

The course itself is viewed as a social system, that we as teachers design and constantly redesign. It also belongs to a bigger social system: the industrial engineering program. Being aware of these multiple recursion levels helps us keep a holistic view of what we do, and how our actions not only affect our students but also other courses.

Research/Practical/Social/Environment implications – This paper presents the design of a course that helps to develop system thinking skills and habits at an undergraduate level. We are sharing our experience so other educators can learn from our story and create their own. From a teaching and learning perspective, this constitutes an opportunity to broaden the use of systems thinking methodologies for individuals interested in this field.

Research limitations – This course was implemented for the first time in the second semester of 2020; there have only been two versions of the course so far. There is still a lot more to learn and adjust as we continue our own learning process.

Keywords: System Thinking, Teaching, Course design, Engineering, DSRP, CDIO

Practical wisdom for addressing contested problems

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The purpose – The modern university as envisaged by Humboldt (Günther, 1988) aimed at holistic education of an elite. However, this dream was soon undermined by the ongoing prioritisation of discipline-based excellence in research, which has increasingly provided a barrier to systemic approaches. Universities prioritising disciplinary knowledge without wider practical wisdom are unable to address the most pressing problems of societies globally. This paper addresses this fragmentation shortcoming and the relationships of universities with their stakeholders.

Design/methodology/approach – The authors have developed a conceptual framework (Figure 1) which starts from the articulation of often ambiguous values by different stakeholders (social, academic, state) and how those values shape (both positively and negatively) the three key outputs of HE, namely skills, knowledge and practical wisdom. (Aristotle & Crisp, 2014). Focussing then on the pedagogic design process (Goodyear, 2001) emerging from viable, as far as possible, non-hierarchical university structures, aimed at holism and the inclusion of stakeholders through the creative design of their relationships. We start from a situation where often there is resistance, to significant change and where resources need to be devoted to the infrastructures of change itself; too often taken for granted in universities.

Three contested problems are highlighted, in all of which a university could and should excel in terms of solutions, but in none of which (in the UK) is there much indication of significant progress.:

- Active citizenship (relationship with communities)
- Sustainable development (relationships with society's ecology)
- Inclusive justice (relationships within university set ups)

It is planned to explore one of these three areas as a worked example in terms of articulating how the 21st century university can undergo reformation to enable it not only to address the wicked problems faced by society generally, but also reformation to enable it to change itself as a precondition of enhancing the wider social impact. The exploration will focus on values and structures for change.

Findings – 1. 19th and 20th century universities were not designed to address wicked problems, and have proved themselves unable to do so. Both whole systems and individual institutions need reformation (based on values as explored in the above figure), but the most likely initial progress to be made is by bottom-up institutional initiatives through exploring global, academic and state structural and complexity management changes.

2. Bottom-up can succeed – the tiny and short-lived Bauhaus provoked international reform of design education, for example

3. Universities have privileges (critic of last resort, ability to experiment) which in times of crisis need to be activated.

Originality/value – Combines a study of historical and relationships changes intertwined with the academic and societal results of inability to address, let alone solve, wicked problems.

Research/ Practical/ Social/ Environment implications – This is important for policy-making at institutional, national and global levels.

Research limitations – It needs still more peer review which WOSC 2021 can provide.

Keywords: Education systems reformation, transdisciplinary, “global & local viability” [sustainability, justice, peace]; Wicked problems; Practical wisdom; variety management/power relationships

Education for the Twenty-First Century

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The purpose – There is a profound and far-reaching transformation in the world. Many are the factors and their interrelations playing a role in it. Some are technological as decentralized communication platforms, increased use of artificial intelligence. Others are socio-economic, as are migratory movements or globalization. Others might have an even more profound global impact as climate change, pandemics, or the diminishing variety of living species. All those issues and their interrelation configure a situation of extreme complexity. Our reflection aims to explore how those issues can be taken into account in the education systems.

Design/Methodology/Approach – In 1970 Conant and Ashby indicated that for managers to have the capacity to regulate (to manage) a system, they must have a model of that system. Furthermore, this model has to be able to deploy an amount of variety (an indicator of complexity) at least equal to the variety of the system they pretend to manage. This consideration takes us to the core of our reflection: the necessary redesign of the education system to get that the persons acquire the required capacity to handle the complexity of the situations they will face.

We have the challenge of educating the human mind to cope with current and future world issues considering the relation between values, education, and new technologies. There are various attributes for a person's mind to be developed, such as creative, disciplined, ethical, respectful, or synthetic capacities. The education system should contribute to developing them. So, an important question is how to educate and empower citizens and develop critical thinking. We have an ambitious aim: to empower the human mind to build on the benefits that the fast-developing technological progress may provide but simultaneously overcome the challenges that communication technologies and large-scale automation present.

Findings – Just as an example of an experience in that direction, we will comment on how various tools are being used in a public university to help students face several kinds of complexity: dynamic complexity, structural complexity, and group decision-making complexity. They are related to various systems thinking approaches, as are, among others, System Dynamics and Organizational Cybernetics.

Originality/Value – Including matters, as are systems thinking approaches in academic studies, particularly in engineering and economics, is scarce. So, the case presented is an example of an initiative to filling this gap.

Research/Practical/Social/Environment implications – The implications to society are significant given the scales of the problems indicated above.

Research limitations – In this reflection, we refer mainly to a reduced group of systemic approaches, particularly Organizational Cybernetics and System Dynamics. The case commented refers only to some concrete studies in one university (the University of Valladolid in Spain).

Keywords: Education; Systems Thinking; Organizational Cybernetics

Design education as an organic project of ontological design: Towards the education of transition designers

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In ancient Greece, the split between the sensible and suprasensible realm, and the ensuing vanishing of *tékhnē* ---the careful disclosing (revealing) of what ever is the case--- paved the way for the emergence of design as the controlled act of disclosing, a mode of revealing which following Heidegger we will call technical (enframing). Thus, the historical figure of the designer emerges as opposed to that of the artisan (*τεχνικός*), and the history of design could be narrated as the history of the vanishing of *tékhnē* and the emergence of design prominently embodying a process that will culminate in the modern era with a mode of disclosing according to the imperatives of ordering, control and efficiency that aims to reduce all things and relationships to mere resources (Bestand) awaiting optimization. The current system of design education continually reproduces this form of technical disclosure, which constitutes an increasingly unviable way of dwelling in the present. Taking inspiration from these heideggerian notions and in the so-called ontological design (Winograd and Flores, 1984; Willis, 2006), a Design Program was created at the University of Ibagué in the year 2015. The design of the program itself has been an experience in ontological design that started from the questions: what type of education/training should a designer receive so that he or she can respond adequately, locally and globally, to a world dominated by a way of being and doing that is destroying the dwelling and the holistic sense of human existence? And, how does the implementation of design that seeks to answer that question go about redesigning the program itself?

Based on the educational experience gathered in the 6 years of existence of this Design Program, we will narrate how the ontological design of this program has evolved an educational model which is weaving a system of relationships between theoretical-pragmatic positions of designing futures and autonomous design, transition design and design of the south, and recently, second-order speculative design.

This organic unfolding is aimed at educating transition designers involved in the transformation of communities ---fully inserted in a technical mode of revealing--- into communities that, driven by a care-full mode of disclosing aim at constituting a dwelling environment in the midst of the de-futuring anthropocenic epoch of the present.

Ontological de-fragmentation: A second order cybernetical University Response

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We live in an age characterized by a loss of the ability to make holistic sense of human existence. We have come to construct a great dynamic puzzle, of multiple pieces that multiply continuously in their diversity and that we do not really know how they fit together, nor what they are all pointing at.

The traditional role of the university, namely, to be the lighthouse that guides society is now being questioned at its most profound level. What is the university we most need for trouble times like these of the present. In this article, we will argue that the university we need in this age must seek to understand/address the systemic challenge that this fragmentation poses in three major headings. Knowing: more and more disciplines multiplying the pieces of the puzzle of reality, thus raising to unmanageable levels of complexity the task of making scientific sense of the whole.

Being: the prevalence of a way of being that is taking the human race and the planet to the edges of its complete unviability.

Doing: designing solutions, to ever increasing complex situations, at the global and local levels, that precisely reinforce the constitution of an unviable and holistically meaningless world. To this end, the university we need must begin by mapping the phenomenal manifestations of this fragmentation in order to gradually advance in the understanding of the onto-epistemological background that constitutes the conditions of possibility of these manifestations. But insofar as this knowledge is constitutively connected with being and doing, the necessary university cannot be thought of only as a great scientific project of the creation of a transdisciplinary science that allows the meaning of the whole to be revealed.

Such a university would be paradoxically seeking to de-fragment on the basis of fragmenting the relational constitution of being and doing. In other words, it would be separating reflection from action and feeling. In this article we will describe the project of a university proposed by researchers at the University of Ibagué, that seeks to comprehensively address (in its teaching-research-extension) the phenomenal manifestations of fragmentation.

We will seek to complement this project by showing how in this de-fragmenting university it will be fundamental to turn to its own becoming (a second-order cybernetic overturning) to help reveal the onto-epistemological conditions that make fragmentation possible and to indicate how this revealing will be incarnated in the university's everyday life.

Enabling Inclusive Curriculum Transformation at a Private Higher Education Institution Using a Cybernetic Approach

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The purpose – In 2015, the United Nations announced the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs). In terms of education, goal 4 is aimed at ensuring inclusive and equitable quality education opportunities for all. Goals 10 and 16 are aimed at reducing inequalities and achieving inclusive societies. Progress in meeting these goals is slow. The UN suggests that renewed efforts are required to improve equity, access, and quality of learning. Societies which have significant inequalities would need to reassess their approaches in terms of education if they are to meet these goals. In South Africa, this was highlighted during the 2015 #feesmustfall student movement where there was a call to “decolonise” education. The call for decolonisation of education had arisen due to the lack of transformation at institutions of higher education. Research alludes that while public universities are currently being decolonised, there currently does not exist a decolonisation and transformation strategy for private Higher Education Institutions (PHEIs). In attempting to address this shortcoming, the purpose of this study is to explore ways to transform the curriculum at a Private Higher Education Institution in South Africa in line with the SDGs identified by the UN. This article explores methods to initiate the, often emotive, transformation conversations of curriculum decolonisation and unpack some of the obstacle’s academics are facing with these transformation goals.

Design/methodology/approach – A Cybernetic perspective is followed that is based on Gordon Pask’s Conversational Theory. Conversation Theory is used as a framework as it provides dialectical tools that may encourage discourse and reflection amongst the educators, students, and other interested participants. By engaging in open reflexive conversations, learning about one’s own and others’ learning and understanding becomes a guide in transforming the curriculum. A cybernetic approach that caters for a multiverse of worldviews is attempted to enable inclusive curriculum design. The process follows a heterarchical layout whereby all role players are seen as equals in the curriculum design.

Findings – The findings of a pilot study conducted suggest that some students and academics at the PHEI are still unsure of what curriculum decolonisation entails and how it may be achieved. Academics agree that institutions are central in creating a more sustainable future and hence PHEIs have an important role to play in society; however, many academics are lost and do not know how to go about transforming a curriculum to improve equality and access. A useful finding was that curriculum decolonisation and transformation would rely on a new generation of citizens through community projects and engagement. By incorporating the voices of the communities, PHEIs will not only be developing sustainable partnerships but will be adopting a multidisciplinary approach to curriculum decolonisation.

Originality/value – Cybernetics has successfully been used as a framework for decolonisation and transformation of public university curricula, but this is the first time it is used in the private sector.

Research/ Practical/ Social/ Environment implications – For universities to make a meaningful contribution to society, fostering a sustainable future for all citizens awareness and active involvement is needed to reach the SDG goals, particularly where there are inequality and lack of access to quality higher education.

Research limitations

The findings from this study reflect a South African society, however, social justice and inequality are also relevant topics in other multicultural societies.

Keywords: Private Higher Education Institution, UN SDG goals, social justice, sustainable development, transformation, Conversational Theory

Empowering Colombian Rural Adolescents to Advocate for Community Well-being through Citizen Science.

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The purpose – This paper aims to evaluate the relationship between healthy lifestyles and characteristics of the built environment, using the Our Voice Citizen Science Model, a systemic approach which utilizes information and communication technologies to empower adolescents to: 1) collect data about the factors of their built environment that facilitate or hinder community well-being, using smartphones with the Healthy Neighborhood Discovery Tool mobile application; 2) identify relevant stakeholders of the system that could address these issues; and 3) advocate for local improvements that allow the community to enjoy increased well-being. It also presents an advance in the Our Voice methodology by incorporating Natural Language Processing as a tool that could enrich the qualitative analysis and enable citizen scientists to make data-driven proposals

Design/methodology/approach – Santa Ana is an Afro-descendant rural population of the island of Barú. Eleven adolescents aged 13 to 17 years from the research club of Santa Ana Educational Institution, were recruited to be citizen scientists and conducted walks within the school to collect data about their perceptions of the influence of the built environment on the well-being of the school population. Then, they found common themes, set priorities to improve community wellbeing, reached agreements on actions to be taken by school stakeholders and we monitored the results. Also, we applied Natural Language Processing (NLP) to find patterns in the participants' comments and identify efficiently insights on the barriers and facilitators exposed by them.

Findings – Furniture, bathrooms and infrastructure in poor condition were the main barriers to well-being within the school. Citizen Scientists reached agreements on concrete actions to address identified barriers, including foster a care culture for the school's infrastructure led by teachers, principals and students and present the results to the action board. When monitoring the results and actions, The Amor por Barú Foundation arranged actions related to the barrier of danger and risk of personal injury, a ripple effect emerged within teachers as they replicated this methodology in their classes in other degrees, and the students are taking more collective actions with community groups like the fishermen's group and the community board, and participating more in the student council. We found that the barriers associated with positive or neutral emotions and the facilitators associated with neutral emotions are proposals for improvement. Also, we found that the most frequent words and the word network provide information about barrier and facilitator groups that can provide important insights to guide conversations in community meetings or complement the results that emerges from them.

Originality/value – The Our Voice in Barú study is the first of its kind in a rural afro-descendant context.

Research/ Practical/ Social/ Environment implications – This work could have applicability to other rural communities, and could inform future interventions aimed at solving these problems, both in Colombia and elsewhere. The use of this systemic methodology allows participants to observe their system, be empowered to think about problems holistically, and create synergies between the actors involved in order to guide actions that consider the needs of all the system agents. In addition, The use of NLP enriches the Our Voice process by increasing its scalability in terms of the number of participants, walks, and audios and texts length.

Research limitations – This study had its limitations. First, although the selection of participants was random, the selection was made on the research group of the college. This could make the findings biased when coming from people in the same group. Second, we were unable to fully monitor the

action plan as the school's activities were suspended due to the pandemic caused by the COVID-19 virus. We were only able to speak with the principal and it was not possible to organize interviews with students and teachers to get their point of view. Despite these limitations, we found very valuable information that informed the school to make decisions that seek to increase the well-being of its community.

Keywords:

Citizen science, rural area, systemic approach, well-being, healthy lifestyles, built environment.

Learning Projects: A Systemic Approach to Learning Ethics and Empowering Students

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Purpose- This paper presents the systematization of the learning projects developed by students attending a Professional Ethics course, part of the General Education Program at the Universidad de los Andes (Bogotá, Colombia). Learning projects are innovations proposed by the Center for Applied Ethics (CEA) to foster ethical deliberation throughout the curriculum.

Design/Methodology/Approach- Applying a systemic approach, we rethink higher education through practice. Two features of the course design are remarkable. The first is Problem-Based Learning (PBL), a methodology in which students carry out the process of inquiry about a specific open problem given by teachers. The second feature, the learning project, allows students to develop an inquiry around their specific interests in Professional Ethics. Both features foster autonomous and collaborative learning. Thus, the methodology we have chosen for this qualitative research is the systematization of practice because it allows us to make a critical, reflective, and dialogical recount of the experience (Jara, 2015), reflecting on the different stages of the process, and recording the successes, failures, difficulties, and opportunities for improvement (Sánchez, 2010).

Findings- The most important finding relates to the reach of students' commitment with their own learning processes, since they explore what they have chosen to learn with their peers, in an autonomous and collaborative way, while designing and developing their own learning plan. On the other hand, students, through the construction of the learning project, realize they are doing a process of self-reflection and analyzing the ways in which they are individually and collectively involved in the topic they investigate, and how they can change their ethical behaviors and attitudes from that initial understanding.

Originality/Value- Much of the originality of this work derives from the learning projects as instruments to promote a democratic learning environment, student empowerment, and student ownership of the course's learning outcomes. Learning projects promote an inquiry that goes beyond the process of formulating a research project in the context of a classroom; students go beyond applying some research instruments to see what others do or say about an ethical problem, since the learning experience implies a process of self-reflection and reflection about others within the framework of the chosen problem.

Research and Educational Implications- The most important implication of this systematization work is that it offers to the research community practical examples of how to do research about the ways ethical reflection occurs within the classroom, as well as some key findings about students' ethics-related learning outcomes.

Research Limitations- A major limitation of this research is the impossibility to trace systematically what happens with students' learning and reflections beyond the context of the course.

Keywords- Teaching Ethics in Higher Education, Project-Based Learning, Curriculum Innovations, Learning Outcomes.

References

Jara, O. (2015). La sistematización de experiencias produce un conocimiento crítico, dialógico, transformador. *Revista Docencia de Chile*, (55), 33-39. Recuperado de <https://cepalforja.org/sistem/bvirtual/wp-content/uploads/2015/06/Entrevista-Oscar-Jara-Revista-Docencia.pdf>

Sánchez, A. (2010). El artículo sistematización de experiencias: construcción de sentido desde una perspectiva crítica. Revista Virtual Universidad Católica del Norte, (29), 1-7. Recuperado de <http://revistavirtual.ucn.edu.co/>],

Teaching systems thinking to deal with complexity in Project Management.

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The purpose – We argue that Project Managers should be trained to deal with complexity, and we suggest how to develop professional competences to lead complex projects. We explain our experience, as we teach Systems Thinking in the Master of Project Management at the University of Valladolid (Spain).

Projects in the 21st century are becoming more and more complex because of variety (technologies, deliverables, stakeholders, etc. and interactions among them), ill-defined project scope, uncertainty, multidisciplinary teams, etc. However, classical project management standards and methodologies emphasize planning and control, and are mainly based on breaking down the problem into smaller, independent parts. Thus, the Project Management textbooks are full of "Breakdown Structures BS's": Work (WBS), organization (OBS), risks (RBS), etc.; Excellent tools for complicated but not complex projects!.

Design/methodology/approach – First, we explain how the project management community has dealt with project complexity. Then we share our experience teaching complexity and systems thinking in the Master of Project Management (University of Valladolid, SPAIN).

Findings – Our students' first contact with the concepts of systems thinking and dynamic complexity opens them up a set of possibilities to think that they had never imagined before. Students improve their competences through building dynamic models and playing with Spatium Simulator, a game simulator specially developed for project management training. Students are also encouraged to see a project as a "temporary organization" and therefore, to apply the viable systems approach for managing complex projects. Finally, they analyze how some of the professional competences described in the IPMA (International Project Management Association) model can help them to deal with improving their skills to deal with complexity.

Originality/value – Although project complexity is a recurrent topic for project management academics and researchers, in practice, it is difficult to find proposals to improve students' competences and to see teaching experiences. We try to fill this gap. In this paper, we describe our findings and experience after 15 years, including the feedback from our current and former students, some of them working as CEO's and executives in their firms.

Research/ Practical/ Social/ Environment implications – Project complexity has grown dramatically during the last decades. According to several estimations, more than 40 % of the economic value will be delivered through (complex) projects during this decade. We propose a way for increasing professional competences, using the main ideas from the Systems Thinking approach.

Research limitations – The main findings of this work are contingent on our experience in the University of Valladolid, after 15 years teaching students of the Master of Project Management and other experiences, not only in universities but also training project managers working for Small and Medium-Sized firms.

Keywords: Project Management; complexity; systems thinking; professional competences.

Socio-humanitarian technologies of education of the future: philosophical and methodological basis

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The purpose – This paper focuses on the problem of integrating the value-target internal orientations of scientific activity in their correlation with social goals and values, preconditions for the transition from technogenic to socio-humanitarian civilization. The purpose of the study is to research the philosophical and methodological basis of socio-humanitarian technologies of education in 21st Century. The article examines the subject and polysubject approaches to the organization of education in the information society. The problematic of environments and ethical systems in the context of the education of the future is explored.

Design/methodology/approach. The research concept is based on modern philosophical and methodological approaches, which focus on self-developing polysubject environments. Post-non-classical ontologies of educational processes are considered and an interdisciplinary approach is used as a system for integrating knowledge about the research topic.

Findings – The conclusion of the study is the initial bases for the development and implementation of the social and humanitarian technologies of anticipatory education. It is shown that it is possible to successfully solve some problems of education through the development of socio-humanitarian technologies, the consolidation of the state, business and society, subject-oriented models and digital platforms.

Originality/value – The originality of this research is in the initialization of the basis for the development and implementation of the social and humanitarian technologies of anticipatory education. The article substantiates the need to educate specialists looking to the future for the no shock transition from technogenic to socio-humanitarian civilization.

Research/ Practical/ Social/ Environment implications. – Research implications basically refer to impact that research might have on future policy of government authorities, scientific organizations and corporations in the development and application in practice of socio-humanitarian technologies of education.

Research limitations – The main limitations of this study are connected to the subjective nature of many of the used concepts and with a low level of evidence.

A new organizational form for a transdisciplinary university - The case of Unibagué

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Fragmentation is one of the main characteristics of modernity. Divide and conquer, tends to be the main heuristic to tackle complex problems. It has been a quite successful strategy to develop science and foster technology. However, at the same time it is the source of many unintended and undesirable consequences of human development: from global warming to social inequality. In a highly interconnected world, fragmented thinking is a recipe for disaster because problems arise as unsolvable dilemmas. The current management of COVID-19 pandemic is a dramatic example.

It is widely accepted that complex problems cannot be fully understood from a specific discipline, we say that we need an interdisciplinary way of thinking to tackle them. I think, we need to go even further and approach them from a transdisciplinary perspective. This paper explores the role of universities to promote a transdisciplinary way of thinking and acting. To achieve this, their main primary activities of teaching, researching and extension should be redesigned as well as the mechanisms used to articulate them. The process of this identity transformation is illustrated with the case of Universidad de Ibagué, a small private regional university located in the center of Colombia.

Systems engineering approaches and tools for redesigning the higher technical education system

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Nowadays, in software, electronics and automotive industries, it takes 1.5-2 years for a new product to appear, although it takes 5, 7 or even more years to develop new space instruments. The update of higher education system standards is even more conservative. It takes 10 and more years. Because of this, graduates come into industry with outdated knowledge. Thus, the problem is to synchronize the processes of updating technologies that ensure creation of innovative products with educational programs. It can be solved by changing the paradigm of products creation based on the synthesis of deep and interdisciplinary educational, scientific, innovative and production activities with the model-based systems engineering (MBSE) software and methodological tools (SMT).

The existing SysML-based MBSE software (SW) tools are complex and expensive. The paper raises the question, "Is it possible to make usage of MBSE SMT available to a wide audience of users?" In order to answer this question, was investigated the usage of the following MBSE approaches and tools: Quality Function Deployment (QFD), The House of Quality (HoQ), and Systems Modelling Language (SysML). For each space instrument design and development (SIDD) lifecycle phase (LP) were developed five methodological tools which represent QFD and HoQ improvements and also theoretical and practical algorithms.

The theoretical algorithm determines "What" (input and output data) and "How" (by using which systems engineering (SE; including MBSE) tools) are methodically analyzed at the certain SIDD LP. The algorithm of practical actions automates the development of SysML-diagrams by using data structured in HoQ matrices and widely available software tools. Altogether, the obtained research results constitute the methodological approach (MA) that reduces time to develop and update SysML-diagrams from several days to some minutes, and also gives the opportunity to implement and operate SysML SW by wide audience of potential users. In order to disseminate the obtained results were created the educational and methodological materials.

In leading Western universities SE education is incorporated with products creation. The experience of teaching SE at Moscow Institute of Physics and Technology showed that in order to improve motivation to study and use SE approaches and tools, students must apply them during their own projects implementation. With this goal SE lectures were supplemented with workshops and project work (practicum). Practicum was focused on teaching how to design and develop (D&D) nanosatellites and technical devices in MBSE paradigm, and was conducted for schoolchildren, students and senior managers.

The results showed that the application of the developed MA "improved QFD for improved HoQ" (iQFD for iHoQ) makes it possible to implement the lifecycle of cyber-physical system in MBSE paradigm in a cost-effective way and a short time - in 6 months, students developed, conducted synthesis and flight tests of CubeSat-format spacecraft prototype, and prepared reporting documentation. In addition, each participant was motivated to study STEM disciplines, MBSE approaches and tools, and become a transdisciplinary specialist.

In addition, SysML-models were used to examine SIDD lifecycle phases of different space projects. Such SysML-models application allowed quickly assess project results, identify inconsistencies with requirements, conduct beforehand all necessary corrections and generate correct new product documentation. Taking into account the above-mentioned advantages of the obtained MBSE SMT, it can be concluded that the usage of such SMT improves the quality and accuracy of current projects,

and speeds up the planning process of future analogue projects by up to 60%. Consequently, projects (their lifecycle phases) can be realized faster by 5-10%.

These results allow to recommend for all interested in the development of complex systems to initiate:

- formation of educational programs based on the project-oriented approach implemented in MBSE (SysML) paradigm;

preparation of materials for online and offline teaching of students and teachers;

- development of domestic widely available software for the development of integrated SysML models (that assures synchronization with CAE/CAD/CAM systems);

- support above mentioned research results and these recommendations implementation at Russian educational organizations of different levels.

The future research is focused on the application of the developed MBSE methodological approach “iQFD for iHoQ” during D&D with numerical modelling of several CubeSats and their operation.

Section 4.2 Going beyond silos in medicine and health systems: the time for Systems thinking and Cybernetics

Marialuisa Saviano, Christian Pristipino, Vyacheslav Moiseev, Igor Alekseevich Gundarov

This session wants to offer a platform for the improvement of health services highlighting what systems thinking and cybernetics can offer to go beyond silos in medicine and health systems.

Medical services are subject to increasing costs and are often unaffordable to the most, but also offer huge opportunities to the development of mankind. Service performance needs enhancement and increased improvement. Health services, however, are often fragmented and constrained by a disciplinary divide. Scientific knowledge seems to still fail in contributing to solve complex people's problems. The reductionism prevailing in modern biology and medicine has reached the 'evolutionary bottom', finally decomposing biosystems into the most elementary parts – atoms and molecules. Further development of biomedicine with the contribution of nano- bio, information, cognitive - and Social (NBICS) technologies in the context of the latest industrial revolution (industry 4.0) is possible on the way of evolutionary rise in the levels of organization of biosystems and the return of wholeness in biomedical approaches and theories, i.e. in the framework of system biology and medicine.

To grasp the complexity of these issues, transdisciplinary approaches must be developed taking into account the diversity of scientific and societal views of the problems, linking abstract and case specific knowledge, and focusing on problem-solving for what is perceived to be the common good (Hadorn et al., 2008).

While scientists are still trying to address these methodological problems, the COVID-19 pandemic has exacerbated the consequences of some 'illnesses' of many healthcare systems and calls for urgent holistic cures. It's time for systems thinkers and cyberneticians to answer this call.

By leveraging the power of systems and cybernetic thinking in identifying and framing the invariances underpinning life-related problems and disciplines, new areas of knowledge can be created that build upon a common and unitary view of life and lead to promote prevention as the best cure for effective, efficient, and sustainable health systems.

Discussion points

- Systems and cybernetic thinking for transdisciplinarity in medicine and healthcare
- Systems medicine and network medicine
- The complexity of networking quantitative and subjective dimensions in medicine
- Challenges of Artificial Intelligence in the clinical medicine
- Complex modelling in biomedicine
- Big data, medicine and social networks ?
- Implementation of systems science and cybernetics in clinical practice, hospital and community healthcare management, global health, or policy
- The human consciousness dimension in healthcare service
- T-shaped professionals in healthcare organizations
- Systems and cybernetic views of organizational solutions to the COVID-19 pandemic

Artificial Intelligence Technology as the Mainstream of Third Millennium Medicine Development

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At the present stage, among the many areas of non-military AI application, the most sought-after use of these technologies is in medicine. There are a number of health care problems that determine the discrepancy between the real quality of medical care and modern technology capabilities/scientific achievements. This factor serves as a serious incentive for setting tasks before biomedical informatics specialists. As a large array of information is accumulated in this multi-profile area, there is a need to create artificial intelligence systems capable to accumulate increasing amounts of knowledge, process these data and consequently produce, for example, an optimal algorithm for patient management. Health care is viewed as one of the key areas capable to reach a real effective level of AI development based on neural networks and machine learning.

A number of key areas and trends have been identified for implementing AI into medicine, which include patient data processing, disease diagnostics, genetic analysis, optimization of administrative procedures and document workflow, pharmacology and others.

Already today, due to the possibility of dealing with big data, artificial intelligence is capable to improve diagnostics performance. AI systems make it possible to minimize possible mistakes and decrease a volume of daily routine tasks. AI-built software and devices are currently used in analysis of X-ray images, CT scans and MR images. "Intellectual" medicine is already applied in chronic disease telemonitoring, robot-assisted surgery and new drug development. We are aware of active development of such area as predictive analytics: already today, AI makes prognosis with accuracy up to 89-90%. For instance, the GoogLeNet algorithm is capable to reveal cancer with accuracy of 89%, which is significantly more accurate than prognoses by an experienced expert (73%).

Certainly, difficulties arise on the way of AI technology implementation in medicine. One of the most important restrictions on proposed innovations in medicine is lack of transparency in the decision making process of the system's intellectual core. Artificial intelligence operates in accordance with the black box principle. If the algorithm contains an error, and the system has taken a wrong decision, it would be extremely difficult to answer the "why" question. So far it is difficult to say who will be liable for a wrong diagnosis, if it has been made by an AI system? Another problem relates to quality and volume of medical information: data accumulated in patients' medical records could be incomplete, contain mistakes, inaccuracies and non-standard terms. To address this problem, AI learning options using small amounts of information are now being offered. Apart from the algorithm itself, which can analyze a high degree of accuracy, a strong project team of specialists with a wide range of competences in the subject area is required to successfully implement an innovation in practice.

Certainly, investigation of scientific and technological development patterns, anticipation of serious problems associated with destruction of the traditional way of life in general and medical practice in particular and study of their features refer to the problems of the highest scientific importance.

Multi-level learning from COVID19 vaccination for the design and implementation of future massive programs

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The purpose – The urgency of vaccination against coronavirus (COVID19) has posed an international challenge to healthcare systems and governments, leading to a wide variety of strategies and learning for each country. This research aims to provide important insights for future massive vaccination programs, based on a multi-level analysis of the strategies and outcomes in COVID-19 vaccination programs in different countries in the Americas. It expects to answer the question: How did health systems adapt their capacities to face the COVID-19 vaccination process? It also aims to promote a regional conversation regarding sharing resources, key activities, lessons learnt, among other useful information to improve the current roll-out of vaccination against COVID-19.

Design/methodology/approach – This study analyzes some of the COVID19 vaccination strategies in the Americas from a multi-level perspective, considering the macro environment as the political, social, and economic context; and the meso environment the healthcare system organization. Following the comparative approach proposed by Charles Ragin (2014), the research will be conducted in a case-oriented manner, considering each country as an individual case, and balancing the complexity with a clear set of variables to look up into each level. The main method considered is documentary analysis, based on the official records of each country to understand decisions inside healthcare systems, policies, and government atmosphere and historical sources to properly address the macro-environment. This data will be supplemented with some interviews when feasible.

Findings –As it is a complex phenomenon, multi-causality is expected. Solely metrics such as GDP or Health Coverage Index do not respond to the adaptation process in the system's capacities. For example, existent and efficient children immunization systems are not necessarily a predictor of future successful massive vaccination programs, coordination among public actors and breaking down barriers in healthcare delivery turned to be more important. The identification and awareness of actors beyond the traditional system helped shape and strengthen the health ecosystem and complement the usual process with new resources. The crisis and urgency atmosphere forces the system to go beyond competition; this implied sacrificing traditional processes, but in the end, successful solutions will tend to an isomorphic way to respond once the main challenges have been overcome.

Originality/value – To our knowledge, this is the first comparative study that looks for analyzing COVID19 vaccination process from the Organizational Theory field, especially with a multi-level perspective view per country. Previously, it has been approached independently, considering separate edges of the challenge according to the actors involved. For example, as a political issue, for health professionals, epidemiologists, or logistic experts. However, there is a path dependence with which each country is burdened that affects how all these actors decide whether to align themselves with the same strategy for COVID19 vaccination. A multi-level study balances the weight of history and encompasses the role of multiple actors, allowing the analysis of an entire system and the comparison between them.

Research/ Practical/ Social/ Environment implications - The research's findings will provide lessons on health systems' capacity and needs of improvement considering those factors that in a crisis and urgency scenario such as COVID19 pandemics were hindrances or decelerators in decision-making and its efficient execution, beyond vaccination. Findings will be shared with various stakeholders in the health systems to inform future massive vaccination programs and current progress with COVID19.

Research limitations – Using documentary analysis as the main data collection method represents a limitation in terms of access to information. In some countries, particularly Latin-American, not all the data is open, or there tend to be some lags in the reports compared to the reality.

Keywords: COVID19 vaccination, Massive vaccination, Multi-level study, Health system and Organizational learning

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Polar Analysis as a self-reference language of the 3rd order Cybernetics

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Purpose The 3rd order Cybernetics, including subjective reality, needs an integral self-referential language, by means of which it would be possible to express both object and subject structures in a relevant way. The article offers a version of one such language, the so-called "polar analysis", which assumes a mathematical explication and generalization of the ideas of the German classical dialectic. One of the main tasks of polar analysis is to build a "polar portrait" of the system X, i.e., to map the system X on a polar vector P in a system of basic polarities P_1, \dots, P_n , as well as to simulate the system dynamics as an evolution of the vector $P(t)$.

Design/methodology/approach According to German dialectics, being is based on different kinds of "polarities" - contrasting determinations that have both the moment of incompatibility and complementarity with each other. A classic example is the polarities of "thesis" and "antithesis", which must find their highest unity in "synthesis".

Findings We propose to use vector analysis constructs for the mathematical expression of such a structure, interpreting "thesis" and "antithesis" as two orthogonal vectors T and A in some vector space, when "synthesis" can be represented as a vector sum $S = T + A$. More generally, there can be more than two "theses", which can be expressed by the basic polar (orthogonal) vectors P_1, \dots, P_n , the "synthesis" of which will be their vector sum $S = P_1 + \dots + P_n$. If the vector space contains the scalar product (\dots), then metric structures on the vectors can be introduced.

Originality/value In particular, we can introduce the "measure of synthesis" $M(P)$ of a particular polar vector P as the projection of P on the synthesis vector S: $M(P) = (P, s)$, where $s = S/|S|$ is the ort of the vector S. We can formulate the "law of development" in the form $dM(P)/dt \geq 0$ – the law of monotonic growth of the measure of synthesis $M(P)$ of the vector P, until the maximum of this measure is reached (in a given polar system). Like the second law of thermodynamics, the law of development is also defined on polarities, but has a different content than the "tendency for uniformity". The measure of synthesis $M(P)$ can also be called a "measure of development".

Research/ Practical/ Social/ Environment implications Numerous examples of the application of the polar analysis are in many of our works, from the structures of the external world (for example, the structures of atoms, biosystems) to the ones of internal world (the falsification of the theory by a counterexample, the dynamics of the process of understanding, etc.). In the application to the 3rd order cybernetics, the problem of "regulation of development" can be formulated by means of polar analysis, when the subject of regulation evaluates the polar portraits of himself and his environment and seeks to maximize the measure of synthesis of the aggregate system, including encountering various counterexamples in relation to his hypotheses and integrating them into more complete synthetic structures.

Research limitations Of course, it should be borne in mind that the polar portrait of a system is only one of the possible representations of its structure, and it cannot express the fullness of its definitions, but the part of these definitions that it expresses deserves to be studied and can play an important role in the structure and evolution of the system.

Keywords: polarity, polar analysis, synthesis, development, measure of development.

Exploring the systems thinking contribution to the modelling of Integrated Home Care

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The purpose – The elderly of population and the growing of chronic illnesses, on the one hand, and the need of cutting the costs of health care, on the other hand, are challenging health systems. In this context, providing health care at the home of the patient is increasingly considered as one of the best solutions to make the service more effective, efficient, and sustainable at the same time. A significant factor of complexity, however, emerges in the provision of home care due to the need to integrate various health care services with social assistance and family support. To grasp this complexity, it is necessary to take into account the diversity of needs, interests and views of the problem, to integrate abstract and case specific knowledge, to focus on problem-solving, hence, to adopt a transdisciplinary approach. These necessities highlight the need of an effective management of variety and the opportunity of exploring the contribution of systems thinking. Accordingly, the work aims to analyse current models of home care in order to identify the key requirements for effectively modelling integrated home care.

Design/methodology/approach – The paper starts with a literature overview aimed at collecting and analysing the main managerial contributions that theorize models of home care. These contributions are discussed in the light of a systems thinking view providing examples derived from the Italian experience of the COVID-19 pandemic. Then, a double perspective of analysis based on the VSA (Viable Systems Approach) structure-system paradigm is used to depict the main structural and organizational elements of effective systems modelling of home care.

Findings – The contribution of the paper is twofold: on the one hand, it provides an analysis of the dominant approaches to home care, identifying the main elements of variety in play; on the other hand, it depicts the key features of an Integrated Home Care Model that is able to effectively harmonize the variety identified overcoming the complexity of an integrated approach to health care through the adoption of a transdisciplinary systems thinking view.

Originality/value – The paper enriches current knowledge about health care management focusing the attention on home care and highlighting the contribution of transdisciplinary systems thinking to the modelling of home care in order to make service integration effective, efficient and sustainable at the same time.

Research/ Practical/ Social/ Environment implications – The study opens up various paths of reflection around the practical, social, and environmental advantages of a systems modelling of integrated home care. Some of these implications are discussed to highlight in particular the great potential of systems thinking and the opportunity, if not the necessity, of adopting it in the context of health care to valorise the use of available resources.

Research limitations – The paper represents the starting point of a study that will require further work to verify the interpretative hypothesis developed on the basis of a systems view and to identify the specific context conditions for effective modelling of integrated home care.

Keywords: Health care management, Integrated Home Care, Systems Thinking, Transdisciplinarity, COVID-19 pandemic.

A cybernetic approach to the management of sports training

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The purpose – The goals of sports training management are to consistently improve the physical condition of athletes, improve their athletic performance and results at competitions, and reduce the risks of overtraining and sports injuries. To achieve these goals, various organizational systems of training in sports have been developed, which consist of many components and are developing dynamically. As these systems are deployed over time, their structure is constantly becoming more complex, as the tasks, age, adaptive potential, and fitness level of athletes change. The purpose of this work is to analyze these systems, identify contradictions in them, reserves for their adaptation to rapidly changing conditions, ways to optimize and improve their efficiency.

Design/methodology/approach – To analyze and understand the processes that take place in these systems, the method of decomposition and methods of Cybernetics of the first, second and third order were used. There are several control contours of the sports training system. First circuit-management of training, recovery, functional state of the athlete, risks of injury and overtraining; second - training management development trainer as a subject of management training athlete, the third - management of formation and development of organizational system, that surrounds the athlete and the coach, which can be considered as a self-developing active-reflective environment and the fourth - the management and development of organizational systems related to sports training.

Findings – Hierarchical levels of the sports training system are highlighted. at each level, subjects, active objects and management goals are highlighted, as well as feedback loops in the system. As a result of the analysis of goal vectors, contradictions in the system are formulated and measures for their resolution are proposed. The requirements for the decision support system for each subject of management are formulated and the ways of digitalization of information processes in the system of sports training are outlined. Evaluation criteria and ways to optimize processes in the system according to different criteria at different levels are proposed.

Originality/value – The cybernetic approach allows us to understand the patterns of athlete training at different levels and create decision support systems for key parts of the sports training system.

Research and practical implications – The athlete's physical condition and fitness can be controlled by changing it in the right direction and developing certain abilities with the help of multidirectional training actions. The use of control laws, information transformation and analysis of complex dynamic systems is one of the most promising ways to develop the theory and practice of sports training. Modern theory and practice of sports training involves a transdisciplinary approach, which is manifested by the simultaneous involvement of specialists from many Sciences: anthropology, physiology, biomechanics, biochemistry, bioenergetics, psychology, pedagogy, sports medicine, computer sciences, psychology, organizational sciences.

Research limitations – Digitalization of many processes, on the one hand, speeds up and facilitates key decisions, on the other, creates additional information noise, which is a source of errors in the management of sports training.

Keywords: sports training system, organizational system, cybernetic approach, decision support system, athlete's physical condition, sports training management.

Predictive algorithms for the management of stroke patients discharge

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The Purpose – Given the complex interaction of the considered variables, the use of machine learning seems to be the best solution for the problem of predicting the therapeutic outcome of stroke patients. This approach has proved to be particularly effective in clinical setting, especially for predicting the therapeutic outcome of stroke patients (Zdrodowska, 2019; Zdrodowska et al., 2018; Chen et al., 2017; Alaiz-Moreton, 2018). The best results were obtained through the use of the Random Forest algorithm (Breiman, 2001; Alaiz-Moreton, 2018; Tin Kam Ho, 1998; Tin Kam Ho, 1995). Considering these research results, it was decided, in collaboration with the Department of Human Neuroscience of the University of Rome La Sapienza, to compare these performances with those achievable through a GNG model.

Design/methodology/approach – The study involved a subset of 20,000 samples taken from the Italian section of the SITS (Safe Implementation of Treatments in Stroke website, 2020). Only data containing the outcome 24 hours after the access, 7-day mRS, mRS at discharge and mRS at 3 months were considered. These variables were chosen as class attributes for testing.

Some data was incomplete, but it was not necessary to perform any kind of cleaning. Data was discretised and normalized before being processed. The predictive models were trained with 60% of samples and tested with the remaining ones. The Weka 3.8.4 platform was used to test PART, SVM and Random Forest algorithms, while a Java implementation was used to test the GNG model (Fritzke, 1994).

Findings – The best results were achieved by the GNG model followed by the Random Forest model. Once trained, it was also possible to use the GNG model to identify which non-class attributes are correlated to particular values of the selected class attribute. For example, it was possible to identify which clinical variables are correlated to the worsening of patients during the first 24 hours of hospitalization. Using the Girvan-Newman algorithm (Girvan and Newman, 2002) communities of nodes associated with clinical deterioration in patients were identified. This algorithm allows to accurately identify the clusters since the evolution of the topology of GNG network is similar to the evolutionary cases studied by Girvan and Newman and for which they developed the relative algorithm.

Originality/value – The results of this study suggest that the use of cluster learning algorithms such as the GNG model allows to identify the clinical variables to be considered to make a good prediction of the clinical outcome.

The GNG model has been shown to be particularly effective in predicting therapy outcome compared to other unsupervised algorithms. The best result in terms of predictive accuracy achieved by this model is due to its ability to identify exactly the input space topology, which also makes it particularly robust to the noise and to lack of data.

By analysing the final configuration of the trained GNG network, it was also possible to obtain useful information on the factors most related to certain clinical outcomes.

Research/ Practical/ Social/ Environment implications – According to the Italian Ministry of Health website (2020), every year there are about 196,000 strokes in Italy, of which 20% are relapses. About 10-20% of people with stroke die within a month, and another 10% within the first year after the event. Only 25% of stroke survivors manage to fully recover lost functions, 75% survive with some kind of disability, and half of them lose self-sufficiency.

So it is important to define an adequate discharge plan taking into consideration complex and multidimensional interactions, not only to improve individual recovery, but also to reduce the high social burden and the further use of health system resources (Mess et al., 2016; Pereira et al., 2014). The presented predictive model can be used to support the discharge plan definition.

Research limitations – There is a considerable amount of literature on the use of machine learning algorithms based on the assimilation of previously treated clinical cases data. Forecast accuracy generally tends to increase over time as new data becomes available (Bishop, 2006), but there is no algorithm that can provide the best predictive accuracy for every category of problems. In stroke patients therapeutic outcome prediction, given the scarcity and incompleteness of data, unsupervised learning machine learning models are the most suitable algorithms due to the fact that they do not require the intervention of human experts (Alpaydin, 2020). The GNG model, by being able to identify the input space topology, can accurately identify the variables to be considered when forecasting a class attribute.

Keywords: data mining, machine learning, healthcare

Section 4.3 Advancing systems economics and economic cybernetics: A Look into the Future

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This session should discuss, from a CyberSystemic perspective, the contours of the new economic and social theories that meet the challenges of the 21st century, the tasks of optimizing the functioning and development of socio-economic systems, to the transition into the balanced and sustainable and socially responsible development of national economies in a multipolar world. We expect that special attention will be paid to issues of harmonization of the interaction of economic objects, self-organization, self-developing environments, intertwining business processes, commercial and non-commercial social and economic projects. This session is intended to provide from an organizational and complexity perspectives the symbiosis of individuals, institutions, innovations, and information technology.

Discussion points

- development of hard, soft, and integrative Systems and Cybernetics theories, methodologies and approaches;
- open issues of cyber-systemic study of flexibility, ergodic, openness and dynamics of organizations;
- dilemmas about cyber-systemic study of systems thinking/theory/behaviour, interdisciplinary knowledge, and transdisciplinary nature of organizations;
- further trends of cyber-systemic study of human, social, organizational, technological and sustainable aspects of society and their interdependencies;
- CyberSystemic study of ecosystems, society, organizations, businesses and human behaviour.
- CyberSystemic contribution in current development trends of organizations and society - like Innovative society, Industry 4.0, Society 5.0 and Socially responsible society.

Global Digital Technologies Impact on Changing Role of Money in Future Society.

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The purpose of this paper is to study the influence of global information technologies on the role of money, which forms the basis of all sectors of society. So, changing role of money has significant impact on the development of socio-economic systems and sustainability of the development of society.

Design/methodology/approach – Main methodology of the paper is system analysis and conceptual design of organizational systems.

The approach is as follows: “Future Society” is viewed as such, where two conditions are met simultaneously:

- any significant information is accessible anywhere,
- computing capacity required for searching an optimal way of exchanging goods is accessible anywhere.

Quantitative changes in Global Information and Computational Availability (GICA) entail qualitative changes in society and various material changes in social-community aspects, particularly, changing role of money.

The key point behind the suggested hypothesis is that each entity involved in commodity relations will have a method based on GICA to easily find the entire chain of exchange of its commodity for any other (non-monetary exchange) and can keep its wealth in any commodity (non-monetary wealth).

Findings – The main conclusion of the work is the hypothesis of a significant change in one of the functions of money in society - the function of a universal intermediary in the exchange (UME) of goods and services. Namely, the fact that global information technologies create conditions in order to significantly reduce role of money as UME and significantly increase role of real goods and services as the basis of exchange. The method that allows us to evaluate parameters of the exchange of some goods for others and thereby abandon money as UME are:

- global availability of commercial information
- global availability of computing power, which allows us to optimally build exchange chains.

In addition, another function of money - accumulation, can also be significantly weakened by globalization and can be gradually replaced by a managed accumulation of goods.

Originality/value – The main difference of the proposed conclusion of diminishing role of money as UME from the widespread view of barter as a very limited phenomenon is that extinction of money as used in commodity exchange, is global in nature and covers the entire mankind.

This global nature results, from theoretical conclusions of Marx about extinction of money as a consequence of increasing social character of commodity production, and, is supported by practical means that have appeared in the course of the IT industry.

With an increase in the public nature of money, they go through following stages:

1. Absolutely private nature of measuring the value of own goods in a primitive communal society, where the owner, regardless of anyone, independently decides whether the exchange of his/her goods is sensible.
2. Partially-public nature of the evaluation of feasibility of exchange, in which money is involved, which represents a public consent to such means of measuring value.

3. Direct public way of measuring the value of goods, binding together all subjects involved in the exchange and based on GICA.

While all the prerequisites for the implementation of the theoretical conclusion about the withering away of money as UME in commodity production are in place, the question remains of how this process of diminishing the role of money will proceed. It may happen gradually in some industries or countries, or it can be as an avalanche in connection with catastrophic events in the monetary sphere, when the "expressor" of public consent to use the main type of currency (dollars, Euros, Yuan, etc.) fails to reflect to the real interests of the main subjects of commodity production.

Research/Practical/Social/Environment implications – The work opens up a new area for researchers to study the impact of global information technologies on socio-economic systems. A careful study of this change in the role of money and its consequences will help harmonize the interaction of the economic systems of the developing world.

Research limitations – The paper considers the conceptual aspects of changing role of money in globalization and does not consider specific methods that implement such changes. Considering huge number of concluded deals, huge range of goods, task of finding optimal (approximately optimal) exchange chains is not trivial.

Keywords: Role of Money, Future Society, Global Digital Technologies, Commodity exchange chains

Designing new economic scenarios from the Sharing Economy Digital Revolution

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The purpose – a critical review for what has been defined as the Sharing Economy or the Collaborative Economy is presented. The accommodation, transportation, and freelance labour sectors have been the earliest sectors to be conquered with examples of well-known companies as Airbnb or Uber that have to be considered from a systemic perspective because they can represent a paradigm shift, at least from the economic approach. To clarify the broad umbrella term of “sharing economy”, identified as the commercial and non-commercial 'peer to peer' economy, is the focus of the paper.

Design/methodology/approach – based on a systematic and selective literature review, and developing a content analysis according to our purposes, we balance the existing proposals of definitions. Empirical evidence can show benefits and costs of the new sharing economy and its implications for sustainability and employment, letting us to consider alternative scenarios for implementing new economic policies even for commercial real estate, health care provision and energy production and distribution, among others. The sharing economy seemingly encompasses online peer-to-peer economic activities as diverse as rental, for-profit service provision, and gifting that we have to consider for future benefits of the world economy and our planet. A timeline is built limiting the search to journal articles (short scientific papers) and books (wide work or relevant).

Findings – the proposed timeline includes sharing activities based on their future possibilities. The sharing economy is providing us with a unique opportunity to exploit existing resources more optimally using modern technology. Social, economic, and cybernetic bridges for the term “sharing” are merged into a conceptual foundation and economic policies of the sharing economy. We face big changes induced by the possibilities of the sharing economy activated by digital platforms used by peers or participants in the new peer-to-peer economy environment that has been created.

A defence of the complex and beautiful concept of “Peer-to-Peer Sharing Economy Platforms” could be the right approach, including the “P2P economy”, plus the idea of “collaboration”, and using “digital platforms” in the alternative new “digital economy”. Moreover, the possibilities of governments to be part of this digital revolution as active actors that can drive sustainable and social achievements in the future; public sector should be involved in the new developments as used to be in the traditional economy.

Originality/value – this paper elaborates a new approach to this phenomenon and reclaims public sectors and governments as main actors to drive the economy of the 21st century revolution, instead of being passive viewers of the changes happening all around. We will consider links among countries in order to build new scenarios in the sharing and collaborative economies to build up. The paper will challenge the traditional vision of the matter as a critical review of the revolution that is really happening now from a wider perspective. The passive role of governments today and the misunderstanding of the new phenomenon is a key element to consider for evaluation as well as the revision of the main concepts related to the matter and the timeline selected for consideration and the ideas highlighted there.

Research/ Practical/ Social/ Environment implications – the paper will provide new insights in the sharing economy literature and will introduce the public sector as main character in future scenarios analysis from economic perspectives to challenge the new possibilities that the sharing economy revolution opens for the whole society.

Research limitations – there are limited good or academic publications on the subject, and a lot of information comes from websites and informal magazines. No official data and methodology

limitations reduces our possibilities to go further on a topic which is still in process of creation, and we are trying to predict scenarios of the future economy.

Keywords: Sharing economy, future, digital, p2p economy, collaborative economy, revolution.

‘Inward Fractalization’ for Building Adaptive Depth and Societal Resilience

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The purpose – This paper proposes the concept of ‘inward fractalization’ as a means of building adaptive depth across a broad range of socio-technical ecosystems – to enable resilient organizations and sustainable economies. Building on the work of fractal innovation (Dyck, 2006), towards addressing hyperbolic trends of world systems evolution (Korotayev, 2005), a mechanism for building ecosystemic ‘endogenous depth’ is posited – which supports the creation of continuously sustainable value propositions. Here, hierarchical coherence and network connectivity are expanded by first a) decomposing, and then b) “fractalizing” the implicit cybernetic loops that stabilize the existing ecosystemic relationships. This creates additional dimensionality throughout the panarchy cycle (Gunderson, 2001) – which builds exergy, enables adaptivity (Holling, 2001) and enhances the overall ecosystemic resilience. The classical theories of economic growth tend to emphasize exogenous activity as primary means of market-space expansion and value creation. To advance this model, the ‘inward fractalization’ enables creation of internal or ‘endogenous depth’ – where products and services can be viewed as building-blocks of experience in inter-mediated economies, that are argued to be better aligned with the emerging "processual" worldviews (Baskin & Bondarenko, 2018); where even states and countries can be considered as ‘fractal actors’ (Läidi, 2002).

Design/methodology/approach – The key research methods utilized in this paper are Literature Review, Case Studies, and Interpretive / Integrative Synthesis (Noblit & Hare, 1988) – utilized in the context of sensemaking within the Systems Theory and Cybernetics fields.

Findings – The key research finding is the hypothesis that sustainable growth of the world systems might be possible – if cybernetic loops are utilized to enable endogenous value creation via fractalized innovation pathways within the various socio-technical ecosystems.

Originality/value – Much of the existing research is superlative and provides extraordinary insights – creating an opportunity for further conceptualization around how the existing theoretical constructs might be most effectively connected, in a way that supports resilient growth of the world systems. This paper advances the state of the art by offering an integrative synthesis of existing concepts – to propose a new theoretical model for considering economic expansion and innovation growth in a sustainable context.

Research/ Practical/ Social/ Environment implications – The impact this paper is expected to provide for researchers and members of the professional communities – as well as, more broadly for the society and the environment – is to offer alternative ways of conceptualizing economic growth and value-creation models that are societally sustainable.

Research limitations – The proposed findings have the explicit limitation of not yet being evaluated in practice by using quantitative or use-case based methods – as means of validating the posited hypothesis.

Keywords:

Cybernetics, Economic Growth, Resilience, Sustainability, Adaptive Cycles, Systems Theory

Social Network Analysis to Understand the Dynamics of Global Supply Chains

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The purpose – Globalization coupled with rapid and revolutionary advances in information and communication technologies (ICTs) have generated different changes in business management. Changes in the expanded vision in supply chains (SCs) that involve virtual project networks that may work and innovate across time and space boundaries have impacted Global Project management. The Global Projects refers to the interaction of team members belonging to different cultures, organizations, and business units distributed in more than one geographical location and time zones, with commons aims to accomplish in a limited period of time. The aim of this study is to increase the understanding of collaborative relationships and assess according to the project size, the influence of the contributory factors in shaping collaboration network structure in projects developed in Global Supply Chains (GSC).

Design/methodology/approach – The paper used a case study methodology applied to eight global projects developed by an Austrian company leader in global market intra-logistics solutions & warehouse automation. The cases were studied by two approaches in network analysis. First, visual and descriptive analysis to describe structural aspects of the network. Second, stochastic network analysis to evaluate the influence of contributory factors in the structure of the collaboration network. Specifically, first, we describe the structure of the project network in order to identify the characteristics of these networks, the key actors in the networks, and who is collaborating with whom in the collaboration network; and, second, we assess the influence of local structural dependencies (endogenous factors) and nodal attributes (exogenous factors) in the overall structure of the observed network.

Findings – Our results evidence the influence of the contributory factors in the overall structure of the collaboration intensity networks. Specifically, independently of the project size and project manager influence, project team roles (PTR) who have a reciprocal communication among other PTR tend to have a higher Collaboration Intensity (CI). Additionally, the results highlight the influence of the project manager in shaping the collaboration network in standard projects (STP) and small projects (SMP). According to the project size, the results show that the PTR that form complete triangles or clusters or who communicate frequently among each other tend to have a high CI, being more evident these tendencies in large scale projects (LSP) than STP and SMP.

Originality/value – Our results highlight the influence of the contributory factors in shaping collaboration network structure in projects developed in GSC. Independently of the project size and project manager influence, the study shows that PTR who have a reciprocal communication among other PTR can be associated with greater-than-chance probabilities to exhibit a high CI. Projects are so likely to benefit from effective two-way communication, which results in a better understanding of the expectations between the actors, easier identification of partners capabilities, and facilitate problem-solving Furthermore, there is not a tendency for PTR either with high values of indegree or outdegree, nor those who share the same set of partners, to have a high CI among each other. It confirms that virtual teams communicate by different communication channels which enable asynchronous and synchronous communication as well as one-to-one and one-to-many communication. Additionally, the study highlights the influence of the project manager in shaping high CI relationships in STP and SMP. The relevance of the project manager participation is important to inspire and motivate other partners in their organizations to have an active and continuous communication, to increase cohesion and motivation, enhance trust, and improve the team performance.

Research/ Practical/ Social/ Environment implications – This research provides a framework to identify the key actors and contributory factors in shaping collaborative relationships in GSC. The

findings could be used to support the decision-making process and formulation strategies for effective collaborative relationship management in GSC. Furthermore, this research could help to provide a set of metrics that would allow managers to identify collaborative links among PTR, to recognize PTR perceived as leaders and the role they play within the network, and to recognize subgroups of PTR working together.

Research limitations – Due to all projects were developed in the intra-logistics sector, the results are more relevant to GSC and organizations with similar characteristics and analogous markets. Additionally, due to that, the projects analyzed in this research were finished when this research started, we could not survey the key actors to complement the results of this study. However, the research team of this study includes one researcher who was working at the subsidiary office company as a Project Manager in some of these projects analyzed. Also, according to the definition of a global project as a temporary endeavor developed into cultural diversity and geographically dispersed conditions, this kind of project should be analyzed in the light of their evolution over time.

Society 5.0 and systems theories: managerial dilemmas about corporate social responsibility

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The purpose – The main purpose of this article is examining managerial dilemmas about integration of systems theories in utilization of Society 5.0 on society's level and corresponding Corporate social responsibility on the organizational level. Society 5.0 paradigm suggested balancing of technological development, responsible economic development, and resolution of social problems via organizations' CSR; that is not possible without systems thinking, interdisciplinary knowledge, and transdisciplinary consideration of organizations.

Design/methodology/approach – Drawing from Society 5.0 as a considered vision of macro-level predictors of sustainable development, we demonstrate the applicability of Society 5.0 in the micro-level CSR context in organizations. Based on desk research with qualitative investigation we designed an integrated model of CSR in line with goals of a forward-looking socially responsible society. Study includes analyzing of present governing principles, systems and cybernetics consideration, and developing of systems framework for organizational CSR.

Findings – The study's findings suggest integration of systems study of ecosystems, society, organizations, businesses and human behavior in the model of Society 5.0 and broadening of CSR discussion with inclusions of flexibility, ergodic, openness, and dynamics issues.

Practical and social implications - The study created guidance for improvement of CSR practice in organizations through consideration of their transdisciplinary nature and integration of relevant systems theories, and revealed new possibilities for cybernetic-based utilization of human-centered society among individuals and organizations.

Symbolic Exchange in the Digital Era: The Value of Immaterial

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The purpose – The purpose of this paper is to investigate the symbolic significance of exchange practices during the digital turn when money becomes immaterial. It is important to deliver the analyses from the perspective of currency design, seeing the epistemological potential of money in the correlation of dematerialization and transformations of social relations, where value becomes a key feature. So the question for this paper is twofold. First, it is crucial to understand what constitutes the value of money in the context of digitalization of exchange practices. And second, it is of interest what is considered to be valuable if money itself becomes highly arbitrary and its value has no grounding in the material reality.

Design/methodology/approach – This paper will be divided into three sections. First, there will be an overview of the philosophical framework for investigations of money, especially focusing on the concepts of Georg Simmel, Maurice Bloch and Jonathan Parry, Viviana Zelizer, Bill Maurer, and Josh Lauer. Second, there will be an outline of Matthew Engelke's concept of social evidence based on anthropological methodology. Applying the methodology of social evidence to money allows to re-conceptualize its functions in the philosophical categories, not purely economic. Third, there will be an analysis of exchange practices in the context of digitalization, and especially NFT (non-fungible token), when currency design becomes almost invisible but still having ideological implications.

Findings – Currency design is a dichotomy of functional and aesthetical, affecting the capacity of money to reproduce social knowledge. With immaterial money, the perceptual aspect of symbolic exchange transforms considerably because money becomes a pure invisible function having no room for ideologically biased aesthetics. Thus digitalization of money is anticipated as a means for liberation, constituting its immaterial value. But digital currencies anchor their value in other systems of exchange proclaiming them as valuable. NFT is an illustrative example here, being considered as a unique certificate of digital artwork. But NFT and digital artworks are immaterial and have arbitrary symbolic significance, this way bringing money as a pure function to the tangled realm of aesthetics with new potential for ideological manipulation.

Originality/value – Interdisciplinary studies of money within the philosophical framework based on anthropological methodology is currently only an emerging field. Moreover, no investigations are focusing on currency design as a dichotomy of functional and aesthetical, which is of special interest when money, in the course of its dematerialization, loses its perceptual and especially visible features gaining the status of a pure function. So the originality of this work is in its focus on currency design as the category, which has an impact on social relations and its relevance to conceptual transformations of the valuable. As to the value of this paper, it contributes to the studies of the epistemology of money as social evidence in the context of digitalization of symbolic exchange.

Research/ Practical/ Social/ Environment implications – Anthropological approach to the studies of money raises a bunch of questions concerning social practices based on symbolic exchange, which has not been yet investigated in detail. And as to the philosophical framework, it produces new potential directions of analyses in the realm of philosophy of culture, where money can be considered as a complex multimodal category wrapping various spheres of social relations.

Research limitations – Having a philosophical framework, this paper is not considered as providing hypotheses in the field of economics, political economy, or semiotics of money as separate disciplines. But it rather opens the floor to the interdisciplinary discussion of the economic, political, historical,

psychological, ethical and cultural significance of symbolic exchange where philosophy gains an aggregating effect.

Keywords: Currency design; digital turn; immaterial; money; social relations; value.

Socio-economic ecosystem of the enterprise: concept and applications

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The purpose – Despite the importance of development enterprise together with its socio-economic ecosystem, the theoretical and practical connection between the process of identification of risk factors of development of the enterprise and socio-economic ecosystem of enterprise remains largely unexplored. The identification of non-financial ESG factors (Environmental, Social, Governance) as criteria for the sustainable development of enterprises emphasizes the special attitude to the environmental aspects of the enterprise's activities, the interest of investors in the social and economic well – being of people-employees, customers, consumers and the importance of ethical principles of enterprise management. Making management decisions taking into account ESG factors can improve the environment, in this case we mean both the human habitat as a living organism and the socio-economic space in which various economic agents operate. The purpose of this paper is to improve a theoretical explanation of why and how concept of socio-economic ecosystems can contribute to the identification of the enterprise's development risk factors.

Design/methodology/approach – To understand how managers of the enterprise can effectively control and reduce risk level of its development, we need to examine complexity of its socio-economic ecosystem and the inter-relationships between control risk level of subsystems and intra-system interactions. The paper builds upon the ecosystems approach, and systemic thinking is used as methodological instrument. The socio-economic ecosystem is considered from the point of view of system economic theory as a localized complex of independent enterprises, business processes, innovative projects and infrastructure facilities capable of long-term functioning.

Findings – Each subject of the socio-economic ecosystem has different attributes, experiences and beliefs. In one side, risk of development of enterprise and its ecosystem can be considered separately as natural risk and artificial risk, in the other side, as global risk and local risk. This depends on the subsystem of enterprise's ecosystem: biological, social, economic or digital. Differences in decision-making principles can lead to unforeseen results at the ecosystems level, therefore it is important to identify risk factors for the interaction of enterprise and other economic agents with different approaches to interaction. The socio-economic ecosystem of an enterprise can operate within a territorial sectoral cluster, in a special economic zone, within a specific region. Some socio-economic ecosystems are created only in the virtual space and provide conditions for further innovative development and distribution of specific information services, digital products, applications and devices in a specific sector of the digital economy.

Originality/value – The paper identifies the practical implications of the general ecosystems theory and utilizes these implications to inform the researchers on the relevant problem of risk of development enterprise and its ecosystem. The concept of "risk" includes not only "risk situations" associated with anthropogenic, technogenic, economic risks and hazards, but also the situational consequences of this manifestation in the environmental, social, and digital spaces.

Research/ Practical/ Social/ Environment implications – The contribution of results of the research may be significant for pre-planning, expertise, coordination processes, estimating and forecasting the efficiency of innovation or investing activity, both inside and outside the enterprise. The formation of a new or joining an existing socio-economic ecosystem is mainly due to the need to overcome the economic fragmentation of the space between economic agents, consumers and suppliers. The cost of transactions and each communication is distributed among all participants of the ecosystem, thus reducing the costs of finding new consumers of goods and services on the market and marketing research.

Research limitations – The concept of an ecosystem defines its boundaries through a common system of products or services. In contrast to the socio-economic system for the socio-economic ecosystem, the concept of evolution is likened to the concept of co-evolution. An essential feature of socio-economic ecosystems is the processes of coevolution. There are two types of coevolution of economic agents: coadaptive variability as a result of competitive interaction and corporate-as a result of symbiotic interaction. The co-evolutionary process includes such elements as codesign and cocreation of values.

Keywords: Socio-economic ecosystem of enterprise, systemic thinking, intra-system interactions, risk factor, risk level, complexity on folding

Section 4.4 Cybernetics, systems and the arts: embodied pedagogies and the amplification of reflexive capacities

Tom Scholte, Alexander Koblyakov, Clive Holtham, Oswaldo Garcia

Recent ongoing global crises, from the coronavirus pandemic to systemic racism, have only strengthened calls from the cyber-systemic community for a wider uptake of its values and methods. But can wide-spread systemic transformation take place without radical onto-epistemic shifts at the level of individual psychic systems? The deeply felt impacts of such dimensions as history and emotion make the cyber-systemic project much more than a purely techno-rational understanding of communications and control. Is science alone up to the task of enabling humanity, as a vast network of feeling individuals who recursively construct and enact our worlds, to navigate our way to more just and sustainable futures? This track is intended as a platform for contributions relating systems, science, cybernetics and art in light of these questions.

Papers in this track will explore the multiple contributions that embodied, arts-based pedagogies are making to the amplification of reflexive capacities necessary to foster second-order systemic thinking and doing across the various sectors of our societies. It will build upon the advances of a small but growing global community that has promoted the “art of management” over the past twenty-plus years through enactive pedagogies in leadership; many of which have engaged with multiple artistic media, including music, dance, paintings, and theatre. These have led to an enhanced variety of possible meanings and actions emerging for participant/observers in the web of their daily interactions.

The distinctions each of us draw as observers create the varied pictures of the world that enable and inspire our subsequent actions (and reflections). Can this ‘adimensional’ web of interactions be modelled, understood and consciously directed towards producing a “better” world (whatever that might mean to each of us) through an embodied experience with modes of artistic practice? How can this important and ground-breaking work be fruitfully extended and what other contributions might art make to the governance of ourselves and our systems in the 21st century?

Discussion points

- Interactive artworks and performances
- Cybernetics and design
- “Double” and “Triple Loop” learning facilitated by artistic works and processes
- Art and the drawing of “distinctions” (a la Maturana/Luhmann)
- Cybernetics and Spencer Brown’s Laws of Form
- Acting and control theory
- Art in/and Action Research
- Art in/and Systems Modelling
- Art in/and Systems Therapies
- Art and Reflexivity
- Art and CyberSystemic education

Amplifying Second Order Observation through the Theatre of Levels

Scholte Thomas

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The purpose – Niklas Luhmann defined second-order observation as the capacity for an observer to “comprehend more extended realms of selectivity and identify contingencies” regarding their own behaviour “where the first-order observer believes he is following a necessary path or is acting entirely naturally.” The first-order observer falls into this role by living “in a world that seems probable and true” rather than recognizing the observer-dependence of the distinctions they draw.

Beginning from the position that the next phase of research in Second-Order Cybernetics should be the development of concrete methods for cultivating and strengthening individual’s capacity for second-order observation, this paper will describe the theoretical underpinnings and practical methodology of the Theatre of Levels; a hybrid form of interactive performance developed by the author for that purpose – Empirical analysis of the method’s efficacy will also be discussed.

Design/methodology/approach – This new hybrid practice combines the ‘high variety’ inter-subjective input of Augusto Boal’s Theatre of the Oppressed and the self-directed introspection of Timothy Carey et. Al.’s Method of Levels; an approach to Cognitive Behavioural Therapy grounded in William T. Powers’ Perceptual Control Theory.

Findings – This work is undertaken in order to create an even more powerful vehicle for wide-spread capacity building in second-order observation than either of the two original modalities can provide on their own. Progress in this effort will be analysed and discussed.

Originality/value – This theoretical/methodological hybrid appears to be completely unique in a global context.

Research/ Practical/ Social/ Environment implications – The commitment to increasing second-order observation across the widest possible number of individuals is sponsored by the hope that it will equip those individuals with the cognitive skills to find their way through many of the deeply polarizing conflicts of contemporary society, leading to a more just, equitable, and sustainable world. For researchers in Second-Order Cybernetics, Theatre of Levels can stand as a pilot model for the development of other methods and tools with similar aims.

Research limitations – The development of the method is still in its early stages and the number of opportunities to employ it in a full-scale performance have been limited thus far. It can also be challenging to obtain robust empirical data demonstrating the impacts of artistic performance

Keywords: Second-Order Cybernetics, second-order observation, Theatre of the Oppressed, Perceptual Control Theory, Method of Levels

Dancing into Being: Honouring the Collective Intelligence of Living Systems

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The purpose – Cognitive thinking, though it dominates problem solving and decision making in modern society, pales in comparison to the multi-dimensional input from our various senses that also inform how we make sense of the world around us. However, despite the fact that modern research compellingly dispels the myth of ‘objective, logic-centered truth’, our cultural scaffolding continues to perpetuate (and prioritize) the false dichotomies embedded in dualistic thinking. Thus, as the scale of complexity increases, the gap in sense-making and what is trusted, is growing, leading to increasing social instability – on a global scale. This paper poses the question: if there are ways of co-creating a future where cognitive knowledge & ‘knowing’ are not at odds, what might that look like from an evolutionary cultural perspective, and why does it matter?

Design/methodology/approach – I am a textile and multimedia artist who also works as a community artist. Largely grounded in place-based participatory learning processes, I explore complex social and ecological issues through art using a systems lens. These processes reveal compelling insights for learning, particularly through the lens of cybernetics and systems thinking.

Findings Being an artist frees me to move between fields of interest, without the related obligations that too often silo us into separate worlds, and more significantly, often limit the discourse to an abstract, cognitive level. When a synthesis of diverse intellectual pursuits combines with the creative processes involved in art making, interesting insights, that may not otherwise have been obvious, and thus not always intended, are often revealed or generated.

Originality/value – The artist, responding intuitively in the art making process, manipulates the materials till they ‘feel right’. This means: allowing space for the subconscious; being willing to put oneself in that place where there are no ‘road-maps’ or edges to hold onto. It requires a deep listening that draws on all of the senses. It requires letting go of the familiar, the safe, and allowing oneself to be fully present and vulnerable, while also trusting the patterns that emerge and that lead the way. Thus, it is uniquely through art that we can glimpse and share the multilayered, multisensory complexity of what is being imagined or felt, individually or collectively.

Research/ Practical/ Social/ Environment implications – Art not only compliments the academic/cognitive approach to systems thinking, it potentially enables new insights. Core to shifting from an old to a new paradigm, is being able to tell a new story (powerful enough to replace the old, outgrown one). This requires not only imagination and knowledge, but a new set of tools. Art is an important part of the storytelling toolkit because it has the power to shift our consciousness at a deep level allowing for openings to new plateaus of understanding. Thus, as we design the cultural scaffolding that will help determine how we evolve culturally, art has a pivotal role to play.

Research limitations – For all original findings presented in this paper, I draw on personal field experience and observations spanning 30 years of practice as a cultural animator and artist. Though I reference peer reviewed reports and the latest statistical data covering the official health status of society at the neighbourhood level, I hope to illustrate the massive gap in knowledge that even the best data reveals. As no paid jobs currently exist in the domains spanning most of the work and examples referenced, my findings rely heavily on the validation and trust of those from the neighbourhood level through to the organization and government level.

What is now proved was once only imagined.

~ William Bl

Keywords: Community Art; Community Cultural Development; Fractal Flourishing; Systems-Lens; Cultural Niche Construction; Prosocial

Multiple paths to one enactive learning destination?

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The purpose – this comparative case study is of two parallel innovative management education initiatives in the UK and Chile. Both have a substantial base of long-term experience, but the Chilean initiative has a more explicit and more radical theoretical framework (The Enactive Laboratory), through which the UK experience can be viewed and compared:

- On systemic and transdisciplinary underpinnings
- Heavily on the arts to provide novel perspectives on change management, including underpinning attitude changes.
- Aimed at student, as well as executive, audiences

However, the Chile initiative arose out of over two decades of theorising about management learning and change, where a cluster of concepts were embedded in the design of an “Enactive Laboratory” (García De la Cerda, Humphreys and Saavedra Ulloa, 2018). This was built on a circular framework (O Technology), and draws on Garcia De La Cerda’s CLEHES (body, language, emotion, history, eros and silence), which involves three strategies of observation:

- Self-observation
- Observation of interactions, conversations and dialogues
- Observation of an organisational network

Design/methodology/approach – The UK initiative (Creative and Cultural Industries), is a capstone MSc module which has evolved over more than a decade (Kernan, Holtham and Jones, 2021). This has eclectic underpinnings. The first aim of this case study is to explore how far, albeit unknowingly and imperfectly, the UK initiative actually did represent a form of Enactive Laboratory in relation to O Technology, CLEHES and the three strategies of observation.

The second aim is to compare the curriculum and teaching/learning methods of the two initiatives, again to explore lessons arising from visible similarities and also differences.

Findings – The hypothesis is that the Enactive Laboratory approach may already be implicitly present around the world other than through those who originated and evolved it, and that collating such experiences could stimulate attention being paid to the original method.

Originality/value – Though there are several cases studies of individual application of the Enactive Laboratory, there has not been a comparative study of this type.

Research/ Practical/ Social/ Environment implications – The aim is to inform management educators about one route to potential evolution of the Enactive Laboratory, most likely through hybridisation with existing parallel methods. It also informs researchers in learning innovation about future experiments in, and possible evolutionary paths for, the Enactive Laboratory.

Research limitations – Because the co-authors are directly involved in the Chile and UK cases respectively, this poses a questionmark over impartiality. On the other hand, it opens up the potential for a constructively critical dialogue being made public in a way that would require much more effort by third parties.

Keywords: Executive learning, self-observation, CLEHES, arts-based learning, innovative pedagogy

The cybernetic perspective in the design process: homeostasis in architecture

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The purpose – The paper aims to associate two disciplines, cybernetics and architecture, within the context of design process strategies of evolving methods in a case study analysis. Under the adaptive process, the purpose is to investigate the parts relations and learning methods. Cybernetics lenses are drawn on the process of homeostasis from Ashby's concepts. In addition, architecture lenses regard the design process of the Linz Cafe designed by the architect Christopher Alexander. The architect process relies on trial and error methods, based on Ashby's machine, in which he performed a homeostatic process model in architectural fields relating to cybernetics concepts.

Design/methodology/approach – The design methodology includes a theoretical background review. It includes four premises. Firstly, the investigation of the homeostasis concept by Ashby's to outline cybernetics indicators. Secondly, the study of the Linz Café design process and the strategies arranged by the architect Christopher Alexander. Lastly, the establishment of indicators and key aspects for a comparative analysis to associate both areas.

Findings – There is relevance in associating architecture with cybernetics to understand operative ways to organize and manage design systems for better performances and increasing complexity. The cybernetic approach regarding Ashby's concepts brings important considerations. Firstly, a mechanics comprehension of the process, through trial and error. Secondly, a more holistic comprehension through self-organization. For the architectural field, these guidings are important to deal with increasingly complex processes. In addition, they drive to a more sustainable design concerning the biological efficiency of adaptive organisms and ecosystems. This relation arouses us to rethink the process and enables considering the architectural object as an ideal machine. In other words, a living machine able to adapt itself to maintain the conditions viable to human limits.

Originality/value – The paper discusses the importance of connecting cybernetics and architecture. Another valuable consideration regards the analysis of the real practice of the adaptive design process through a pertinent example. It shows that is possible to model the homeostatic designs process. Besides, cybernetics enables both mechanistic and holistic approaches. The last brings closer to biological aspects improving the design processes into a more sustainable and complex design process.

Research/ Practical/ Social/ Environment implications – Due to the demand for revision architectural methods, cybernetics should assist the practice into an adaptative process, an interconnection of process elements, the stability of the system and the proper relation between the object and its environment. The understanding of a real practice opens for further attempts to make the process more homeostatic. This way, it provides an evolving process that increases complexity. Increasing complexity can generate more integrations within the system. It enables the inclusion of the context in which it operates. This approach goes beyond the integration with the environment. It also considers the relationship of a higher boundary, a quality that is strived at inclusive design.

Research limitations – The architect practised trial and error methods, turning it into a homeostatic process. Although the model of the Linz Cafe refers to a valuable design process, the moment the design was complete, it became a static project. How turn a design continually adaptive? Due to the covid pandemic, the research was limited to the literature review, impeding a practical experiment.

Transdimensional Relationships and the Metasystem Approach - the New Resources of Cognition

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What is the Meaning, the Purpose, the Whole? How does a new quality, that is absent in parts, evolve within the Whole? What is the essence of disjunction-to-conjunction transition (the creativity formula according to A. Whitehead)? From antitheses to synthesis (the evolution formula according to G. Hegel)? What determines the direction of the main evolution vectors of evolution? The existing natural science knowledge about the world obviously does not record a very important type of relationship.

The purpose of the research is to demonstrate the new cognition resources based on the humanitarian model.

Methodology – In research of musical piece, we identified a new type of relationship that we refer to as ‘transdimensional relations’, or ‘transdimensionality’ (TD) (from Latin trans – “through”, “via” (dimensions)).

Under TRANSDIMENSIONALITY, we imply the whole complex of relations between spaces of different dimensions within the whole, such as: embeddings, mutual reflections, convolutions-unfolding, connections between the dimensions, projections, transitions from one dimension to another, etc. The dimension of space is the number of degrees of space (system, element) freedom that admit both the geometric and the parametric interpretations: in music a sound has one-dimensionality (1D), an interval – two-dimensionality (2D), and a chord – three-dimensionality (3D).

The whole is now divided not only into parts and elements, but also into the nested subspaces of various dimensions. We call the dimension-to-dimension transition ‘transdimensional transition’ (TDt). Transdimensionality allows us to make the generalization of Godel and Tarski’s restrictive theorems as follows: “The resolution of the fundamental contradiction through the synthesis of antitheses is only possible in the metaspace relative to the original space, i.e. only through a TDt to a space of higher dimension” (transdimensional transition theorem).

The Whole is identified with metasystem, a unity of a higher level compared to the system – the conjugation of systems with different complementary organizational principles (music as speech). We refer to this extension of the system views as the metasystem approach, which has a formula: the whole = two forces = two organizational principles = two systems!

Findings – The metasystem approach allows a formal (algebraic) description of the Whole. Let the general algebraic space U be the total of subspace L (conditionally – the ‘left’) and subspace R (conditionally – the ‘right’). Then the algebras of these subspaces shall be referred to, respectively, as L -algebra and R -algebra. An L -algebra has its negation: an \bar{L} -algebra such that $L \vee \bar{L} = I$. Their intersection creates the right algebra R such that $L \wedge \bar{L} = R$.

The movement from the left to the right is the movement from disjunction to conjunction, from problem statement to its solution through a TD (from 1D to 2D space). Overall, a polydimensional algebraic metasystem is formed that combines classical and non-classical logics within a single representation.

In our opinion, the metasystem methodology becomes especially relevant for cybernetics. To bring Artificial Intelligence closer to Natural it would be necessary (as a consequence of the above):

- 1) to supplement the left algebra L with the ‘algebra of negation’ \bar{L} ;
- 2) to make their union R in a space of higher dimension.

In addition, the metasystem approach suggests a way to expand cybernetics using analog models based on recognition ('pattern recognition' without calculation).

The introduction of TD into research thesaurus makes it possible the rational definition of some traditionally difficult concepts (categories): the presence of transdimensional relations determines the Whole; resolving a problem through a TDt – determines Sense; the transition to a space of a greater degree of freedom determines the Purpose (of the evolution).

Originality – Conjunction is located in greater dimension than disjunction, synthesis – than antithesis! It is a new degree of freedom that allows the oppositions within a disjunction to become the additional elements within a conjunction. The TDt from disjunction to conjunction creates a new quality of the Whole, which its parts are lacking. New quality = new dimension! It is TD that distinguishes creativity from craft, organism from mechanism, the whole from a conglomerate.

The evolution itself is a TDt from L-space to R-space, which allows one-root way to explain the direction of its main vectors: the entropic (to greater uncertainty), the structural (to greater complexity), the temporal (from the unambiguous real to the variable possible) and the psychological (from the past to the future).

Practical implications – The new approach is significant, in our opinion, both for holistic knowledge and for education, since it presupposes the simultaneous work of interdisciplinary researchers, which, we believe, will ultimately lead to the creation of a new superscience ('Uniology', according to our terminology). If all existing sciences consider the world in its parts, Uniology considers it a single whole, grandiose creative act of synthesis taking place within various materials, however, according to the same scheme – "from disjunction to conjunction"!

Keywords: Transdimensionality, transdimensional transition, metasystem approach, algebra of logic, cybernetics, uniology.

The Logics of Initiation: cybernetics and art

Westermann C.

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The purpose – In the 1943 short story *Mimsy Were the Borogoves*, written by Catherine Lucille Moore and Henry Kuttner under the pseudonym of Lewis Padgett, a box with children toys originating from a future time and place is sent to Earth. A young boy finds the box and carries it home. While he gains enough of an understanding of the toys to play with them, to his parents they remain obscure. It is the boy's baby sister, still unconditioned by language, who, from her understanding of a different order, shows the boy how the toys can form an exit, assisting both children to escape the world of prediction toward the future. In line with the conference's theme, the paper argues for an in-depth investigation of how the future can be addressed.

Design/methodology/approach – Commencing with the short story *Mimsy Were the Borogoves*, which was included by the cybernetician Gotthard Guenther in the first German-language collection of American Science Fiction, published in 1952, the paper develops on the idea that cybernetics and art share what could be called a logic of initiation. Language matters in this context, the paper argues, and influences the way we understand both time and space. Writings in second-order cybernetics with a focus on Guenther, von Foerster and Bateson are juxtaposed with texts in the philosophy of art in the Western and Chinese traditions.

Findings – The article argues that second-order cybernetics as a logic of initiation is feasible exclusively on the basis of a theory that extends the well known binary logic that has been dominant in the Western world since antiquity. Openness is intrinsic to the logics of initiation and entails an understanding of time that goes beyond the dominant understanding of time as historical and linear. Logics of initiation, the paper further argues, are at the basis of ecological thinking and of relevance for all activities that entail and aim at social communication, including design and education.

Originality/value – The paper brings together understandings of time and space from various schools of thought and traditions for an in-depth investigation of second-order cybernetics' ecological approach to art, design and education.

Research/ Practical/ Social/ Environment implications – The paper will be of specific interest to researchers and practitioners working in art, design and education and everyone else who is interested in processes and frameworks that are sufficiently open to ensure the agency of others.

Research limitations – There are no known limitations.

Keywords: Second-order cybernetics, aesthetics, philosophy of art, design, education

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