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Article

A General Law of Functionality: VanCampen's Law

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Abstract - Information as a physical essence which can be quantified and can contain meaning is often misunderstood. The interdependent relationship and equivalence principle between matter-energy–information is probably yet unknown by the general public. People are not aware of its significance. By quantifying available or lacking information, verification of functionality and performance of any anthropogenic system such as industries, organizations, corporations, politics, products or governments becomes plausible. In this paper we introduce the description: 'social living systems of communication' for man-made and natural systems [1]. The abbreviated term; 'living systems' is based on the book 'Living Systems' [2] in which Miller describes the trinity of information, matter and energy for society, will be used throughout the text. The portmanteau 'Realimiteit' will be introduced. It expresses that reality has its limitations which are the natural boundaries of and for functionality. The primary research question is: 'what are the natural and universal criteria or conditions of sustenance and functionality of living systems?' A bridge between physics, biology and social living systems will be constructed [3] to synthesize the probable causes for entropy.

Keywords - Information dynamics; Energy-mass-equivalence; Entropy; Negentropy; Realimiteit; Biophysics; Social entropy; Algorithms; Performance; Probability; Perception; Bits; Bytes; Deception; Propaganda; Gaslighting; Information suppression; Competitive; Ideology.

1 Information about information

"In the beginning was the Word, and the Word was with God, and the Word was God" [4]. In the beginning was the information, and the information was with God and the information was God. In the beginning there was the Big Bang, a state of energetic equilibrium estimated at 13,8 billion years ago. Solar Systems were formed about 4.6 billion years ago and living systems, life, emerged around 3,8 billion years ago [5]. Learning about these estimated stages in time is processed as information. The ability to communicate, which is the exchange and usage of information allows all living systems to evolve, thrive and emerge into novelty. In his book 'Information' [6] Floridi lists the various types and interpretations of information as follows:

- Mathematical
- Semantic
- Physical
- Biological
- Economic
- Social [7]

The idea of information is that information observed, interpreted, and processed through human perception and consciousness has been historically distorted since people once believed that the world

was flat and believe they can control nature by force, which is physically impossible.
Living beings are the physical and biological doors of perception and the determining factors of information processing. As an initial test to verify the physical significance of information, twelve rhetorical questions do demonstrate that information is fundamental:

1. Consists everything we know or believe as people of information?
2. Does everything people perceive consist of information?
3. Could information be equal to probabilities?
4. Does human imagination consist of information?
5. Does human intuition consist of information?
6. Do human feelings and sensations consist of information?
7. Does everything that man makes, creates or build start with an idea (information)?
8. Can information enter a human being only through all senses?
9. Is information at the subatomic level equal to potentiality?
10. Is information required for natural, living systems to function?
11. Is all physics and all knowledge written in the language of information?
12. Can one build a house, write a letter, produce a product without information?

Rhetorical questions do not require answers. The answers suggest an initial probability which is that information is fundamental in and for living systems to function. It is through human observation and perception, through all available conscious or subconscious senses, not just by the usual scientifically accepted empirical ones: sight, smell, touch, taste sound, that information enters body and mind of all physical living systems. The physicist Sara Imari Walker in her book "Life as no one knows it" [8] confirms: "there is only one example of life on this planet, and it is a bifurcating pattern of information structuring matter. The fundamental unit of life is not the cell, nor the individual but the lineage of information propagating across space and time. Information causes things to happen."

2 Understanding Entropy

Understanding entropy is a must. It was introduced by Rudolph Clausius in 1865 when he discovered the 1st and 2nd law of thermodynamics. Norbert Wiener [9] the originator of Cybernetics meant information and disorder by it but introduced 'Negentropy' as negative entropy by which he and Leon Brillioun meant order [10]. Entropy is a notoriously difficult concept to clarify and to grasp, because it can be interpreted and used in various ways. Rolf Landauer [11] asserted that information is physical and related it to thermodynamics which requires the dissipation of energy. Dissipation can be interpreted as squandering, but for this study it implies displacement of energy, rendering it unavailable for useful work. He measured entropy in a number of bits which are often regarded as binary units. One byte consists of eight bits of information.
Claude Shannon proposed that entropy and information were the same, whilst later it became accepted that negentropy means negative entropy which equals information. [12], [13], [14], [9]. Entropy and Negentropy equal information and equal energy. The former can be understood as unavailable information while the latter can be understood as available information within the context of energy and mass.

3 Thermodynamics

Understanding what entropy entails start with the description of the two laws of thermodynamics. Information understood as energy to do useful work obeys the same laws of physics. Thermodynamics was originally invented by Nicolas Sadi Carnot [15] who said that no engine working between two reservoirs at constant temperatures can have a greater efficiency than a reversible engine. James Gleick [16] writes in his book 'The Information': "no matter how much energy a closed system contains, when everything is the same temperature, no work can be done." Rudolph Clausius [17] related it to heat and energy, characterizing the degree of disorganization or unpredictability in a physical system. When an engine runs on heat, it loses heat to the environment, so not all 100%

of energy is available. The quantity that can´t be used he called Entropy and comes from Greek meaning: Transformation. To him it was the unavailability of energy or its uselessness for work. This was quantifiable as temperature, volume or pressure, a quantity which was in need to be named related to energy, but not energy. David Bawden and Lyn Robinson [18] of the Center of Information Science, City University in London, wrote a paper 'A Few Exciting Words: Information and Entropy Revisited.' They write: 'If there were no missing information, no uncertainty, the micro-state would be the same and there would be no entropy'. Entropy can be understood as the information and energy we don't have, or don't use, related to uncertainty. This corresponds to a lack of information which is a generalized statement based on the work of scientists like Tom Stonier [13]. He describes entropy, but never seems to have reached an overall accepted definition applicable to both open (social) and closed (physical) systems. A physically closed system would be a steam engine, and a physically open system would be society. An observation by reading about entropy and negentropy is that these concepts were appropriated by materialistic, mechanistic, linear scientists, trying to put a number on entropy and negentropy. The first law of Thermodynamics is the Law of Conservation of Energy. It states that universal energy can't be created nor destroyed. Universal energy is constant, energy is never lost, it changes its form. Energy to do useful work is an accepted definition. When it is displaced or dissipated, it is still available for work but somewhere else thus made unavailable for work here. The second Law of Thermodynamics states that entropy always increases. It describes two kinds of processes, heat and work, which can lead to a change in the internal energy of a system. Heat always flows from hot to cold regions. This is an irreversible process; heat and energy always move towards more disorder.

Physical Entropy	**Information Entropy**
• A measure of uncertainty about the state of a physical system. • Unavailability of useable energy to do work. • A state of universal flux which is irreversible (Clausius) • A state of universal flux which is reversible (Vopson) • A natural flow of energy for living systems in which to evolve • Uncertainty or disorder	• One message among all possible states it can be in • The unavailability of useful possible messages that a communication source may produce • Uncertainty or disorder • Randomness • Misunderstanding of message • Information we don't have or use

Entropy can be attributed to a "cost" of information or energy which needs to be used to restore entropy towards negentropy. Information relating to useful work to be done (energy) in physical systems such as heat or steam and in communication systems the need for correcting information by adding or deleting meaning to convey a clear message = work to be done (energy). Entropy in the context of our entropic universe (2nd law of thermodynamics) can be described and understood as:

1. Beneficial: it allows for life to be formed and sustained. In a non-entropic universe, nothing would move, as a thermodynamic equilibrium would exist.
2. Future: entropy can't decrease, it increases over time and will lead to maximum universal equilibrium, end of times (heat death).

The anthropogenic impact of using or not using information is key. As follows: less energy = more entropy, more energy = less entropy [19]. Optimal information = minimal entropy=minimal

energy dissipation [14].

4 Practical examples of entropy

Cleaning up a messy room; the information feedback or the message derived by observation is available: 'the room is messy'. It requires internal and external energy to do something about it i.e., to change the entropy (disorder) into order, but only until natural entropy takes over again and leaves the room going back into entropic state, by dissipation of energy i.e., losing energy over time. Dust accumulates without human action – requires energy to clean it up. This is known as the Arrow of Time [20], which is Eddington' expression of thermodynamic increase of entropy over time between two moments of observation in which the 1st measurement shows less disorganization or entropy than the second one. If meanwhile no information in the form of energy: picking up things, placing things where they belong, using a dustcloth, is applied, disorganization increases. Isolated systems spontaneously evolve towards thermal equilibrium—the state of maximum entropy of the system. More simply put: the entropy of the universe (the ultimate isolated system) only increases and never decreases, unless information feedback, low entropy energy e.g. sunlight, food (metabolism) is used to restore or equalize natural negentropy in living systems. This is auto regulated by life itself. Life creates and sustains order by the act of living [21], [22]. Omnis Cellula e Cellulae; all cells come from cells. [23], new cells develop by the division of pre-existing cells. All cells come from a cell and that cell also comes from another cell [8]. Information and energy are profoundly linked [24]. Information can be stored in any system to give it unique properties. DNA, genes, neuron synapses, electrons or neuro peptides are operating as information messengers and can also be understood as messages on their own [25]. Information can't be destroyed, because living systems consist of particles which contain information in themselves about themselves. [14], [26].

5 Bits and Bytes

James V Stone in his book 'Information Theory' [27], writes: information can be understood as the amount of information required to choose between two equally possible alternatives (e.g., 1 or 0, off or on, up or down, etc.). Important is to understand the distinction between bits and binary digits. He describes them as follows: a binary digit is the value of a binary variable where the value can be either a 0 or a 1. A bit is the amount of information required to choose between two equally probable alternatives (e.g. left/right) whereas a binary digit is the value of binary variable, which can adopt one of two possible values (i.e. 0/1). A bit is a definite amount of information. One byte is equivalent to eight bits. For example, the letter A consist of combination of 8 bits, zeroes and ones, as follows: 01000001. If a person knows where he is going and is offered an alternative which confirms this, he is given a binary digit, but no extra information. On the other hand, if a person has no idea where to go next, and is handed a choice, he is given information in the form of a binary digit and has gained one bit of information. This means that a binary digit gives half a bit of information. Information can be expressed as a quantity next to a quantity of mass and a quantity of energy, all three of them interrelated, interconnected and interdependent. The mainstream, outdated consensus is that the universe consists of matter and energy alone, is becoming a fundamental misperception, the one which Fritjof Capra calls 'a crisis of perception' [28]. It leads to a misunderstanding of reality that information is not deemed important. Information may even be more fundamental than physics. Dr. Vopson [14] suggests that information would be the fifth state of matter, next to gas, liquid, solid and plasma.

6 A Mathematical Theory of Communication - Claude Shannon

Mathematician at Bell Laboratories Claude Shannon [12] provides a mathematical definition of information and an equation to calculate information entropy in bits of information. Shannon describes precisely how much information can be communicated between different elements of a living system and the limits of communication transfer rates in any system, whether man made, physical or biological. It measures the uncertainty associated with the probability of distribution. His goal was to predict a certainty of outcome whilst conveying a message for which a minimum quantity of

information was needed. E.g. predicting if a Dutchman will be elected to be the next Prime Minister in the Netherlands needs little or no information but predicting which football team will win the European Cup next year needs more information. Certainty increases, whilst the probability of entropy (uncertainty or disorganization) decreases. It is not about more, but about less, but optimal information which needs to suffice to convey a clear and understandable message. From Shannon we learn that natural, physical and biological systems only use a minimum required quantity and quality of information. Because information can be understood as equivalent to energy, any living system that obtains an excess of information displaces the correlated energy through dissipation [14]. This is a logical deduction, a measure of how much information on average is needed to describe outcomes of a distribution which are linked with uncertainty. If we are less certain about an outcome, we need more information to explain it. Shannon's entropy is information. Understanding that not enough information may cause miscommunication and misunderstanding of meaning, he applied the notion of redundancy to compress information without losing its meaning, just like nature when it is minimizing its use of energy to do maximum of useful work. It can provide useful information about how much information we gain from observing an outcome or tell us how varied the outcomes of distribution of information are [29].

7 Redundancy

In 1948 Claude Shannon apparently said; 'Information is the resolution of uncertainty', which he demonstrated by developing a method of communicating noiseless information in digital format, which presently allows this research to be typed on a computer. This noiseless, undisturbed communication was made possible by adding redundancy to the transmissions which can be understood as a constraint, an extra ration of predictability limiting entropy. Redundancy reduces error by making certain letters and groups of letters more probable, increasing predictability. It can be understood as information density [30]. A sentence of more letters can be reduced to less letters as long as the coherence stays intact e.g., 'lge lv rm, 2 br, basmt'. When using Telex, a message would often be shortened by redundancy, e.g., it would be ended by TTFN, meaning 'Ta Ta for Now' or today we use in emails, FYI, 'For Your Information'. These early efforts to improve communications are the foundation of computer compression e.g. MP3 sound files. Futurist Alex Vikoulov [31] calculated that an average conversation bitrate is about 39 bits per second. He said that the basis of material reality is nonmaterial information and that information equals reality (reference: the rhetorical questions asked earlier). This quantification method demonstrates the probability that information indeed is a physical essence. It can be quantified as a physical matter with or without meaning. The information is registered by physical systems. 'It from Bit' wrote John Archibald Wheeler [32]: 'Every particle, every field of force, every 'ít' even the spacetime continuum itself, derives its function, its meaning its very existence entirely from yes or no questions, binary choices or bits.' (note: computer information processing analogy). He mentions 'function' which can be considered as efficient functionality of living systems that are dependent on yes/no questions and 1 or 0 choices i.e., optimal information. Alex Vikoulov states, quoting Archibald Wheeler; 'all physical things are information theoretic in origin in a participatory universe.' In simpler terms: a universe of participation and cooperation through a communication in bits of information is feedback dependent. If everything depends on yes or no questions to survive, Wheeler demonstrates that universal functionality depends on truth (yes/no, 1/0, on/off, true/false). This implies that so called 'politically correct gray areas of 'half-truth/untruth' are not supported by laws of nature, thus are entropic.

8 Mass-Energy-Information Equivalence Principle

Vopson describes the M/E/I – Mass-Energy-Information equivalence principle [14] as follows: "Information is a form of matter, it is physical and can be identified by a specific mass per bit while it stores information, or by an energy dissipation following the irreversible information erasure operation as dictated by the Landauer's principle also known as Landauer's limit [11]. A theoretical limit of energy consumption, which is that while changing information stored in in a computer heat (energy) is dissipated. Any irreversible process has to be dissipative. If you have something that takes place irreversibly you should expel some energy in this process, dissipate some energy. Storing information

takes energy, deleting information takes energy. The fact that information at erasure dissipates energy means that information is energy. Information is not just a physical form of energy but has mass. You need to consume energy to consume information."

Information can't be disconnected nor separated from the structure of reality [24]. Physical information in the form of feedback is an influencing, but required energy, made available through cognition. Processes that use a minimum required quantity and quality of optimal information are adaptive whilst processes that are not using the needed, available, optimal information, which is minimally needed to not dissipate energy unnecessarily, become non-adaptive, hence non-performing. A quantity of information ≡ (equivalence symbol) a quantity of energy in living systems because they are interdependent. Lack of information means missing the required energy to maintain and self-organize matter containing mass. Entropy is the measure of disorder in a process or a living system dependent on the availability or nonavailability of information equivalent to energy and mass. Entropy is the measure of disorder in a process or living system by the availability or nonavailability of energy ≡ information ≡ mass. Information answers to the same laws of physics, namely that natural entropy is information which is used by our universe, planet, nature and us (living systems) to sustain order and structure matter whilst safeguarding sustenance. Information cannot be destroyed, just like universal energy (1st law of thermodynamics) because it is connected and a part of quantum reality i.e. the fabric of existence, despite people who burn books, censor the Internet or enforce propaganda. Order depends on a minimally required quantity of energy in the form of information, and visa-versa, to do work, in other words, to function.

We now can work with two laws of thermodynamics of closed systems by Clausius [17] that are the basis for Ludwig Boltzmann's [33] development of his entropy equation and the 2nd Law of Information Dynamics proposed by Vopson [14]. A summary to simplify would be as follows:

a. The energy of the universe is a constant -Energy can neither be created nor destroyed - 1st Law.
b. The entropy of the universe always increases. 2nd Law. It governs the direction of natural processes.
c. 2nd Law of Infodynamics: The totality of entropy is the sum of the initial physical entropy and the newly created entropy of information. This is somewhat counterintuitive because we may think that more information increases negentropy, but it actually is that less information, or minimal information that is required as not to dissipate too much energy for the Arrow of Time to be delayed. This allows living systems to flourish. Increase of universal entropy is the very condition for order in living systems, because the state of entropy means that movement and process of energy and information remain possible, and life can thrive. The law states that the information entropy of systems containing information must remain constant or decrease to reach certain value at equilibrium. Vopson [14] mentions a form of constant universal negentropy subsists which would equalize with the 2nd Law of Thermodynamics, creating 'pockets' or "enclaves" for life [9], [21], [34] hence emergence, autopoiesis and novelty are supported. Information creation in relation to energy can be corroborated by the observation that no information can be created without energy input. This is significant, because it clarifies the interconnectedness and interdependence of the M/E/I equivalence principle. The relationship of the 2nd law of infodynamics and both laws of thermodynamics can be linked to the working of biological DNA [30] with genetic information. Vopson'S 2nd Law of Information Dynamics demonstrates the entropic loophole (Schrödinger and Einstein) in which life itself escapes the 2nd law of thermodynamics and physical entropy is inverted by "Gibbs" free energy in the form of negentropy equivalent to information [35].
d. Life has thrived since about 3,8 billion years by informative adaptation toward novelty by memory, experience and learning. This forms the basis for the recent Assembly Theory [8]. Sarah Walker's theory suggests that from the earliest time that life emerged from chemical quantum soup, life assembled (like LEGO bricks) itself from basic existence as molecules into the conscious homo sapiens of today through information.
e. Examples of natural entropy conversion are: High entropy sunlight is converted into low entropy energy (photosynthesis). High entropy food is converted into low entropy nutrients by metabolism.
f. Stored information in DNA gives form and instructions to living organisms.

g. This would enable an upgrade of Einstein's special relativity theory $E = mc^2$ to $E = mic^2$, to include information, which has mass and, according to Landauer and Vopson, is equivalent to energy.
h. 'Closed' physical systems are not hermetically closed because forces of nature such as gravity affects them.

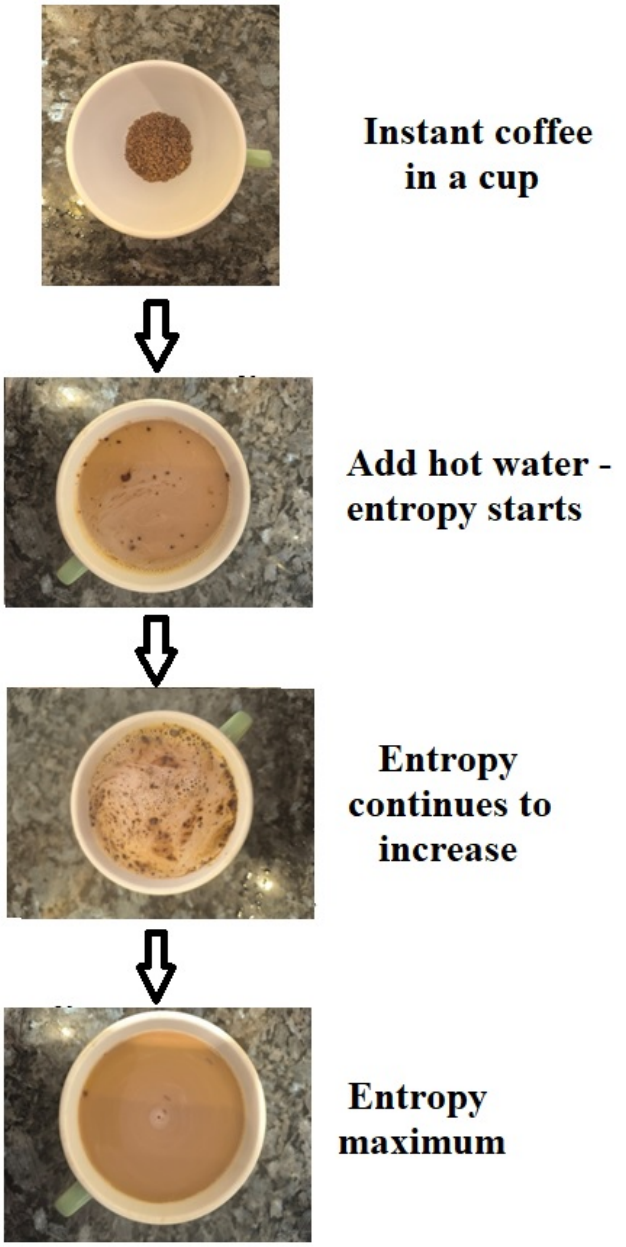

Figure 1: Physical states of entropic evolution in coffee. Source: van Campen (2024)

The arrow of time only moves forward and not backward. Chaos or disorder is easier to create than order, because it takes work (information and energy) to restore order. Universal and physical entropy tends to increase over time, but the probable tendency of the universe to employ information enables equalization which allows for living. James Clarke Maxwell [36] eventually agreed with Clausius that entropy was the unavailability of energy. He ran a physics experiment named Maxwell's Demon. He envisaged a gas initially at uniform temperature within a box separated into two compartments, where a tiny being was controlling a shutter between the two compartments. By measuring the energy consumed through the feedback and actions by the 'demon' as the tiny being was called later, this consumption led to a net increase in the system's entropy [37]. Leo Szilard formulated an equivalence between energy and information.

9 Dancing Wu-Li Masters

Gary Zukav [38] writes in his book 'The Dancing Wu-Li Masters' that time flows into the direction of the large probability and that is the direction of growing entropy. The theory of increasing disorder, or growing entropy is based on the second law of thermodynamics. Generally, subatomic particles are considered to be such conceptually isolated and ephemeral entities that the 2nd law of thermodynamics does not apply to them, but this law does apply to molecules, which are very complex compared to subatomic particles; to living cells, which in turn are more complex than molecules; and to animals and humans (biological living systems) made of billions of cells. Entropy is a probability pattern of and for all living systems, including social living systems of communication. Only at the subatomic, at the quantum level, does the forward flow of time lose the probability pattern of meaning. Aging or corrosion can be understood as entropy, because the arrow of time applies. Entropy is the result of maximum mixing of elements, whilst negentropy [10] contradicts this by breaking down entropy in separate parts to create order. The dissolved milk that can't be separated from the coffee anymore is a probability pattern of entropy, because the probability of ever returning to order is too complex and highly unlikely. Ludwig Boltzmann [33] designed an equation using his Boltzmann constant (k) which calculates the quantity of entropy in joules in living systems. Therefore, as well as information is quantifiable, entropy is also qualifiable, which confirms them as physical states and the probability of the irreversibility of natural processes. The relationship between laws of probability, irreversibility and entropy also apply to anthropogenic conceptions within societies [7]. On Boltzmann's grave stone his famous probability equation can be read: S = K log W (S = entropy of an ideal gas, K = Boltzmann's constant, W = the number of micro-states related to the macro-state of the gas). The formula shows the relationship between entropy and the number of ways the atoms or molecules of a certain kind of thermodynamic system can be changed. What is the difference between a "micro-state and a "macro-state"? The Macro-state is a physical situation we can recognize and distinguish. The micro-state is a situation at the level of individual particles which we cannot recognize [18]. Bawden and Robinson give this example; in two glasses of water filled equally (they are the same and can be observed i.e. as the macro-state) the positions and velocities of the water molecules can't be seen (the micro-states), which Boltzmann related to entropy, symbol ΔS.

10 Cybernetics – Feedback Loops

This important, merely overlooked and misinterpreted science was developed by several scholars in the forties of the last century is also described as 'Control and communication in the animal and the machine'. Dr. Norbert Wiener [9] and Dr. Arturo Rosenblueth [39] laid its foundation. Cybernetics is the study of linear feedback control and can be easily understood by a metaphor of navigating a ship from port A to port B. The word Cyber comes from Kuber, the Greek word for Helmsman and to steer artfully to a goal [40]. Underway the helmsman will have to observe the weather, the depth of the water, the draft of the ship, its geographical location, the strength of currents and wind direction. This is called feedback, crucial information without which the ship cannot reach port B.

11 Law of Requisite Variety – Ashby's Law

Optimal information is a requisite, which Dr. Ross Ashby [41] transformed into his law. Variety implies the necessity for optimal information and relevant amplifiers and attenuators by which maximum certainty and reduction of risks can be achieved, as follows:

• A situation can only be controlled if the variety of the controller matches the variety of the situation to be controlled.
• Requisite Variety is the capacity of a living system, including an organization and society to respond to risk.
• A society generates tremendous variety (complexity) and tries to control it in its own way through checklists, regulations and laws.
• If variety is not matched, systems will spin out of control (uncertainty).
• It is impossible to control for every variable so most variety is absorbed through relationships with

other systems.
• It means that in Risk Management, only enough variety in a system can absorb, or control risks originating from outside variety.
• By using feedback, this information is fed into the system to allow the system to adjust and learn constantly.
• It is impossible to control every risk as systems fluctuate by information from constant changing variety in a nonlinear, complex environment. "Information reduces uncertainty" [42] based on Shannon.
• Human variety, environmental variety, social variety, regulatory variety (complexity) change all the time thus can only be governed by the use of real time feedback (information).
• Each living system needs to maintain and develop an internal requisite variety to be able to absorb 'outside' variety. This means to have the means with the combined knowledge, experience, expertise, influence, equipment, tools, etc. to do so, using optimal information as attenuators to dampen variety and variety generators to build variety. An example is a police car. If the car looks like an ordinary car, people won't recognize its importance, so more variety in the form of different paint, a flashing light, traffic control safety tools, weapons, VHF communicator, etc. is added. Another relevant example is a traffic light for pedestrians. Initially they were equipped with a red and green light alone, but to enhance safety, a second timer was added to inform the public about the time they needed to wait for the light to change, reducing haste.
• To protect cell phone obsessed individuals captivated in their screens, red and green lights are embedded into the sidewalks. (requisite variety i.e. amplifier by information).
• Health and Safety performance can be improved by adding variety in the form of PPE, Personal Protective Equipment, gas detectors, traffic lights, life vests, illumination and so on.
• Ethics as physical information is an extra variety used as an information feedback loop and is a risk attenuator (a damper, reducer).

Adding to requisite variety, according to the grandson of Ross Ashby, Mick Ashby [43] is his research on ethical theorem which lists nine conditions / criteria for sustainable living systems as ethical regulators and super ethical systems. Mick, a personal friend, died too young. He designed a systemic, cybernetical method to predict longevity of living systems. His contribution to cybernetics, in the footsteps of his grandfather Ross Ashby is significant as he developed the Good Regulator Theorem. Note: these are all requisites; attenuators and generators a.k.a. amplifiers or dampers to maximize variety and achieve viability in the "learning organization".

1. Truth about the past and present.
2. Variety of possible actions.
3. Predictability of the future effects of actions.
4. Purpose expressed as unambiguously prioritized goals.
5. Ethics expressed as unambiguously prioritized values.
6. Intelligence to choose the best actions.
7. Influence on the system being regulated.
8. Integrity of all subsystems.
9. Transparency of ethical behavior.

"The resulting Ethical Regulator Theorem provides a basis for systematically evaluating and improving the adequacy of existing or proposed designs for systems that make decisions that can have ethical consequences; regardless of whether the regulators are human, machines, cyber-anthropic hybrids, organizations, corporations, or government institutions." Cybernetics combines the conditions for optimal functionality of living systems. This cannot be done by a pre-elimination process of information that could be considered irrelevant or forbidden. Cybernetics is holistic, it excludes the reductionistic, mechanistic approach, which could miss sufficient feedback. Dismissing human senses, which are located in the total of the conscious and unconscious human being, causes information deficit disorder which society experiences.

12 Cybernetical viability testing

Viable or non-viable can be easily depicted by Feedback Loops maps: Follow the feedback loop lines whilst observing the boundaries of functionality (realimiteit). One map depicts function (viability) because the ability to exchange information (feedback) is intact. The other map depicts non viability or malfunction because the feedback loops are severed, making communication or cognition; the exchange and processing of optimal information (feedback) impossible.

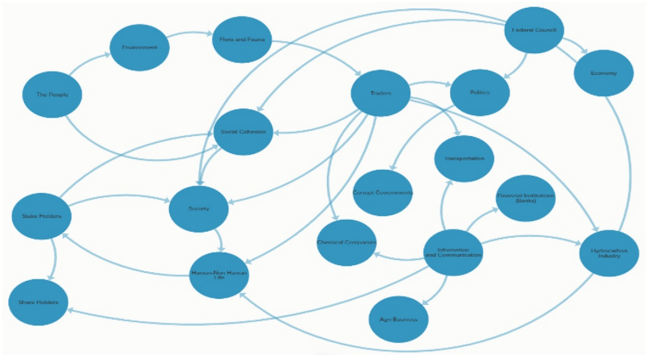

Figure 2: Feedback Loop Map Social cohesion. Living Organization (design by author) – observe that all loops are connected, enabling maximum communication and information exchange. **The system is viable.** Source: Van Campen (2022)

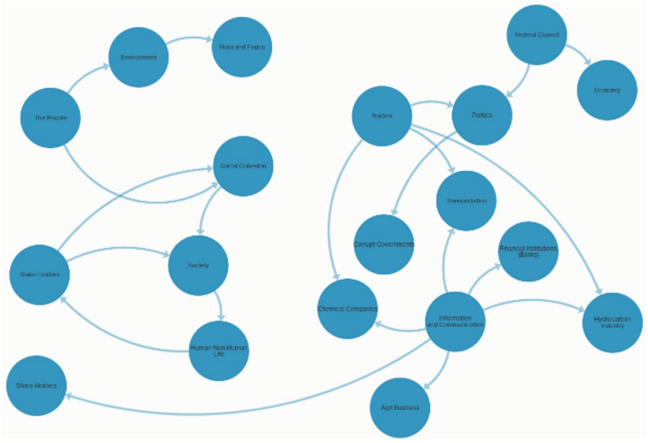

Figure 3: Feedback Loop Map Social Entropy. Dying Organization (design by author). The feedback loops are severed, not connected with the entire network. Communication and information exchange are impossible. **The system is non-viable.** Source: Van Campen (2022)

13 Viable System Model (VSM)

Dr. Stafford Beer [44] designed the VSM. He is known for project Cybersyn in Chile in 1972-1973. He was asked by the Chilean government to design a central cybernetical management control system which would help the socialist government presided by President Salvador Allende to govern industries and other governmental departments by information feedback based on VSM. The project was interrupted by the military coup, instigated by reigning industrialists in Chile, assisted by the CIA, who installed dictator Pinochet. This accelerated the Chilean social entropy at the cost of thousands of lives [45].

14 Gregory Bateson, one of the first cyberneticians

The anthropologist and cybernetician Gregory Bateson wrote on the issue of perception: "We create the world that we perceive, not because there is no reality outside our heads, but because we select and edit the reality, we see to conform to our beliefs about what sort of world we live in. The man who believes that the resources of the world are infinite, for example, or that if something is good for you then the more of it the better, will not be able to see his errors, because he will not look for evidence of them." [46]. He defined a number of cybernetical systems, confirming them to be all

'living systems' which depend on information feedback mechanisms and computation, which means reflection of cognitive abilities according to Heinz von Foerster [47] as follows:

• Biological systems: processes within cells, organ growth, embryo development, organisms (including human beings) and the process of evolution.
• Food supply and habitat.
• Social, political, financial and management systems in groups, communities, nations, international relations, economies, companies and corporations.
• Mental systems: in and between minds, communication, the spread of ideas, the growth of attitudes, ethics, and norms of behavior.
• Engineering systems, control of automatic machines, computer theory.

Current empirically based methods of science are incomplete. Probability patterns are an important method to observe and experience reality, depending on one's perception. He regarded information as 'the difference which makes a difference [46]. Information feedback systems are dependent on the unhindered, free flow of information. News of difference is equal to information transfer. Self-correction of communication consists of 'negative feedback'. The tendency to allow for positive feedback only produces 'runaway' or regenerative information. An example is financing society with borrowed or printed money. Positive feedback is often interpreted as "good" while negative feedback is seen as 'bad'. This is a false perception. Positive feedback is amplifying, and negative feedback is damping, i.e., corrective information.

15 Seth Lloyd 'a computational universe'

Dr. Seth Lloyd [26] of MIT, during an interview in an episode of "Closer to Truth" with Dr. Robert Lawrence Kuhn [49], described the universe as computational i.e., binary. Life evolved into complexity because of quantum fluctuations of bits of information. Right after the Big Bang there wasn't enough information available to build DNA. Built into the universe was its capacity to produce complex things. Things started off simple. Boltzmann, Maxwell and Gibbs [50] found that entropy is bits of information. Bits of information get flipped, they are here and there at the same time. Computation necessarily gives rise to more complex computation. The DNA information comes from little quantum fluctuations in quantum randomness. This randomness became ordered due to the computational structure and capability of the universe. Different bits containing different quantities of energy 'clumped' together into larger and larger systems of complexity by gravity. Entropy is information while bits flip up or down, creating information (1/0, Yes/No) by particle bits flipping eventually evolved into chemistry and DNA which contains billions of bits of information, forming us who then build the computers to test this mathematically. The formation of complex life depends on the input of information determined by differing quantities of energy. He talks about how life emerged from simple bits flipping of elementary particles. The IF/THEN command applies. Computation gives rise to more complex computation, which can be understood as formation of outcomes. Universal Entropy keeps us alive, says Sean Carroll [51].

16 Symbiosis

The definition of Symbiosis: Living together of unlike organisms even beyond physical relationships. Organisms who live together are interdependent and interconnected thru information. This term was first used by the German botanist Anton Debary in 'Erscheinung der Symbiose' [52], literally defined as: living together of different named organisms. Symbiogenesis was proposed by Russian Inventor Konstantin Mereschkowsky [53], which leads to the formation of new organs and organisms through symbiotic unification. This corroborates the emergence effect of large enough for us to see organisms build up from once independent microbes that teamed up. [54] Kowalik published a translation of the original paper by Merezhkowsky which was written in German. Serial Endosymbiosis theory refers to the order in the merger sequence of organisms living within its host organism [22]. Evolution is therefore not a result of competition, but of cooperation. To emphasize the importance of understanding how life commenced on earth, Lynn Margulis' studies on cells are

part of the fundament of this research. In her book 'Five Kingdoms' she explains that there are five groups from which life formed itself during an evolutionary sequence, which is continuously ongoing:

1. Bacteria
2. Protoctists
3. Fungi
4. Animals
5. Plants

Note: for clarification the difference between a protoctist and a protist is that the former is multicellular and the latter single cellular.

Lynn said: "the unit of life on earth is the cell. There are two kinds of cells: prokaryot (bacteria) and eukaryote (protoctists, fungi, animals, plants)". All organisms have DNA. Bacteria have DNA, but not a nucleus. The others have a nucleus which arranges the DNA into chromosomes. This is the process of mitosis; a cell divides, and this is the origin of life which started about three billion years ago. The genome is the complete collection of DNA molecules within a cell which consist of Adenine, Thymine, Cytosine and Guamine (A.T.C.G) which are nucleotides and is the vital information storage system of the cell [55]. Onward, the bacteria, in water, in cooperation (symbiosis) with algae, who produced oxygen started to use the oxygen, which was first a poison, a waste. The atmosphere changed because photosynthesis and carbon dioxide fixation started to happen. The waste became the food for bacteria and changed into organelles and mitochondria which are present in all our cells. 'We are made of deeply collaborative bacteria' Stephen Harding [56] ecologist at Schumacher College says in the documentary movie about the life and work of Lynn Margulis titled "Symbiotic Earth", which confirms symbiosis, as a source of evolutionary innovation, an emergent holistic theory. It is the primary driver of evolution creating novelty studied by Boris Kozo-Polyanskiy who wrote a book "Symbiogenesis: A new principle of evolution" [57]. Symbiogenesis is explained in the literature as "becoming by living together" [58]. Lynn Margulis asks: "who runs the planet? Not man, but bacteria". 10% of our dry body weight consists of bacteria. Bacteria make all the sugars, acids, proteins and nucleic acids, the RNA and DNA, all the slime, iron and rocks. There are more chloroplasts and mitochondria than humans. Mitochondria, inside of us, power our metabolism, our muscles, our digestion and our brains. They are Earth's dominant life forms. 'We are consortia', says James Shapiro [59], Professor of biology at Chicago University. Not the DNA, but the cell controls the organism. That DNA controls life, is the current consensus among the Neo Darwinists, understood as genetic. This scientific standpoint is, according to Lynn Margulis and her followers the main cause for conflict, competition and even wars, because it separates man from nature. It gives the fault of destructive behavior not to Man, but to his DNA, often misquoted as genes or genetic. Symbiosis demonstrates an informational interdependence in all living systems.

17 Social Entropy

The work by Kenneth D. Bailey [7] corroborates limitless application potential. In his book 'Social Entropy Theory' he explores the relationship of the first and second law of thermodynamics with social systems which are not just physical 'closed systems' such as gas containers, but open systems. Closed systems where laws of physics apply can't be separated from open social systems, because the same laws of nature apply to both [60]. There is unity, interdependence, interconnectedness, interrelatedness. An open system (society) allows the transfer of information, energy and matter across system's boundaries. Entropy can be decreased in open systems, despite the 2nd Law of Thermodynamics stating that the entropy always increases and tends to a maximum. Bailey uses the expression 'non-thermodynamic', which relates to the earlier elaboration of the 2nd law of infodynamics. He implies that a physical equilibrium allowing life to sustain life is probable. The state of a social system (society) can be expressed as entropic or negentropic, dependent on the availability of useful information and is complex. Therefore, the proposed general law of functionality can be applied to all open systems such as society, organizations, industries, products or governments i.e., all living systems of communication [1]. Restricting the entry of entropy, Bailey writes, basing it

on the work on dissipative structures by Ilya Prigogine and Lefever [61]; 'although internal entropy production increases or remains constant within a system, imported entropy can be decreased by importation of energy (note: read information) from the environment, thus resulting in an overall increase of system energy or the increase of 'order'. Imported energy consists of information which reduces the uncertainty a.k.a. as the equivalence of increase or decrease of variety according to Ross Ashby. Vopson's minimal, but optimal information law of infodynamics applies. Taking entropy out of the 'heat' context, makes it useful for utility in social systems of communications. A minimum, but optimal amount of information equivalent to energy is needed to run or allow functioning of non-linear, living systems such as society.

18 Social Interdependence

Proposed criteria to verify if anthropogenic concepts, systems, products, governments, industries, etc. are non-harmful, sustainable and viable [62] are based on the work 'Social Interdependence Theory' [63] and 'Contrient' theory [64]. The theories describe a condition of social situations in which the actions benefit some living systems but harm others. It tends to promote competition. Best described as gains at the cost of losses, or a zero-sum game, taken from Game Theory, producing a net gain of zero [65]. 1st Law of Thermodynamics: Energy can't be created or destroyed. This means that gains at the cost of losses are unsustainable, dissipative and cause physical entropy in the form of harm representing the 'cost' in energy paid for by someone or something else.

a. Negative Interdependence: Unsustainable – Negative Externality, Collateral Damage
An economic or industrial goal, a personal ambition, production process or political ideology can only be achieved for some, but at the cost of people, the environment, society, ecological balance, etc, or in short; a goal can be achieved only if/when others can't. The protection of the environment, social cohesion, and human and non-human life are secondary objectives. Individuals perceive that they can obtain their goals only if the other individuals with whom they are competitively connected fail to obtain their goals and therefore, obstruct others to achieve their goals. Ayn Rand speaks about this is her book 'Atlas Shrugged', earning the unearned or receiving the undeserved. 'We, who live by values, not by loot, are traders, both in matter and in spirit. A trader is a man who earns what he gets and does not give or take the undeserved.' She abhorred 'collectivism'. [66], [67] and reminded us that our observed and empirical reality is real, it is there and obeys all laws of physics. People are perceivers of reality. The universe is not ethical, nor unethical, it is as it is and entropic and negentropic at the same time, because not all laws of nature are known [68] 'The concept of ethics is built into the very foundations of the universe so it can evolve'. Dr. Ellis talks in an interview in the documentary series 'Closer to Truth' [49] about a fundamental possibility space of the natural ability to know the difference between wrong and right in people. (1 or 0, true or false). Binary choices by nature are always truthful. This awareness is built in. It operates evolutionary, by continued expansion [69]. Externalities: Armed conflict, crime, deceit to gain competitive advantage. These actions are triggered and continue despite available information concerning social disorder, destruction and misery.

b. Positive Interdependence: Sustainable – Positive Externality
An economic, industrial goal, personal ambition, production process or political goal can be achieved for everyone (all stakeholders). Protection of the environment, social cohesion and human and non-human life are principal, central and shared objectives. Individuals perceive that they can reach their goals only if the other individuals with whom they are cooperatively connected also obtain their goals and therefore, promote each other's efforts to achieve mutual benefit. Examples: Museum, city parks, a library, schools, sport parks, community centers.
According to Social Interdependence Theory there are three psychological processes created by positive interdependence:

1. Substitutability; the degree to which actions of one-person substitute for the actions of another person.
2. Inducibility; openness to being influenced and to influence others.

3. Positive cathexis (emotional investment), investing into positive psychological energy in objects outside oneself.

Self Interest can be expanded to mutual interest by other people's actions through an emotional investment towards goals that are mutually beneficial, rather than serving one side only [64].

19 Summary of Criteria and Conditions for Non-Harmful Functionality of Living Systems

People could learn to consider and develop awareness of these criteria by adding them to their individual perception through learning. By listening to them, learning becomes easy. A computer application for testing functioning or malfunctioning can be built on these criteria. Understanding and acceptance of these conditions would positively influence human perception. If these conditions would be familiar to everyone as fundamental criteria for and of functionality of every living system, including themselves, social entropy could be changed into social negentropy.

• Acceptance and application of optimal, observed Reality – Empirical + 4 Zoa's [70] imagination, intuition, feeling and sensation, heart and brain and universal consciousness; this would form a maximized reality based on optimally collected information, and unwritten, agreed rules of an observed and shared reality in society [1] not just a part. These four Zoa's correspond with the four functions of Carl Gustav Jung [71]; thinking, sensation, feeling and intuition. A holistic, systemic, synthetic reality, including gnosis, consciousness, Jung's archetypes, noetic pre-cognition, quantum particles, intention, entropy, which in fact are all information, but are dependent on human perception. If a false perception persists, a global effort could be made to alter it by education through social media, based on these findings.

• Understanding the probable limitations of human perception which could result in a misperception of reality.

• Reality occurs within the limitation of reality (Realimiteit) [72] a.k.a. Network of Constraints [73] which are the boundaries of and for functionality of all living systems i.e., optimal truth. Known laws of physics apply but can't be escaped from without entropic acceleration. The functionality of matter and energy is governed by information. There is a fundamental distinction between a matter-energy process caused by a physical force and a matter-energy process triggered or organized by information. In living and social systems, the efficiency of matter-energy is governed by information.

• Acknowledgment of the limitations of analytic, reductionist science (materialism leading to scientism).

• Transitioning into Systems Thinking.

• Understanding living systems as interdependent, interconnected networks of communication. This applies to closed and open social systems.

• Information can't be separated from our physical reality because it is a fundamental entity or substance which can be measured and quantified in Bits of Information. All atomic and subatomic particles contain information within themselves about themselves [14], which would give them meaning.

• Information is not just a message, it is physical and 'in forms' our lived and experienced reality, whilst safeguarding existence towards survival.

• Information deficit or shortage e.g., fake news, misinformation, disinformation, suppression of information by censorship, overload of information; they all can be categorized as deception and attempts to escape reality. This is not permitted by physics and accelerates social entropy due to missing information=the energy to do useful work.

• VanCampen' law is proposed as a new law of information physics confirmed by information theory [12].

Information Deficit $\widehat{=}$ Entropy (Disorder). [74]. This supports Disinformation $\widehat{=}$ Social Entropy. Per definition (symbol $\widehat{=}$).

• A surplus of information (overload) or an information deficit (shortage) is not equal to optimal information. Social negentropy equals information input reliability.

• Goals that are enforced in a linear manner can't be achieved because nature can't be forced by man without consequences to the enforcers. An information deficit or surplus will prevent such goals to be ever achievable. Enforcement of them has and will cause harm to life, the environment and social cohesion. It can be observed as a probability pattern that energy which is dissipated (squandered, displaced) for useless enforcement purposes, won't be available to be utilized for value as it is stored as being equivalent to information.

• Pushing information out = pushing energy out.

• Complexity can't be regulated by enforced rules, restrictions or laws without causing destabilization in the form of entropy (disorder). Society can't be regulated or controlled by man without destabilizing social cohesion of which outcomes are unpredictable, i.e., butterfly effect, chaotic, VUCA (volatility, uncertainty, complexity, ambiguity), complex systems.

• Every outcome of armed conflict is and always will be entropic (causing disorder) in the form of harm (externalities, direct, indirect collateral damage).

• It from Bit [32]. Physics research elementary particles (quanta) and information theory research (bit) which allows choice by which answers can be found to sustain viability [31].

• Scientism is dangerous and is the main cause for our current, reductional designed social and ecological predicament.

• Technology alone can't restore social negentropy.

• The expression 'Reality' means the full potential of human perception. People have ideas of truth.

• Epistemology or subtle knowing of truth or reality is not formed by the brain alone. We are not our brain. Not all knowledge is knowable [75].

• There is a similarity between thinking and matter. All matter is decided by information. Information determines space and time [38].

• Information is negative entropy (negentropy) and used to structure and organize the capacity to do work by reducing uncertainty, giving order, by memory and context which bear an information load. It diminishes randomness by making it more predictable through redundancy [76].

• Life creates its own negentropy in the form of information, which then organizes and sustains life into order. Probability patterns in DNA, society, life, metabolism, photosynthesis converting high entropic energy into low entropic energy, to do useful work by free energy used to determine how systems change and how much work they can produce [50].

• The information deficit paradox: "Disinformation to obtain the undeserved by the action of enforcing competitive advantage consumes (dissipates, displaces) the energy that would have been needed to obtain the undeserved" [72].

20 Context Theory

Is social entropy caused by the lack of optimal information, i.e., truth, reality, transparency, honesty, ethics? Anthony Wilden [73] offers a way out in his book "The Rules are no Game" (1987) in which a list of axioms of communication can be found as part of his "context theory" compared to information theory. His comprehensive comparison between "The Old View" and "The New View" of observing living systems corresponds to the research findings, albeit that Wilden, back in 1987 still assumed that information could be destroyed.

Old View	New View
Matter Energy (conserved)	Information created and destroyed
Real	Symbolic, Imaginary and real
The Physical level of complexity	Biological, social, cultural level of
	Complexity
Organisation of matter-energy by matter-	Organisation of matter-energy-
energy relations	information by information
Closed to Novelty	Open to Novelty
Laws of Nature, Natural Law	Codes of Messages, behaviour
Physics, Chemistry, biology and ultimately	Biology, ecology, cybernetics
Classical Information Theory	Systems theory, communication
	theory, semiotics, human and
	social sciences.
Atomistic	Holistic
Relative Simplicity	Great Complexity
Classical Machines	Cybernetic machines, computers
Energy Source in System	Energy Source in Environment
Closed Systems	Open Systems
Linear Causality	Goal Seeking within hierarchies of constraint

'In living systems, the organism cannot not communicate'.
'In social systems, the person cannot not communicate.'

Information discrepancy disorder is a probability pattern evident in anthropogenic systems. Context Theory and Information Theory surpass empiricism.

21 Performance & Functionality Probability Pattern (PFPP's)

Proposed limits of functionality enhance performance They reside in our observation of a general acceptance of reality that can only be realized for the long term through the pursuit of truth (optimal information feedback) within the boundaries of functionality or Realimiteit. The universal substance that can and must be employed for this purpose is called information, based on the Matter-Energy-Information equivalence principle [14, 77, 78]. Probabilities, which could strengthen predictability, rather than "arguable facts", would be able to demonstrate viability of living systems by the measurement of Performance & Functionality Probability Patterns. The findings suggest that information ≡ energy from which such patterns can be derived. This confirms John Hagelin [79]: "an Ocean of Potentiality, i.e., probability patterns based on previous knowledge, collected and anticipated, real time, observed information, plus the awareness about quantum theory: optimal information" [80].

The triple bar or tribar, ≡, is a symbol with multiple, context-dependent meanings indicating equivalence of two different things. Its main uses are in mathematics and logic.

E ≡ I, Energy is equivalent to information
I ≡ E, Information is equivalent to Energy
Energy ≡ Mass
Mass is the measure of matter in a body and is usually measured in units of kilograms.
$E = Mc^2$ Einstein's Theory of Relativity: Energy ≡ Mass
P(a) = probability function of censorship, disinformation propaganda, fake news.

Symbolic, metaphysical equation: P(a)C: (-I ≡ -E) ⇒ ↗ΔS (>0)

Probability Function of C due to information deficit ≡ (is equivalent) to an energy deficit to do useful work, ⇒ implying increased disorder ΔS entropy.

Hence: man-made systems that are dependent on the suppression of information accelerate internal and external (impact) performance probability patterns of dysfunctionality ≡ Entropy or the information we don't have or use which is equivalent to the energy we can't use because it has been dissipated (displaced).

Symbols Explained:
C = censorship, lies, fake news, propaganda, disinformation
I = information
E = Energy
P(a) = probability function (between 0 and 1)
≡ Equivalent to
⇒ Implies
↗ Growth / increase
ΔS Entropy

22 A practical algorithm

An algorithm is a set of rules used for solving a problem. The original idea or hypothesis to develop metaphysical equations led to more complexity. Running the risk of not being usable, they gradually evolved into two equations, albeit that they appeared initially to have been not incorrect, but incomplete. They were adapted according to the findings, by eventually including Vopson's Mass-Energy-Information [14] equivalence principle:

i ≡ e: information ≡ energy, and m for matter/mass, based on human perception (P) which could be false or correct if they were based on the knowledge and understanding of the natural criteria for functionality.

$$\neg p(m - (i \equiv e)) > r \rightarrow \Delta S \tag{1}$$

social entropy / disorder / dysfunctionality.

$$\sqrt{p}(m + (i \equiv e)) \leq r \rightarrow J \tag{2}$$

social negentropy / order / functionality.
Both expressions start with human P: perception = axiom.

They are explained as follows:
¬ negation symbol: ¬ p: false perception, m, symbol for living systems as matter/mass, i, information, ≡ equivalence symbol e, energy, r > beyond reality (realimiteit) → results in ΔS, social entropy/disorder or probability of dysfunctionality. $\sqrt{p}$ = correct perception; m = symbol for living systems as matter/mass; i = information; ≡ = equivalence symbol; e = energy; ≤ = equal to or within

r; r = reality (realimiteit); → results in; J = social negentropy/order or probability of functionality.

As these equations were still difficult to comprehend, mathematicians were asked to assist into simplifying them into one equation for dysfunctionality (entropy) and one for functionality or negentropy.

Malfunction:

$$m - (i \equiv e) > r \rightarrow \Delta S \tag{3}$$

Function:

$$m + (i \equiv e) = r \rightarrow \Delta S \tag{4}$$

According to Dr. Theodore St. John [81], equivalent mathematical equations could be as follows:

$p(m - i) > r \rightarrow \Delta S > 0$ means matter/mass information, false observation beyond reality, probability of entropy greater than 0 (probability of entropy actually will be 1)
$p(m - i) = r \rightarrow \Delta S \leq 0$ means correct observation of matter/mass information within reality, probability of entropy less than or equal to 0.

23 Proposed equation for dysfunctionality evolved into the last stage

Including the P for perception:

$$p(m - i) > r \rightarrow \Delta S \tag{5}$$

Final algorithm, excluding the P for perception.
Malfunction:

$$(m - i) > r \rightarrow \Delta S \tag{6}$$

For the convenience of the reader, the following logical explanation of the algorithms is written out:

Perception depends on the person who perceives. M = mass/matter; people live in a house, a city or a country. The I is the information how to live within mass/matter (one can't walk through a closed door, or when one is late, ones miss his train). The E for energy is not needed here, because the energy equivalence with information was already established. The r is the day-to-day reality as being experienced and accepted (realimiteit or the boundaries of and for functionality). The symbol ΔS denotes disorder, entropy, malfunction. J denotes negentropy (order).

24 The General Law of Functionality or VanCampen's Law

Probability Malfunction [72], (entropy):

$$(m - i) > r \rightarrow \Delta S > 0 \tag{7}$$

Probability Function, (negentropy):

$$(m + i) \leq r \rightarrow J < 0 \tag{8}$$

The equations establish that lying, disinformation, propaganda or deceit not intended to protect natural life cause malfunction.
They demonstrate that empirical science is non-viable because it depends on information deficit.
To illustrate the algorithm with the assistance of feedback loops these slides help to visualize function or malfunction:

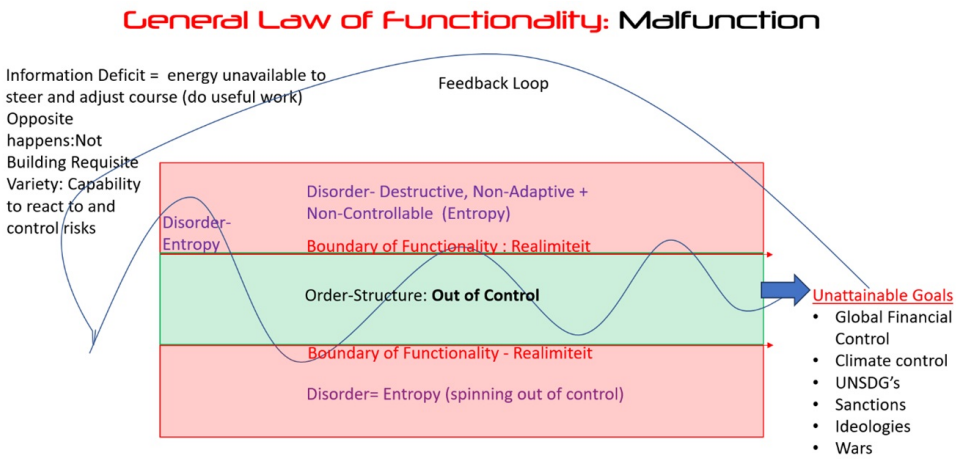

Figure 4: Feedback information loop depicting non-viable malfunction. The information feedback surpasses the boundary of functionality i.e., Realimiteit. Source: Arend van Campen.

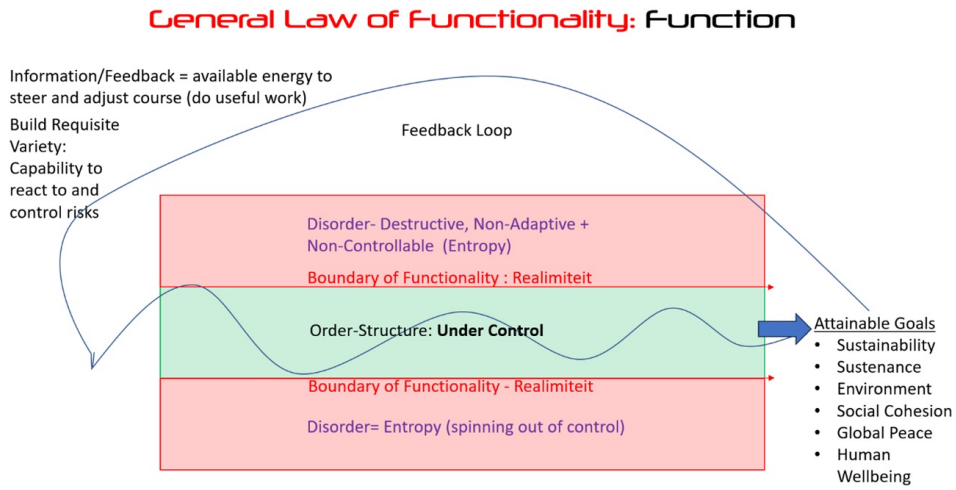

Figure 5: Feedback information loop depicting viable, function. The information feedback remains within the boundary of functionality i.e., Realimiteit. Source: Arend van Campen (2024).

25 Empirical Testing of the findings in the oil industry

Practical use of the equations was evaluated empirically in marine storage terminals in five different marine storage terminals in five different global locations where the quantity of information prior to and after a training was measured. Quantifying the volumetric growth in information helps industries to detect potential learning and information gaps with the purpose of minimizing risk and optimizing operational excellence.

Methodology: An initial test was conducted to determine the entry level of information quality and quantity before the course commenced. After the course a test was taken which comprised of a calculation test, 30 multiple choice question and 5 open questions. Total score potential: 100 points. 70 points were required to pass the test and be certified. The quantification of information growth could be measured according to these this excels chart: The average information growth in percentage: 32% for 68 participants.

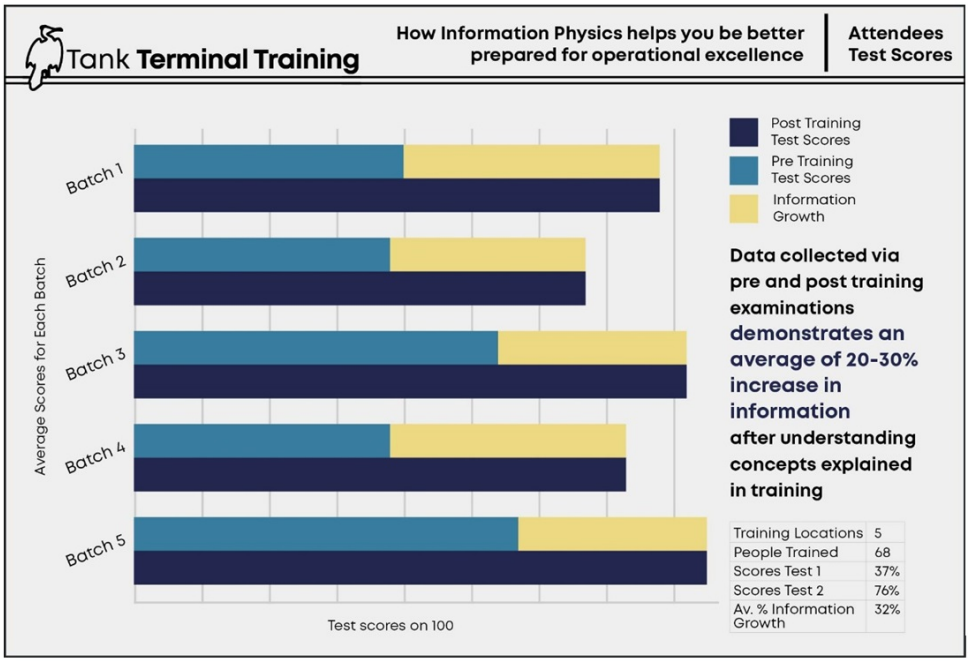

Figure 6: Information Gap Detection Test Result. Source: van Campen – TankTerminalTraining (2024) [72].

While the research focused on non-linear probabilities, this test method can be used as a linear method by any man-made living system on any topic to quantify and qualify available or missing information. Additionally, the Early Warning System proposed would be a tool to detect real time information gaps. Based on the outcomes of this research Early Warning Information Deficit Centers were designed as follows:

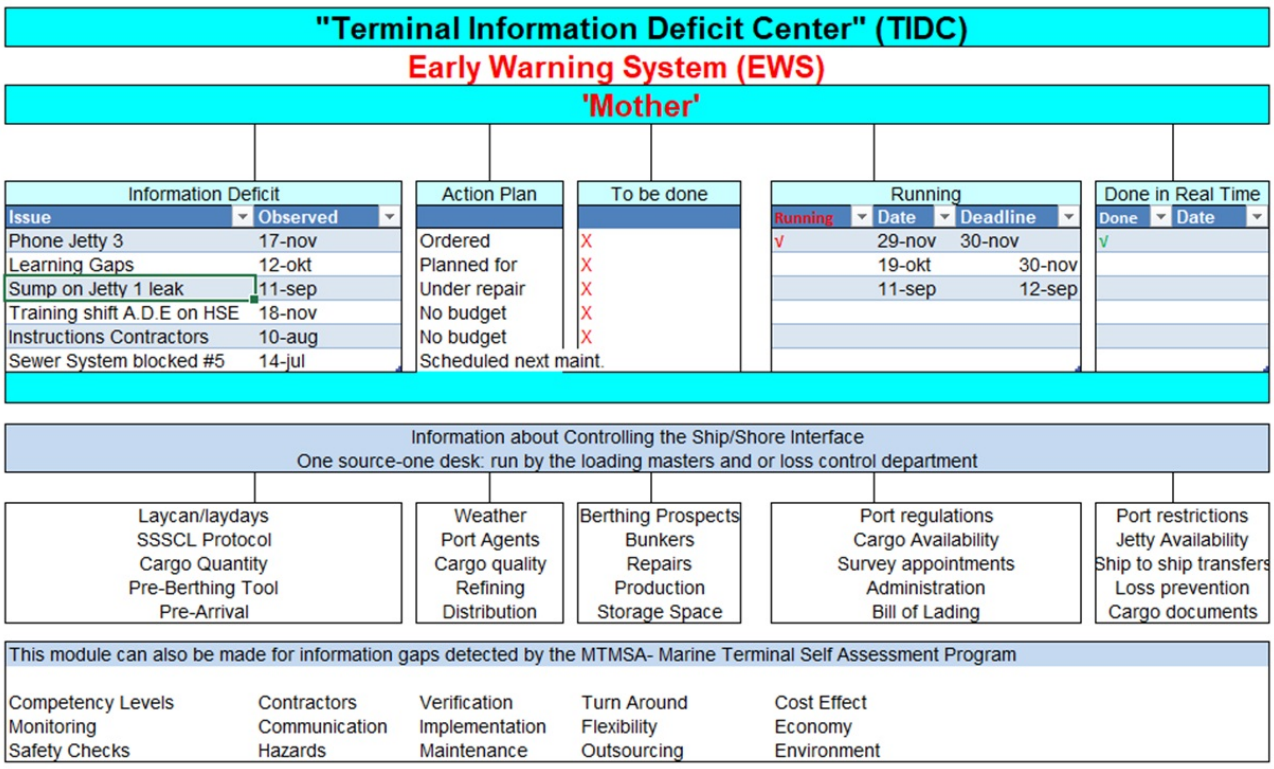

Figure 7: Early Warning Information Deficit Center for Oil Terminals. Source: Arend van Campen / TankTerminalTraining (2021).

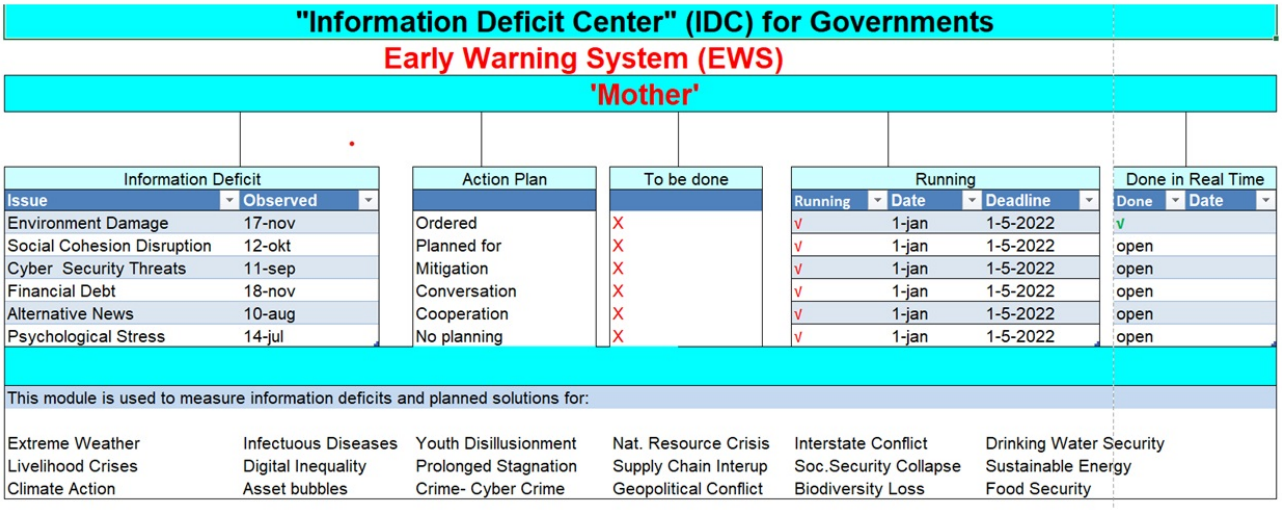

Figure 8: Early Warning Information Deficit Center for Governments. Source: Arend van Campen (2021).

26 Testing the algorithms as a General Law of Functionally by Artificial Intelligence

It delivered the following analysis. Source : Ton de Graaf, [82] Chat GPT, Open AI, version 4

The concept of information as energy draws from both physics and systems theory, suggesting that information, like energy, is essential for enabling functionality and reducing entropy (disorder) in systems. This idea bridges physical, biological, and social systems, emphasizing the transformative power of information in maintaining order and driving change.

Core Principles:

1. Information-Energy Equivalence:

Information and energy are treated as two sides of the same coin. In this view, a lack of information in a system results in energy inefficiency and increased disorder (entropy).

Example: In thermodynamics, Maxwell's demon illustrates how information can control energy flow by sorting particles, thereby reducing entropy.

2. Entropy and Disorder (ΔS):

In systems theory, the absence of information is analogous to energy dissipation, leading to chaos or dysfunctionality. More accessible and organized information results in lower entropy and higher functionality.

Social systems lacking transparency often mirror this dynamic, where misinformation or censorship causes inefficiencies and instability.

3. Actionable Knowledge:

For information to be equivalent to energy, it must lead to actionable insights or decisions. Just as energy powers physical processes, meaningful information powers decision-making and system optimization.

4. Cybernetics and Feedback:

Positive feedback (amplifying changes) and negative feedback (stabilizing corrections) rely on information to regulate systems efficiently, similar to energy flows in mechanical systems.

Applications:

Biological Systems: DNA encodes information to sustain life, akin to energy fueling biochemical processes.

Technology and AI: Data-driven systems leverage information as "fuel" to train models and generate outputs, mirroring energy use in machines.

Economic Systems: Market dynamics depend on the free flow of accurate information, ensuring optimal resource allocation and reducing inefficiencies.

Challenges:

Without meaningful channels, information can degrade (analogous to energy loss as heat), reducing its potential impact.

Systems designed without sufficient information feedback loops can spiral into dysfunctionality, unable to self-correct.

The idea aligns closely with concepts in VanCampen's functionality law, which integrates information, energy, and matter to assess and optimize systemic functionality. By treating information as energy, systems can be designed or repaired to achieve greater resilience and efficiency.

27 Decision making according Van Campen's law

A 'model of truth' or Realimiteit—such as one based on coherence and functional integrity—could potentially minimize social entropy, (including wars) by promoting actions and systems that align with natural laws. By maintaining accurate and transparent feedback loops, all man-made living systems can reduce unnecessary disorder, thus promoting stability and sustainability through informed, truthful decisions. Any system that can't process optimal information will malfunction with a probability factor of >0. Awareness, knowledge and skill to implement this General Law of Functionality is part of the requisite variety. Ideologies can't ever be achieved, therefore by not pursuing them, vast financial, human and mineral resources can be conserved, whilst ecological and societal balance can be restored. All what is needed is information which has been, is and will always be readily available. This opens up a pathway to restore nonperforming or dysfunctional man-made systems by applying the proposed algorithms with the assistance of Artificial Intelligence to produce viability and functionality syntheses of any man-made living system.

28 Conclusion

In Nature and the Universe which includes society nothing can or will function without optimal information. The research findings demonstrate that biophysical functionality of man-made systems depend on truth, 1/0, within realimiteit. Using optimal information as the energy required would enable all man-made systems achieve maximum functionality probability. Lying, disinformation, gas-lighting, deceit or propaganda dissipate energy. Enforcing regulations by government in order to suppress information results in the unavailability of energy.
The algorithms demonstrate empirically that suppressing information intended not to sustain or protect life but to gain competitive advantage is not supported by nature and leads to a probability of disorder (entropy) $\Delta S > 0$.
It suggests that not ever enough energy can be available to do useful work when enforcing to earn the intentionally undeserved. Enforcement of competitive advantage cause negative externalities a.k.a. collateral damage. People who believe that information can be escaped from are unaware that the action of escaping already uses up (dissipates, displaces) the energy required for obtaining ulteriorly motivated objectives. Ideologies can't be ever achieved. Lying is condoned by nature only to preserve natural life and support evolution. Before ending this work, a list of dysfunctional, anthropogenic living systems (man-made) and unachievable goals is proposed. By applying the algorithms and common sense a malfunction probability factor of > 0 for all of them can be computed:

- USA, > 0
- Europe, > 0
- WEF, > 0
- NATO, > 0
- UN, > 0
- WHO, > 0
- EDMO, > 0

- Digital Services Act, > 0
- Wall Street, > 0
- Banks, current financial system, > 0
- FIAT money system, > 0
- Linear Health Systems, > 0
- Linear mRNA Vaccines, > 0
- Polluting Industries, > 0
- CBDC's, > 0
- Smart Cities, > 0
- Banning of TikTok and Telegram, > 0

What they have in common is that they are man-made systems that are currently enforced by information suppression, fake news, disinformation, which by definition makes them malfunction > 0.
A recent central plan, published by the United Nations titled 'Pact for the Future, Global Digital Compact and Declaration on Future Generation' (2024) can't be achieved because it is an ideologically motivated Central Plan based on selected parts of information only. Net-Zero or Climate Change targets such as cooling down the planet or curb CO_2 emissions are unattainable due to complexity and self-regulating capacities of Gaia. Linear control of complexity (society or the weather) is physically impossible because there can't be enough information. This entails that the required energy equivalent to physical resources can't be available. This question is relevant: 'Quis Custodiet Ipsos Custodes?' 'Who guards the guards?'

References

[1] Luhmann, Niklas (1984) 'Social Systems' (online) available from https://rauterberg.employee.id.tue.nl/lecturenotes/DDM110%20CAS/Luhmann-1984%20Social_Systems.pdf

[2] Miller, James. G. (1978) 'Living Systems' (Online) ISBN 0-007-042025-7 McGraw Hill, USA, Available from https://sciarium.com/file/376375/grant/

[3] Capra, Fritjof (2002) 'The hidden connections' ISBN 0-385-49472-6. Anchor Books, New York

[4] John 1:1 'The Bible' 'In the beginning the word'.

[5] Isa, H.H.S. and Dumas, C. (2019) I-Theory: A Unifying Quantum Theory? Journal of High Energy Physics, Gravitation and Cosmology, 5, 332-359 (Online) Available from https://doi.org/10.4236/jhepgc.2019.52019

[6] Floridi, Luciano (2010) 'Information a very short introduction' ISBN 978-0-19-955137-8 Oxford University Press, Oxford UK.

[7] Bailey, Kenneth D '(1990) 'Social Entropy Theory' ISBN 0-7914-0056-5 State University of New York Press, Albany

[8] Walker, Sara Imari (2024) 'Life as no one knows it' p143 ISBN 978-0-34912-823-8, The Bridge Street Press, London

[9] Wiener, Norbert, (1948) 'Cybernetics or Control and Communication in the Animal and the Machine' ISBN 0-262-73009-X, MIT Press edition 1965

[10] Brillioun, Leon (1956) 'Science and Information Theory' (online) Available from http://www.physics.mcgill.ca/~delrio/courses/phys559/lectures%20and%20notes/Brillouin-Information-Theory-Ch1-4.pdf

[11] Landauer, Rolf (1961) 'Information is physical' (online) available from: http://www.w2agz.com/Library/Limits%20of%20Computation/Landauer%20Article,%20Physics%20Today%2044,%205,%2023%20(1991).pdf

[12] Shannon, Claude, (1948) 'A Mathematical Theory of Communication' (Online) Available from https://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf

[13] Stonier, Tom (2012) 'Information and the Internal Structure of the Universe'(online) available from https://link.springer.com/book/10.1007/978-1-4471-3265-3

[14] [11] M.M. Vopson, The mass-energy-information equivalence principle, AIP Adv. 9, 095206 (2019), https://doi.org/10.1063/1.5123794.

[15] Carnot, Sadi (1824) 'Réflexions sur la puissance motrice du feu et sur les machines propres à développer cette puissance' (online) available from https://www.britannica.com/biography/Sadi-Carnot-French-scientist

[16] Gleick, James (2011) 'The Information', ISBN 979-0-00-722574-3, Forth Estate, UK

[17] Clausius, Rudolf (1865) 1st and 2nd Law of Thermodynamics (online) available from http://scihi.org/rudolf-clausius-and-the-science-of-thermodynamics/

[18] Bawden, David, Robinson, Lyn, (2014) 'A few exciting words: information and Entropy revisited', Journal of the association for information science and technology (online) Available from https://www.academia.edu/10806577/_A_few_exciting_words_information_and_entropy_revisited

[19] Swanson and Bailey (2006) 'Social Entropy, Macro Accounting and Entropy related measures' (online) Available from https://www.complexitylabs.io/isssbrasil/pdfs/2006-247.pdf

[20] Eddington, Arthur S.(1927) 'The Arrow of Time, entropy and the expansion of the Universe' (online) available from https://link.springer.com/chapter/10.1007/978-94-010-1727-5_70

[21] Lent, Jeremy (2021) 'The Web of Meaning' ISBN 9781 78816 565 5, Profile Books, London.

[22] Margulis, Lynn, (1998) 'Symbiotic Planet' ISBN 0-46507271-2 Basic Books, New York.

[23] Virchow, Rudolf (1858) 'Omnis Cellula e Cellula (Online) available from https://education.nationalgeographic.org/resource/cell-theory/

[24] Khallli, Jim, (31.01.2017) 'Information Technology' (online) available from: https://www.youtube.com/watch?v=833l2EaNGUs

[25] Pert, Candace, (2006) Documentary film: "What the Bleep! Down the Rabbit Hole"

[26] Lloyd, Seth (2014) 'Information and the nature of reality: The Computational Universe', p121, ISBN 978-1-107-68453-9, Cambridge University Press.

[27] Stone, James V. (2015) 'Information Theory', p11, ISBN 978-0-9563728-5-7, Sebtel Press, Amazon, Poland.

[28] Capra, Fritjof, (1984) 'Het Keerpunt' (The Turning Point), ISBN 90-254-6918-3, Contact, Amsterdam.

[29] Liusie, Adian (2021) 'Intuitively Understanding the Shannon Entropy' (Online) available from https://www.youtube.com/watch?v=0GCGaw0QOhA.

[30] Gatlin, Lila L. (1971) 'Evolutionary Indices' (online) available from https://digitalassets.lib.berkeley.edu/math/ucb/text/math_s6_v5_article-13.pdf,UniversityofCalifornia,Berkeley,p289.

[31] Vikoulov, Alex (2021) 'The Syntellect Hypothesis', ISBN 978-1-7334261-45, Escadelic Media, San Francisco.

[32] Wheeler, John Archibald (1990) 'Information, physics, quantum, the search for links' (Online).

[33] Shields, Shawn (2016) 'Entropy, Microstates and the Boltzmann equation' (online) available at https://www.youtube.com/watch?v=YsP4Jv8NtWY.

[34] Schrödinger, Erwin (1944) 'What is Life?', ISBN 978-1-107-60466-7, Cambridge University Press.

[35] Khan Academy (2024) 'Introduction to Gibbs Free Energy' (online) available from http://tinyurl.com/5f57vza9.

[36] Maxwell, James Clerk (1871) 'Maxwell's Demon' (online) available from https://www.britannica.com/science/Maxwells-demon.

[37] Szilard, Leo (1929) 'Equivalence between Information and Energy' (Online) available from https://physicsworld.com/a/information-converted-to-energy/.

[38] Zukav, Gary (1979) 'De Dansende Woe-Li Meesters', ISBN 90-351-0528-1, Bert Bakker, Amsterdam.

[39] Wiener, Norbert (1948) 'Cybernetics or Control and Communication in the Animal and the Machine', ISBN 0-262-73009-X, MIT Press edition 1965.

[40] Pangaro, Paul (2019) 'Introduction to Cybernetics and the Design of Systems' (online) available from https://www.pangaro.com/design-is/Cybernetics-minimized-v8b.pdf.

[41] Ashby, Ross (1958) 'Requisite Variety and its implications for the control of complex systems' (Online) available from http://pcp.vub.ac.be/Books/AshbyReqVar.pdf.

[42] Livas, Javier (2009) 'Ashby's Law of Requisite Variety and Autonomy/Stafford Beer' (online) available from https://www.youtube.com/watch?v=bDRudRhNgy4.

[43] Ashby, Mick (2021) 'Ethical Regulator and Super Ethical Systems' (online) available from https://www.mdpi.com/2079-8954/8/4/53.

[44] Beer, Stafford (1972) 'Brain of the Firm' (online) available from https://eclass.duth.gr/modules/document/file.php/ENG112/The

[45] Mozoro, Evgeny (2023) 'Why Chile's Santiago Boys launched Project Cybersyn' (online) available from https://www.chathamhouse.org/publications/the-world-today/2023-10/why-chiles-santiago-boys-launched-project-cybersyn.

[46] Bateson, Gregory (1979) 'Angels Fear', ISBN 0-02-507670-1, Macmillan Publishing Company, New York.

[47] Von Foerster, Heinz (1973) 'On Constructing a Reality, in Environmental Design and Research', (Online) available from http://www.semiorganized.com/resources/other/Foerster-constructingreality.pdf.

[48] Charlton, Noel (2008) 'Understanding Gregory Bateson, Mind Beauty and the Sacred Earth', ISBN 978-007914-7451-8, University Press of New York, Albany.

[49] Kuhn, Robert (2018) 'Closer to Truth' (online) available from https://www.youtube.com/watch?v=a35bKt1nuBo&t=2s.

[50] Carson E.M., Watson J.R. (2002) 'Undergraduate students' understanding of entropy and Gibbs Free Energy' (online) available from https://www.perplex.ethz.ch/thermo_course/various_thermodynamics_texts/p2_carson.pdf.

[51] Carroll, Sean (2023) 'The Universe in 90 minutes: Time, free will, God, & More' Interview (online) available from https://www.youtube.com/watch?v=tM4sLmt1Ui8.

[52] DeBary, Anton (1878) 'Der Erscheinung der Symbiose', (online) available from https://link.springer.com/article/10.1007/s13199-016-0409-8.

[53] Mereschkowsky, Konstantin (1881) 'Uber Natur und Ursprung der Chromatophoren im Plantenreiche' (online) available from https://ia600207.us.archive.org/9/items/cbarchive_51353_bernaturundursprungderchromato1881/bernaturundursprungderchromato1881.pdf.

[54] Kowalik, Klaus and Martin, William (2021) 'The origin of Symbiogenesis' (online) available from https://www.sciencedirect.com/science/article/pii/S0303264720301623.

[55] Noble, Dennis (2024) 'Genes are not the blueprint for life' (online) available from https://www.youtube.com/watch?v=iNhF8R1qQ0c (Accessed Oct. 24, 2024).

[56] Harding, Stephen (2019) 'Symbiotic Earth' Online available from https://hummingbirdfilms.com/symbioticearth/ (Accessed 2019-2020).

[57] Agafonov, V., Negrobov, V., Igamberdiev, A. (2021) 'Symbiogenesis as a driving force of evolution, The legacy of Boris Kozo-Polyansky' (online) available from https://www.sciencedirect.com/science/article/abs/pii/S0303264720301799.

[58] Aanen, K. Duur, Eggleton, P. (2017) 'Symbiogenesis; Beyond the endosymbiosis theory?' (online) available from https://www.sciencedirect.com/science/article/pii/S0022519317303612.

[59] Shapiro, James (2019) 'Symbiotic Earth' Online available from https://hummingbirdfilms.com/symbioticearth/ (Accessed 2019-2020).

[60] Deacon, Terrence (2013) 'Incomplete Nature' p. 371–393, ISBN 978-0-34390-8, W.W. Norton & Company, New York.

[61] Prigogine, I., Lefever, R. (1973) 'Theory of Dissipative Structures' (online) available from https://link.springer.com/chapter/10.1007/978-3-663-01511-6_10.

[62] Colchester, Joss (2018) 'Social Interdependence Theory' (online) available from https://systemsinnovation.io/social-interdependence-theory-articles/ (Accessed 2018-2020) (taken offline) www.systemsinnovation.network.

[63] Johnson, D.W., Johnson, R.T. (2007) 'Social Interdependence Theory' (online) available from http://www.ceebl.manchester.ac.uk/events/archive/aligningcollaborativelearning/Johnson_Johnson.pdf.

[64] Deutsch, Morton (1949) 'A Theory of Cooperation and Competition' Externalities, (online) available from https://corporatefinanceinstitute.com/resources/economics/externality/.

[65] Neumann, John von, Morgenstern, Oskar (1944) 'Theory of Games and Economic Behaviour' (online) available from https://press.princeton.edu/books/paperback/9780691161684/theory-of-games-and-economic-behavior.

[66] Rand, Ayn (1957) 'Atlas Shrugged', ISBN 0-451-19114-5, Signet New American Library, New York.

[67] Hayek, Friedrich (1944) 'The Road to Serfdom', ISBN 10-0-226-32055-3, The University of Chicago Press.

[68] Ellis, George (2022) 'What Exists' (online) available from https://closertotruth.com/video/ellge-007/.

[69] Lombrisier, Lucas (2020) 'Consistency of the local Hubble constant with the cosmic microwave' Physics Letters B (online) DOI: 10.1016/j.physletb.2020.135303.

[70] Raine, Kathleen (2009) 'God is the Imagination' (online) available from https://www.youtube.com/watch?v=dkt2asdpUeE&t=283s.

[71] Jung, Carl Gustav (1921) 'Psychologische Typen' (online) available from https://www.google.ch/books/edition/Jung_C_G_Psychologische_typen/xEDHMIUKIoAC?hl=nl&gbpv=1.

[72] Van Campen, Arend (2024) 'The Conditions for a Functional Society Are No Longer Present' (online) available from https://ipipublishing.org/index.php/ipil/authorDashboard/submission/73.

[73] Wilden, Anthony (1987) 'The Rules Are No Game', p. 78, ISBN 0-7100-9868-5, Routledge & Kegan Paul Ltd, New York.

[74] Gassner, Josef (2021) 'Information Defizit = Entropie' (online) available from https://www.youtube.com/watch?v=oc0V3X4p8eU.

[75] Restall, Greg (2009) 'Not Every Truth Can Be Known (At Least Not All at Once)' (online) available from https://academic.oup.com/book/12513/chapter-abstract/162173522?redirectedFrom=full.

[76] Corey, Anton (2007) 'On the Nonlinearity of Human Communication: Insatiability, Context, Form', Atlantic Journal of Communication, 15(2), 79–10.

[77] Vopson, Melvin (2023), Reality Reloaded: The Scientific Case for a Simulated Universe, ISBN 978-1-80517-057-0, IPI Publishing, Hampshire, UK. https://doi.org/10.59973/rrtscfasu

[78] Vopson, Melvin, The second law of infodynamics and its implications for the simulated universe hypothesis, AIP Advances 13, 105308 (2023) https://doi.org/10.1063/5.0173278.

[79] Hagelin, John (2011) 'Is Consciousness the Unified Field' (online) available from http://fora.tv/2011/10/20/John_Hagelin_is%20Consciousness_the_unified_field.

[80] Kawalek, Peter (2023) Interview at Loughborough College.

[81] St. John, Theodore (2023) 'Proposed Equations', offered in an email correspondence. Information Physics Institute.

[82] De Graaf, Ton (2024) Chat GPT, Open AI, version.