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Early warning of risk in system dynamics

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Abstract. Society has a dynamic resulting from the interaction with the environment in which it operates, as well as from the policies and strategies that guide it towards predetermined objectives. Development plans must be systematically updated, so that the system as a whole is of an adaptive type, reacting to influences that appear over time. As a rule, planners and politicians focus almost entirely on this model that is applied more or less well or constantly. In parallel, there are germs in the system neglected by analysts or decision-makers and that develop unnoticed, becoming, after a while, precursors of transformations that can lead to evolution, but also to the degradation or even destruction of the system. Precursors act at first in the quantum micro-reality, later becoming visible through collective emergence into the physical macro-reality. Analysts should identify in advance the precursors of future events, analyze them and extract from them early alerts to provide them to decision-makers.

Keywords: development, risks, precursors, quantum reality, interdisciplinary.

1. Introduction

Technological transformations have radical trends in many areas, especially in interaction with the human factor. We consider human interaction with technology at the deep level of quantum reality, although there are still disputes regarding the acceptance of some or other of the current theories [1][2]. The speed of processes increases, the required quality is increasingly high, which requires real-time analysis and decisions. Early warning involves the identification of signals, especially weak signals, precursors that indicate the approach of a critical point (tipping point), a phase transition or a loss of resilience. Hence the need for early

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identification, in an inter-, trans- and multi-disciplinary approach, of phenomena and processes that occur, especially, at the interference between micro-reality (including quantum) and physical macro-reality. There is the possibility of accessing the subtle information generated by quantum reality, the precursor of subsequent events in physical macro-reality. Thus, the position of the observer, the speed of action and reaction of the system and its elements, the development and large-scale implementation of artificial intelligence, new occupational professions integrated with technology, the affirmation of the human factor, which can be considered a natural quantum system for decisions making at the level of consciousness, become important.

2. Between quantum and physical reality

The variability of reality

Reality is seen differently from one individual to another and is also changeable, including at the quantum level. The ignorance of reality, in a deterministic way, creates the feeling of insecurity in the human mind, a state that is difficult to bear. Through quantum collapse, man is facing a reality accessible to his perception, which gives him a certain security, making it approachable, regardless of difficulties. Indeed, *everything that is formulated becomes more tolerable* (Emil Cioran).

The interdependence of micro- and macro- realities

The quantum state of a particle manifests itself at the classical level C, but also at the quantum level Q, being visible through the operators, respectively, through the complex numbers z_1 and z_2. The tensorial product of the wave functions represents the dynamic state of the system of the two particles [3]. It's important the role of the observer, in relationship with quantum micro-reality, being admitted that the observer and the "particle" are together part of the whole. The conscious observer and the chain of wave functions of the measurement system are interrelated. The relationship of quantum phenomena with those in physical reality is realised by collapse of wave function (reduction, decoherence), etc.

Quantum camouflage

A quantum phenomenon unfolds "cleanly" if it is not influenced by the observer. It follows that at least one of the two concepts must camouflage its presence, leave as few traces as possible so as not to influence each other or unilaterally. A supply-demand market functions naturally if the mechanism for negotiating and awarding transactions is not known and controlled. Market observation and, especially, the real-time publication of the variation rate of the value of observables, influences the functioning of the market, moving it away from the contestable, disputable, and

perfect market state. Many interested market actors (agents, stakeholders) are not able to receive, process and react quickly enough to the information provided by the observer. The variations in market prices during negotiations are close to their quantum state. But, the improvement of AI assisted decision-makers will tend to lift the quantum camouflage, transforming the market into a quasi-deterministic or even deterministic object.
Similar things happen in other systems influenced by or even defined as integrating quantum processes: works of art evaluated by specialized critics and art consumers, planning and implementation of strategies, evolution of natural environment, etc.

Multivariable or composite quantum reality

An example of counterfactual history can be instructive for different approaches to quantum reality. The saying "if I had lived in Athens, I could have been a shipowner today" could be approached this ways:

- quantum state with two observables, X- to have lived in Athens; Y- to have chosen a career in maritime transport;
- current quantum state as a result of the superposition of states X and Y;
- by generalization, n quantum observables can be considered: X_1, ..., X_n ;
- convolution of observables, when the influence of one on the other is delayed in time, etc.

3. Precursors of future system states

Precursors of risks are symptoms that predict the approaching of a critical point and that are difficult to identify in the informational noise or institutional inertia: systems return more slowly to the equilibrium state after a disturbance (critical slowing down); system fluctuations become larger and more frequent; significant deviations from the average behavior; redundancy decreases, systems become more rigid and less adaptable to the environment; state changes expressed by indicators-parameters-characteristics, etc.
State transformations in the future of the system, planned or accidental, do not appear out of the blue, but are preceded by such precursors.
For example, the events and changes that occurred in the decades after 1989 were preceded by precursors, some of which were small oscillations, phenomena and germs specific to quantum reality (generated by the human mind, which was also changing its mentality), but which announced their subsequent emergence in the entire society that they influence through contagion.
Some examples of precursors presented below may be representative in suggesting to analysts and decision-makers new theories and models to assist them in predictive and proactive decisions.

Precursors in the quantum reality of society

There are precursors that have as their source the quantum reality generated in the human mind and that have an impact, especially in electoral campaigns: hesitant, unfounded political decisions, seeming to be intended to mislead the electorate towards different tricks; *double bind effect* - the state of confusion of voters who do not know who to vote for because parties cannot be identified by ideologies or programs, which are often absent; politicians lost in nothingness, intrigues, violating the Constitution and laws, drowning in crimes, corruption and betrayals, supporting occult forces to the detriment of national interests. At the polls, voters' decisions will collapse the states of the quantum political-social system in results that can be surprising and with the potential to generate new precursors that will be at the origin of future changes. More critical problems arise when the precursors who were already in power before the elections return to power after the elections. As George Orwell said, *you can't rebuild a nation with the same people who destroyed it*.

The objective function, strategic precursor of system dynamics.

The notions of purpose, objective, goal or target have had, have and will have different meanings over time, from one generation to another, with differences even between individuals in their evaluation, choice and interpretation. These change depending on the systems, their typology, the time horizon, the approach (deterministic, probabilistic, random, quantum), and can be criterial or multicriteria objectives. The strategy of choosing objectives has the role of precursor for the future states of the system, which follows evolutionary, stagnant or regressive dynamics.

The optimization criterion is usually a multi-criteria function, containing:

- Quantitative criteria: minimum costs, maximum revenues, minimum distances, etc.
- Planning horizon makes the difference in the application of different types of costs [4]:
    - Very long-term planning is a visionary, foresight strategy, across generations.
    - Long-term planning:
        - it is based on long-term marginal cost: the cost induced by an additional system or product when the production infrastructure is optimal compared to the demand;
        - it is used for optimal strategic development of the society and its systems.
    - Short-term planning (operational management on the spot market):
        - it is based on short-term marginal cost;
        - it is used for allocation of the production capacity.
- Qualitative criteria, refer to: the degree of demand satisfaction; social demand priorities; regularity of supply; availability of production capacity; safety and

security; rapid response to capacity demand; adaptability to ad-hoc requests; accessibility of demand to supply; mobility and flexibility; modal and intermodal coherence of networks; reduction of the risk of congestion; minimum energy consumption; minimum pollution, etc.

Refinement of logistics chains

The notion of logistics chain is of practical use, but it is not strictly correct theoretically. The logistics chain has no finite limits. A correct name would be *logistics segment*, and it is a sequence of operations between two specific points. The need to compose logistics chains and segments is a precursor to the future coherent bundle of logistics segments that will be sequences of operations that link two nodes in the network and that, at least in the mind of the decision maker, exist according to the principle of superposition. By composing the logistics segments S_1,..., S_m, upstream of node P, a product results that is delivered through segment R which is also a superposition of logistics distribution sequences downstream of node P. All of these become, in turn, precursors of an *algebra of logistics chains and segments*.

Market Destructuring

Analysts state that in the decades that followed 1989, Romania's national economy was almost completely destroyed, even civilization was seriously damaged. Exceptions confirm the rule. Among the precursors were the destructuring of internal and external markets, abandoning systems in multiple chaos that followed. Consequently, most production systems were destroyed, the economy becoming dominated by over 70% of companies controlled from abroad and which are mostly super- and hyper- markets that sell goods produced in other countries. The share of the national supply makes the new socio-economic structure unsustainable, generating deficits, inflation, poverty, etc. Transport activities (t.km), logistics in general, are too high compared to the total quantity of goods brought from producers located far outside the country, generating logistic chains over long distances that increase the consumption of materials and energy, as well as environmental pollution, fig.1.

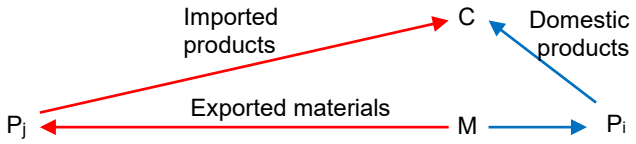

Fig. 1. National and international supply chains, 2024
(C - consumers, P - producers, M - raw materials)

It follows that the national economy, especially industry, must be revived in harmony with the activities of foreign traders and investors [5].

Destructuring of technological chains and networks

In the decades following 1989, the disappearance of economic development strategies, primarily of industry, was the precursor to going back in time and transforming the country into an *eminently agrarian country*, a status it had over a century and a half ago. The fall into the past began with the breaking of technological chains by destroying industrial links, which was the main precursor to the almost total liquidation of the economy. The change of political regime often led the national system to bifurcation points on the spatio-temporal continuum from where, one could choose evolution into a new paradigm on a higher level of reality.
However, the system's involution to a much lower level of reality was chosen.

The nonlinearity of the overstressed system

This contains generic precursors of structural market instability. If demand is very high, while supply is limited to the maximum value of production and logistics capacity, then the cost of production and price vary nonlinearly in relation to the supply exploited or the demand fulfilled, which is more visible as production approaches maximum supply, fig. 2.

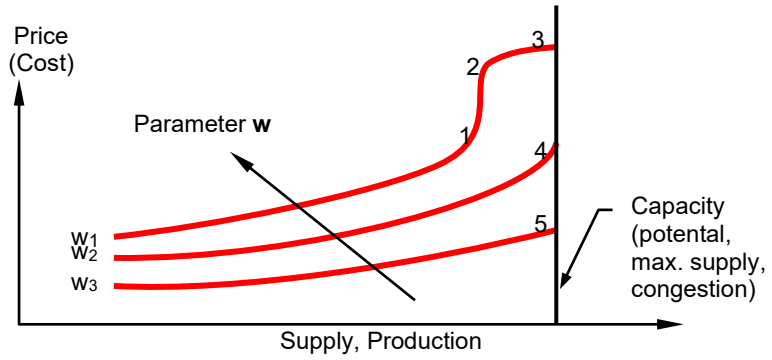

Fig. 2. Neliniarităty of overstressed system.

Considering a parameter w, such as the energy price, costs and prices have very large and nonlinear variations near the maximum potential supply barrier, risking structural instability followed by the 1-2 jump on the conjuncture curve w_1 [6].
Some examples may be suggestive:

- Freight variation when the demand for maritime transport is comparable to the capacity of the world fleet or on a given market, especially when the price of oil varies greatly.

- The cost of introducing additional slots on a congested infrastructure sector.
- The phenomenon of congestion on an arc or node of productive infrastructure when the production flow approaches the maximum capacity of the manufacturing or logistics line.
- The cost could evolve to the upper level on the 2-3 trajectory, even slightly above the production capacity barrier in overload mode, through organizational and management measures, as well as by neglecting maintenance work, a situation that is especially valid in the short term.
- The irrational behavior of the manager will be automatically penalized. The increase in energy prices is a precursor to a high elasticity of the supply curve (w_1). And if the maximum supply is much too high, fixed costs become very high. If the market demand is low, then the price or tariff that can be obtained per unit of product sold is much lower than the fixed costs of maintaining production capacity in operation, because customers are aware of the overcapacity of the supply in the market. As a result, in order to obtain the prices specific to the elastic curve w_1, the bidder must reduce its production potential by various methods: reducing the production rate, closing some technology lines, scrapping and dismantling some equipments, etc. Otherwise, even though the price of oil is high (w_1), the supplier will offer a less elastic curve and much elongated to the right due to the overcapacity.
- So, the main precursor to obtaining maximum profit is the adjustment of supply to demand.

Hysteresis in market fluctuations

Demand, as a precursor to market equilibrium, causes a hysteresis in the nonlinear dependence between cost [tariff, price] and supply, when demand is increasing or decreasing, fig. 3.

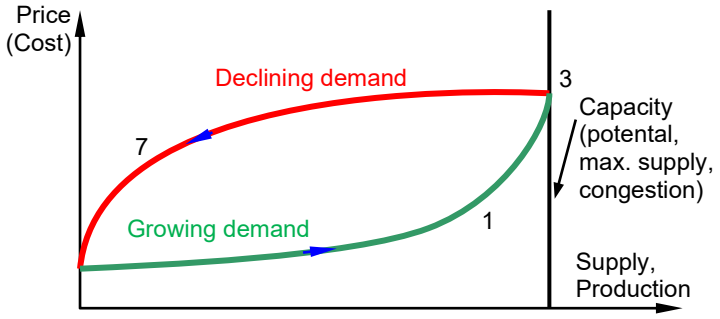

Fig. 3. Market in hysteresis.

Doppler effect for online perception of critical states

The mind of the analyst or decision-maker has the ability to detect changes in the state of the system from the quantum reality of its subtle dynamics, by deciphering the wave function of the events that are approaching, that are about to happen, as well as those that are extinguished by attenuation.
When the threat of crises approaches in relation to a certain system, concerns increase, oscillations of the current state, fibrillation appears through the increasing frequency of signals. When crises are removed, optimism, relaxation increase, calm returns, deconcentration, forgetting through the decrease towards flattening of the frequency of disturbances.
Similarly, such dynamics occur before and after technological changes, events in the financial market, electoral campaigns, competition, etc.

The system under the greenhouse effect

A system can be, for various reasons, under influences similar to the greenhouse effect. The claustrophobic state of an isolated system is a precursor to its collapse in the near future.
Some examples of such precursors are significant:

- the isolated systems in terms of information, technology, economy, trade, embargo;
- the isolation of a contaminated area: epidemic, radioactive leak or toxic gas;
- the failure of the quality management system to function correctly;
- areas or domains affected by restrictions or constraints;
- barriers to entry-exit into or out of the market (non-contestable market);
- logistic barriers that affect the normal operation of systems: liquidation of the maritime fleet led to discretionary freights offered by third parties who knew that national fleet no longer existed, etc.);
- the isolated system is a subnet of the network, and as a result, over time, a double circulation is created at the border of the subnet, one internal and one external, caused by the natural need to complete the internal connections of the two parts of the fragmented network; reinvented objects appear because there is no access to the other subnet;
- the isolation of systems is a precursor that leads to their fragmentation and lack of networking, deterioration of relationships, conflicts worsen, accidents increase in intensity and number, and competitiveness decreases.

Technological ethnicity

Like any ethnicity, technological ethnicity is a precursor to the stagnation of its component systems. Therefore, the respective community of systems should not remain for long in a distinct state, isolated within a certain context, environment or

market, because stagnation eventually turns it into a resource-consuming "black hole". It must be metabolized by the comprehensive system in which it is located.

Price liberalization, precursor to market anomalies

The destabilizing situations in the energy market are significant through the perverse effects of revenue diversion to intermediaries on whom analysts have raised reasonable suspicions of corruption and hidden interests. They pressure politicians to liberalize tariffs in the energy market, although this is not a free and contestable market that would lead to a correct balance between supply and demand. As a result, the markup of intermediaries selling energy to domestic consumers is comparable to the cost of production and even more, reaching even 100% and above, instead of being 1-4% compared to it.

Destructuring the authority

Corruption is the main precursor to the destructuring of authority on every central and local level of reality. Therefore, strange antisymmetric measures were generated, that became precursors of other social slippages [7] according to the rule "take from the poor and give to the rich", increasing the incomes of certain categories of employees so that they are not tempted by corruption, special pensions, unjustified social benefits that generate anomalies on the labor market, etc.

The post-factum transformation of revolutionaries into mercenaries

This was achieved through precursor actions, such as rewarding them with various advantages and facilities: land, apartments, allowances. They became a privileged category, their number increased according to saying "we were a few, but we remained many", generating new forms of corruption.

Tax amnesty

This is a precursor to premeditated tax evasion. Such an attempt, initiated in the second half of 2024, consists of erasing the debts of bad payers. Questions have arisen on precursors to future evils:

- Is it right, moral, normal, legal? Are those who pay their tax obligations on time wrong?
- Will those who are fair still be fair? Will they not say that social values are inverted?
- Will anyone still pay their tax obligations, knowing that amnesty is possible, the precedent being set?
- Does tax amnesty, like any tax exemption, corrupt market competition?
- Is tax amnesty a disguised subsidy that benefits some market actors?

- Will parliamentarians be infected with such habits and vote the wrong way in the future?
- Will children be shocked by such decisions that go against what they know about right and wrong?
- Is the institution of tax collection still necessary? Etc.

Granting salary bonuses

As a rule, bonuses are not related to the work performed, some being ridiculous (bonus for embarrassing work, bonus for sitting in a chair, bonus for being a woman, bonus for bonus, etc.). The bonuses, cumulated, sometimes exceed the actual salary. These were also the precursors that announced later phenomena, such as special pensions without contributions.

Granting allowances for social positions

The allowances granted to individuals do not always reflect their contribution to the results of the institutions and companies concerned. In the crowded boards of directors of companies with majority state-owned capital, the members' allowances are set as a fraction of the company CEO's salary and not according to their contribution to the annual result. The allowances are granted monthly or per meeting. As a result, the salary of CEO, set by the interested members of the boards, have increased aberrantly, although many companies are at a loss or make a profit comparable to a newsstand.

Incentives to do their job

Sometimes, it is said that certain categories of employees should receive additional income, in addition to their salary, as well as special pensions, in order not to be corruptible, although it would be enough for them to respect the job description and the employment contract. In such an approach, there is a risk through contagion that other workers will also request such aberrant bribe in order not to do the opposite of what is in the job description for which they are already paid [7]. These kind of reward is absurd because the worker receives the contractual remuneration (Luke 17.9-10).

Ignoring differences between categories of public servants

The deliberate confusion between the categories of public servants is a precursor to disputes pro and cons regarding waste of public money. There are two categories of public servants:

- *professional public servants* (those in education systems, in health, culture, religions, defense, public order and others like them), who are part of the infrastructure of society;

- *clientelist public servants* (politicians and their acolytes from central and local institutions) who, as a rule, are toxic to society - exceptions reinforce the rule, and it is necessary to reduce their number to the minimum. Clientelist public servants are the precursors who ruin society by increasing the number of employees, bureaucracy, increasing and supplementing their own income, inventing ridiculous and unjustified bonuses, and granting favors.

Eliminating these anomalies must begin with separating the two categories of public servants, even giving them different names, thus avoiding their confusion [7].

Precursors of large-scale waste and plunder

Some politicians, obviously amateurs, insist on selling everything that is valuable, effective and efficient in the national wealth, to cover the expenses and debts incurred by them. Someone tell them that a leader, be he manager-administrator-minister-president, who sells assets from the organization, institution or national patrimony for which he is responsible to cover the expenses, is wrong and must be removed. The leader's objective must be to make the assets and the national wealth, more efficient and increase them.

Paying employees through income from asset rental

Some clientelistic managers and administrators, appointed to manage companies with majority state-owned capital, pay a large part of their employees' salaries with money from income obtained from renting the company's assets, assets that belong to the company's shareholders and not to the respective employees. That is, a precursor to remuneration without work and tax evasion by diverting income to salary expenses.

Governance and NGOs

There is often pressure to replace government decisions with NGO opinions. So, if a musician gets a trowel, does he automatically become a bricklayer? And vice versa?

4. Conclusions

This paper is a plea for the systematic identification and tracking of risks, for the use of the early warning capacity of precursors to put a preventive and adaptive system management mechanism in the hands of decision-makers in advance. Capturing the signals given by precursors contributes to increasing the resilience of systems, avoiding or at least mitigating crisis situations through intelligent management. It is necessary to organize the online functioning of an inter- and trans-disciplinary precursor management system or to include for this purpose

only, a module in the quality management system. This means anticipatory leadership that can act before the damage occurs.

References

[1] Hameroff St., *Ultimate Computing*, Elsevier ISBN 978-0444702838, UK, 1987.
[2] Penrose R., *The Emperor's New Mind*, Oxford University Press, UK, 1989.
[3] Messiah A., *Mécanique quantique*, Tome 1, Dunod, Paris, France, 1969.
[4] Cuncev I., *The Principles of Pricing for Infrastructure Access and Capacity Allocation*, Managing Development for CFR/Marfă/Călători, Systra, Bucharest, Romania, 2007.
[5] Cuncev I., *Fundamentals in very long term planning*, Proceedings of ZASTR 2024 Conference, Craiova, J. Eng. Sci and Innovation, **9**, 4, 2024, p. 471-480.
[6] Cuncev I., *Structural instability of overstressed systems*, Preliminary study, ICPTT, Bucharest, Romania, 1978.
[7] https://cuncev.wordpress.com