Threats and Consequences of Non-Smart Industry Quo vadimus? Quo vademus?

Zorislav Šojat*, Karolj Skala*

* Ruđer Bošković Institute, Centre for Informatics and Computing, Zagreb, Croatia
sojat@irb.hr, skala@irb.hr

Abstract - **The questions "***Where do we rush? Where will we go?***" are essential for our present day civilisation. The first question is: on which path are we now, and where will it lead us. The other one is: which future do we want, and which path shall we take to get there.**

Where do we go? Well, we rush in all kinds of directions, like children we try out whatever can be done, but very, very rarely we consider system stability consequences. And that usually only much late after the destabilising action. Unfortunately, a general driving force of our civilisation can be detected: Faster, Better, More... A typical case of a dynamic system with a positive feedback loop. It is known that positive feedback, without a regulatory opposition of a negative feedback is destructive for a system at any level. Only a balanced regulatory process of positive and negative feedback is homeostatically sustainable. But, furthermore, the positive feedbacks (!) we constantly strive for are of extremely diverse natures, though all fall into the "Faster, Better, More..." category. This develops additional strain on the whole system stability [the whole (eco-)system of the geosphere, biosphere and technoshpere, as presently we pushed our survival possibilities largely into the sphere of technology]. However, the negative feedback comes from the whole ecosystem with, in human terms, very long latency, and than in ways which are either not obvious, or generally regarded irrelevant for everyday personal life, or generally regarded as terrible, but what can we do? So the question "Where do we go?" necessitates a thorough answer.

But to know where we go it is essential to know the present state of the system. There are two highly pronounced areas of our civilisation's destabilisation of the system. The first is resource consumption, the second is garbage production. Both of those cling on uncontrollable overgrown consumerism, grown out of the contradictory philosophies and the conflicting economic and social principles throughout last several centuries. Constant uncertainties of future during that time, and an earth-shaking (even literally) change in technological surroundings, led to "Let's enjoy the life while we can" and "Let's survive the day" being some of the basic generic philosophical postulates prevailing in the subconscious of the population. Therefore, to answer the question, it is necessary to involve a huge amount of effort in two main directions: 1. Development of a model of the present eco-system state - where, what, how much, why... is researched, mined, produced, consumed, wasted... 2. Development of a philosophical framework which will enable global human acceptance of a stable nature-human-machine ecosystem.

Where do we want to go? There are two main constraints for any sustainable future path: *the unavoidable influence of ecosystem transformations on future production and distribution principles*, and *necessary adaptation of our wishes to the ecosystem stability needs*. Firstly we will have to significantly reduce the wasteness of short-term products, unnecessary extreme energy consumption, enable long-term availability of spares and services, develop self-contained coordinated local economies, drastically reduce long-haul transport and "re-educate" ourselves in keeping in check our wishes for faster, better, more...

The approaches of our future economy, which shall be based as much as possible locally, the production and product life-cycle management etc., will have to drastically change, from the level of prevailing philosophies and paradigmatic systems down to everyday life. With the use of properly organised local/global cybernetics and computer science aided coordination, through the emerging hierarchy from Dew to Cloud, it is possible to envisage a Rainbow Services System which would enable the existence of enough prerequisite variety and low latency information for timely decision making and action, as well as long term strategic planning, to achieve the sustainable longevity of our future civilisation.

Keywords – **Smart Industry, Sustainability, Ecosystem Balance, Chaotic Developments**

I. INTRODUCTION

"*There are seven things that will destroy us: wealth without work; pleasure without conscience; knowledge without character; religion without sacrifice; politics without principle; science without humanity; business without ethics.*" — Mahatma Gandhi [1]

Modern day civilisation aspires to develop machines which take over most of the physical, orientational and intellectual work from humans, perpetuating an almost two centuries old idea that if we do not have to work, we will have more time for individual (cultural, expressional, intellectual) growth. However, it is obvious that work is an essential part of human nature, and if left without any work, our organs conclude that they are not needed. One can not be healthy, i.e. wealthy, without constant working of all of our faculties: physical, mental, emotional, orientational, intellectual, perceptual... [2].

It certainly is pleasurable to have nice little packages of candies, milk, washing powder..., it is pleasurable to earn bitcoin by mining or trading it, it is pleasurable not to think about how we get our food, it is pleasurable to think electric cars will solve all of our problems, it is pleasurable to imagine new products and new ways of production... but is it done with conscience?

Why are we afraid of the future? Because all knowledge we ever had has been used not only for good, but always also for bad.

It is important to note that religion, in its true sense, is actually a specific philosophical approach towards the world, where the philosophy, as any philosophy does, provides a general framework in which the world can be perceived, understood and lived in, as well as an ethical framework of acceptable interference with the individual/collective environment, including other beings, nature in general and the whole planet.

Any stable homeostasis, any successful self-organisation or any autopoietic emergence is possible only in reasonably stable environmental conditions ([3], [4]). Politics, the craft (Greek -ικη) of organising the common life of a city (Greek πολις), and consequently any larger human community, must be long term consistent, and in compliance with the highest ethical norms of the actual philosophy.

And it is also essential to understand that the notion of humanity can not exist without the complete global ecosystem, as any major change in the behaviour of "humanity", as we can see well in present times, may make a drastic change in the global ecosystem, as also any major change in the behaviour of the (human-)environmental ecosystem can make a drastic change on the "humanity" (as e.g. the destruction of Thera [5], and consequential changes in the Mediterranean cultures).

Business is the common term for the "active", inventing, producing, distributing "side" of the economy. However, ecology, and its more technical companion economy, are dynamic systems of very delicate balance, and only the application of highest active ethical norms, with full consciousness of appropriateness regarding possible disruptive consequences of any "business", can steer that delicate system into a comfortable focal condition.

II. QUO VADIMUS?

The first question, "where do we rush", is: *on which path are we now, and where will it lead us?*

Last several centuries our civilisation experienced an exponential turmoil of new philosophies, new ideas, new discoveries, new machines, new communication means, new ways of socialising, new knowledge and misknowledge fountains, and is presently, to all of that, starting to experience new company of human-stimulated intelligences[1].

---

[1] Presently we are calling this kind of, still (probably, or at least partly) pseudo-, intelligence "Artificial Intelligence". However, intelligent behaviour, i.e. such behaviour which enables coping with new and previously not experienced environmental actions based on abstraction and association of previous experiences (knowledge), can only be named "Intelligence". As we are presently rushing into enabling the emergence of such intelligence through use of learning, computer-based, "neural" nets, we will have to adapt a more appropriate term, as e.g. the old "electronic brain", or a presently fancy style of e-intelligence (EI).

Roughly we can see five stages of our present civilisation's technosphere/sociosphere development in last approximately 300 years, starting with the time of "Enlightment" and important philosophical treatises of Francis Bacon, René Descartes, Thomas Reid, Immanuel Kant..., and the scientific and technological breakthroughs enabled by freeing the development of science in the 17th century:

Stage 1: cca. 1720 – mechanisation, hydro-power, steam power; development of manufacture and first "industrial" production, hard changes in social structures: new class of workers emerging – duration approximately *120 years*.

Stage 2: cca. 1900 - mass production, assembly line, electricity; development of mass transport and communication possibilities, hard changes in social structures: wide social differentiation, emergence of communism, socialism, nationalism etc., as answers to this widening socio-economic gap – duration approx. *70 years*.

Stage 3: cca. 1970 – computers, automation; huge geopolitical and political changes: gradual disappearance of worker and farmer classes, growing dependence on technology, wide abandonment of experimental social systems and adoption of a predatory type of liberal capitalism – duration some *30 years*.

Stage 4: cca. 2010 – cyber-physical systems; transfer of most communication and public services to the internet, higher and higher amount of surveillance, integrated systems, social confusion due to overexposure to information and misinformation, extreme power of multinational companies in all areas of human activity, though no change in political systems – duration could be around *15 years*.

Stage 5 (very near future): 2025 – globalisation, cognitive systems, cooperative systems, Electronic Intelligence; huge advances in production without human intervention, constant perceived and actual threats to privacy and security, general social confusion, unknown reaction of the humanity on the emergence of other high intelligence (electronic brains), fast growing distrust towards received information, media, governments, large companies and even science. High internal social opinion/belief/philosophy tensions, even inside families – duration *?*

So through the last several centuries the emergence of rationalism, and of scientific progress directly flown into techniques, and consequently developing technologies, led to the emergence of materialistic philosophies, on top of older idealistic and theistic philosophies. The sudden change in material means, resulting from the application of the scientific progress (much stimulated by the materialistic approach), naturally led to sudden exponentially growing changes both in the internal relationships inside human societies and the civilisation, and in the Nature as well as human natural and human-made environments. This led to further philosophical dispersion, development of questioning (and not modelling) philosophies, as for example existentialism, atheism and finally nihilism.

The extreme constant changes in internal human relationships led to a very diverse complex of economic (unfortunately not ecologic) approaches, theories and philosophies, from nationalism, imperialism, socialism, communism, all kinds and forms of capitalism, up to anarchism, always thoroughly intermixing morale, economy, ethics and philosophy.

This hotchpotch, without any clear common stance and viewpoint of us in our environment, led us to rush in all kinds of directions, like children playing with all what is and can be done. And the direct consequence of this philosophical confusion is that extremely rarely we do something, develop something, invent, introduce or produce something with the view of wider consequences. It is important to note that something seemingly beneficial to a certain group of humans, or some other environment, i.e. a specific sub-system, can be directly harmful to other sub-systems or the supra-system, or can be long term harmful to everybody.

And through this cacophony of philosophies (and their associated ethics or "ethics") we can unfortunately see the push of our common civilisation into a frenzy of "More, Better, Faster...".

It is well known that any system with a positive feedback, without the balancing act of negative feedback, will eventually tear itself apart, i.e. positive feedback, without the regulatory action of the negative one is destructive to any system at any level. The opposite is also true, a negative feedback without the counterbalance of a positive one, will kill the system, i.e. excessive negative feedback will stop the system activity. This delicate balance in our civilisation is completely lacking.

Our drive to further and further expansion of all kinds of goods, and the notion that the economy can be "expanding" in this sense of overproduction of mostly low quality, disposable products and packaging (a fresh milk's plastic bottle is supposed to be thrown away, or, maybe, recycled, after a maximum of 6 to 7 days of its use!) develops a huge strain on the stability of the whole of our ecosystem, including the geosphere, biosphere, sociosphere, and, finally, becomes a part of the technosphere, which, naturally, is also part of our nature's and planet's ecosystem.

A technosphere is an ever-present part of human civilisations, as each has a certain, sometimes even specific, type of developed and developing technology, which, based on the complexity of the developed techniques and technology, defines the technosphere of that civilisation. It became obvious in all to us known civilisations throughout the history that any technosphere progressively effects the emotional and social stance [6], isolates people from their natural environment, as well as from the global planetary ecosystem, giving them a false sense of "supremacy" over the other ecosystem spheres. Unfortunately this becomes more and more dangerous to the global ecosystem as the complexity of technological achievements grows, and presently it grows exponentially. Arthur Clark said that "Any sufficiently advanced technology is indistinguishable from magic." [7]. This leads, with a consequent unprecedented level of over-consumerism, to further problems, both educational, and, as mentioned, in the approach towards understanding the viability of our civilisation on Earth.

In cybernetic terms we could describe this situation as "competing" of two systems, the Nature and the Human, which should never had happened. The last century, with its devastating wars and, in a way, ground-shaking technological growth, together with a constantly generated and unsolved myriad of socio-economic and socio-political problems, i.e. problems in the, to us, essential sociosphere, brought (as mentioned earlier also in the philosophical views) to a standpoint of "Let's survive the day", "Let's enjoy life while we can", and the stance of "Let it be", "I can't do anything about it", "It's not my problem". Actually it is a problem of all of us, and we have to find ways to solve it.

In a very inspirational article by Frank, Grinspoon and Walker, entitled "Intelligence as a planetary scale process" [8] they explore the different levels of intelligence a specific planetary ecosphere has and should have.

They "propose five possible properties required for a world to show cognitive activity operating across planetary scales (i.e. planetary intelligence)." (see Fig. 2 in [8]). Basing their work on cybernetic principles, they propose the five principles of Emergence, Networking, Semantic Information (!)[2], Complex Adaptive Systems and finally Autopoiesis as the evolutionary means of planetary intelligence from the abiotic Geosphere, the lowest level of evolved intelligence, over the biotic Immature Biosphere towards the Mature Biosphere, an ecosystem with an extremely high level of viability robustness. With the introduction, as already stated, of technics and technology, whatever level of complexity they be, humans started developing the technologic technosphere. This brings to the state of Immature Technosphere.

It is important to note, and, unfortunately quite obvious from the present day highly dis-balanced global ecosystem, that the level of global planetary intelligence of an Immature Technosphere, or the technosphere we presently have and are eager to develop further, is quite a bit lower than that of the extremely robust Mature Biosphere. This is primarily in the areas of emergence and networks[3] and, most drastically in the area of autopoiesis. This in turn significantly lowers our robustness.

And let us not forget that we are presently the cause of the Sixth Mass Extinction Event in Earth's history [10]!

---

[2] It is important to distinguish syntactic information in Shannon's sense, by which e.g. data transfers may be measured, from semantic information, information which has meaning to the recipient sub-structure, i.e. the recipient sub-structure is partly isomorphic with the sending sub-structure, and the non-isomorphism of them enables the information to be of value, as it then conveys meaning.

[3] We should not confuse our feeble technology based networks with the global ecosystem prerequisite of a highly evolved and robust inter-sub-systems communication network, involving all abiotic and biotic elements of the planetary sustenance of a viable robust ecosystem. A very small but indicative example of the complexity of inter-species ecosystem communication and cooperation can be found in forest soil when regarding the function and functioning of mycorrhizal mycelia (e.g. [9]).

This global ecosystem reduction in biodiversity is a very dangerous path, as we directly deprive the system of prerequisite variety necessary for proper self-organisation of the system in case of any major disturbance [11].

III. RECOGNISING THE PATH

From the previous discussion it is is obvious that it is quite essential to come to a thorough answer on the question "quo vadimus".

But to know where we presently go towards, it is essential to know the present state of the system (the whole global ecosystem!), and see, in our knowledge and civilisation's experience, where such paths lead finally. The ancient Greeks, following other Near East civilisations, regarded future as being behind them, and the past in front of them [12]. They were aware of the fact that we look only into the past. This is a very proper way of looking at it, though we, in our present day civilisation, always pretend to go forwards into the future, look into the future, etc. Actually this is even on the lowest level of physics completely impossible, as all what we perceive of our environment are signals which originated earlier and needed time to get to us. So, actually, each and every "thing" existing in the Universe is actually at it's own now, which is temporary the latest point regarding the age of all other information streams flowing into it [13]. Consequently, the only thing we can do to "see" or "predict" the future (and in our case it is essential to see where we are presently, if no drastic changes are made, going as a civilisation) is to use multidisciplinary abstraction and association of previous experience, i.e. gathered knowledge.

One of presently hard things to cope with is the negative feedback from the whole Earth's ecosystem. This feedback is, in human terms, very slow, i.e. it can have extremely long latencies just to be perceived (and specifically as we generally slowly or abruptly perceive the change from quantity into quality [14], particularly on the level of the whole of humanity). Therefore predictions based on multidisciplinary ecological and cybernetic evaluation and modelling of long term observations and explorations (such as geological, palaeontological, palaeoclimatological, planetological...), and slightly shorter term knowledge of sociological, politological and technological experiences of last several thousand years are the only possible way to "foresee" the future well enough to have time to start long term corrective actions in our behaviour.

And before we find an answer to this question, we can not fully intelligently answer the next question, "quo vademus", "where shall we go".

Therefore it is necessary to involve a huge amount of effort in primarily two main directions:

1) Development of a Model of Present Ecosystem State
Firstly it is important to make a dynamically updated inventory of where we (our planetary ecosystem) have what, in what quantity and quality, and what are the cycles of these. Furthermore we need to know what do we research, mine, produce, consume, waste... and where, in what quantity and quality. We need to dynamically know what is transferred from where to where, and how much energy is used by each of our infrastructures and efforts, as well as understand natural energy flows.

This will then enable us to have a reasonable model, which will most likely be developed by cooperation with e-intelligence(s), as its hovering complexity would be impossible to manage without computer science development help.

By managing different scenarios in this model we will than be able to get a glimpse in possible futures, as probabilistic trends of a very complex system adaptation to disturbance and steering.

2) Development of a Global Philosophical Framework
The other, in present day probably even harder task to do, though absolutely essential, is the development of a global (thin) philosophical framework enveloping all of present day cultures on our planet. We say a thin framework, as it is essential that no cultural, philosophical, ethical or moral specificities, so extremely common in humanity, are endangered by the new philosophical framework. This is not an impossible task to achieve, as almost all present day philosophies do share same fundamental ethical norms.

The big work that has to be done is to educate the whole Earth's human population to understand that we are all (living and non living entities on our planet) extremely interdependent, and that the common ethics we try to apply to humans must be extended by the conscious "feeling" that hurting the nature in any way, without giving ecosystem-appropriate compensation is an ethical crime, or, in milder cases, misconduct.

Only such global high-level realisation, acceptance of the absolute interdependence inside a planetary (and wider, as we go into the space) ecosystem, will ensure a stable future nature-human-machine ecosystem, and elevate us from a dangerous position of an immature technosphere to a stable and robust existence on a mature technosphere planet.

IV. QUO VADEMUS?

The second question, "where shall we go", is: *which future do we want, and which path shall we take to get there?*

There are two aspects to this question. The first one is the wishes, the futurism, the stories of other worlds we would like to live in.

a) The What
"Ready-cooked meals will be bought from establishments similar to our bakeries of to-day. They will purchase materials in tremendous wholesale quantities and sell the cooked foods at a price much lower than the cost of individual cooking. Food will be served hot or cold to private houses in pneumatic tubes or automobile wagons."

"Wireless telephone and telegraph circuits will span the world. A husband in the middle of the Atlantic will be able converse with his wife sitting in her boudoir in

Chicago. … By an automatic signal they will connect with any circuit in their locality..." [15].

"Use the replicator, and take with you the tricorder!", "Computer, lights on!" (possible Start Trek commands, almost fully functional today[4]).

The first two citations are from the year 1900. Those were some of the wishes we, partly or slightly differently, accomplished in 100 years. The Start Trek things we are slowly getting, but that was imagined only around 50 years ago.

What is important to stress here is that any civilisation steers its efforts towards some imagined "magical" future. Therefore it seems extremely important that we imagine a viable future of human-kind [16], where kind humans live in a mature technological ecosphere.

b) The How
The second aspect of this question is the *How*. A question much much harder to answer, though directly actually a consequence of the first one, is how do we organise long term viability, sustainability and stability of the whole Nature-Human-Machine ecosystem [17], in other words how do we steer such a system, as minimal planning times for such a system are often in the hundreds of years. It is known from the control theory that controlling processes with very slow reaction and huge latency is much harder than controlling processes with fast reaction times and low lag and latency. The processes we will have to monitor and steer in the mature technosphere era are extremely slow in all aspects, but can also be reasonably abrupt (in the tens of years range), and are based on an extremely complex network of informational and physical interdependencies.

The "how" will have to be solved in a constant self-organising learning process by using and applying cybernetic models, with the starting point of the present state (discussed earlier) model. Stafford Beer developed a very applicable model of a recursive complex viable system, which is well worth studying and applying ([18], [19], [20]).

However, the enormous development of computer science necessitates a global integrating environment, and a practical, applicable recursive philosophical model, both for the hierarchical layers of implementation and for the recursive hierarchies of wider ecosystem modelling. For that purpose the authors propose the "Rainbow" model, a non-hierarchical recursive model based on 9 essential interrelated areas of an intelligent ecosystem (infrared - energy, red - matter, orange - creativity, yellow - appropriateness, green - environment, blue - communication, indigo – cooperation, violet - interference, ultraviolet - visions) described in [17], [21] and elsewhere.

As a kind of conclusion to the answer on "how", we may state that the "Smart Industry" can only be "smart" as a part of a smart technosphere and a smart sociosphere,

which are, inevitably, part of the planetosphere. Therefore any development of smartness in the area of development, production, distribution etc., which we may term as being "industrial", has to be extremely conscious and done with utmost responsibility towards the global ecosystem of our socio-, techno- and planeto-sphere.

And exactly for this reason it is essential to develop this kind of global smartness harnessed throughout our civilisation, and specifically in the area of proper globally ecologically based local economy, in which effort the aims of "smart industry" are extremely important.

On this path there are two major points we have to understand and follow:

- *The necessary adaptation of our wishes to the ecosystem stability needs*, and

- *The unavoidable (bidirectional) influence of ecosystem transformations on future production and distribution principles*.

In this sense the consequences of development of "smart industry" can pose *huge long term threats* to the civilisation, and the ecosystem, *if used for economic growth*, and can have huge *long term benefits* to the civilisation and the ecosystem as a regulatory agent which recognises the basic cybernetic facts of stable systems, *if used for the benefit of all planetary spheres* (abiotic, biotic and technologic).

V. OUR TOOLS
And finally, what are the tools we can use to properly steer our civilisation to be compatible with the nature we are part of (but not an obligatory part!)?

Philosophy - our main values have to be compatible with Nature, whose part we are, and our moral standards and ethical understanding/behaviour will have to be expanded towards the whole global ecosystem

Cybernetics - science of dynamic systems and their behaviour

Ubiquitous Ecology - science of the Whole and interrelationships of all its sub-wholes

Local Economy - localizing production and consumption as much as possible

Kairological Synergism - cooperation at a proper moment and in proper sequence

Education - extremely fast changes necessitate new knowledge frameworks

Quality - high quality and reliability products

Repairability - low level easy repairability with minimal waste

Computer Science - opportunity to organise a proper Nature-Human-Machine ecosystem by integration of the reactions on environmental stimuli through sensors and effectors, throughout the Dew-Fog-Cloud computing hierarchy ([22] and elsewhere)

Energy Balance - *production and distribution cost is Energy, not money*

---

4   Replicator – an advanced version of a 3D scanner/printer. Tricorder – much of it, together with the communicator, we have already in much of our mobile equipment, and things like atmosphere analysis etc. are becoming consumer goods.

A properly envisaged approach towards what we like to call "smart industry" is essential, and directly responsible, for several of the above-mentioned tool-developments. Therefore it is also of most profound possible consequences, and heavy responsibility lies on the shoulders of those who develop these new "smart" technologies, on us computer scientists and multidisciplinary researchers, developers, idea-makers, producers and distributors.

VI. Conclusion

Although we would like to have quite a lot of time, the time to make major changes to our approach towards the Nature and coordinate that intelligently with our Technosphere is very short. If we do not approach this problem from a very wide and multidisciplinary angle, we would easily end up, as a civilisation, at a point of no return.

Not that the Earth's Nature would not survive, however, it would certainly not survive in the ecological form we presently know, due to the huge species extinction we induce, the devastation of soil quality, the introduction of microplastics, the chemical and particles pollution etc.

A point of no return is a known phenomenon, described both in philosophy (the transition of quantity into quality), as well as in physics (e.g. critical mass), psychology (emergence of mass behaviour) etc. However, it is harder to envisage a possible point of no return for our civilisation (excluding e.g. an all out nuclear war, or some similar act of absolute general destruction), due to an enormous amount of interdependent sub-systems, for whose complexity we do not have presently even a viable common philosophy, less a viable predictive model. However, it is possible to predict that the amount of disturbance humans introduce may transition in an undesirable new quality.

The development of our future production and consumption principles, and therefore of our ability to survive as a civilisation, relies heavily on ideas we form now, during initial development of what we like to call *"Smart Industry"*, which, as we already mentioned, *may not be used for economic growth*, but instead must be used for ecosystem stabilisation and balancing.

Though, the quite old and old-fashioned notion of "Industry" will have to change drastically its present meaning in the sense of *Global Ecology and Local Economy* (production, distribution, use, repair, reuse; component and raw material recycling; natural growth, plant cycling, soil repose; …), *based on Energy Consumption*, and *not on Money*.

Acknowledgment

References

[1] Mohandas Karamchand Gandhi, "Seven Social Sins", Young India, October 22, 1925.

[2] Ann Wilcock, "A theory of the human need for occupation", Journal of Occupational Science, 1:1, 17-24, 1993, doi: 10.1080/14427591.1993.9686375.

[3] W. Ross Ashby, "An Introduction to Cybernetics", Chapman & Hall, London, 1956, Internet (1999), http://pcp.vub.ac.be/books/IntroCyb.pdf [15/6/2020, 7:01].

[4] Ante Lauc, Josip Miličević, Ivan Šešo, Zorislav Šojat, "Global autopoietic university as fides et ratio", http://grgur.irb.hr/Library/PDF/Lauc.Milichevicy.Shesho.Shoyat.Global-Autopoietic-University-as-Fides-et-Ratio.pdf [21/4/2022, 22:13].

[5] Walter L. Friedrich, Bernd Kromer, Michael Friedrich, Jan Heinemeier, Tom Pfeiffer, Sahra Talamo, "Santorini Eruption Radiocarbon Dated to 1627-1600 B.C.", Science 28, April 2006, Vol. 312 no. 5773, p. 548.

[6] Douglas S Massey, "A brief history of human society: The origin and role of emotion in social life", American sociological review, 67/1, pp. 1-29, American Sociological Association, 2002, http://www.wimvanmourik.eu/logica_gevoel/theorie/a_brief_history_of_human_society.pdf.

[7] Arthur C. Clarke, "Clarke's Third Law on UFO's", Science 159 (3812): 255, 19/91/1968, doi:10.1126/science.159.3812.255-b, ISSN 0036-8075.

[8] Adam Frank, David Grinspsoon, Sara Walker, "Intelligence as a planetary scale process", International Journal of Astrobiology 1-15, 2022, https://doi.org/10.1017/S147355042100029X.

[9] Jonathan Leake, David Johnson, Damian Donnelly, Gemma Muckle, Lynne Boddy, David Read "Networks of power and influence: the role of mycorrhizal mycelium in controlling plant communities and agroecosystem functioning", Canadian Journal of Botany, 82(8): 1016-1045, https://doi.org/10.1139/b04-060.

[10] Gerardo Ceballos, Paul R. Ehrlich, and Rodolfo Dirzo, "Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines", Proceedings of the National Academy of Sciences of the USA, July 25, 2017, 114 (30) E6089-E6096, https://www.pnas.org/content/114/30/E6089 [21/4/2022, 18:48].

[11] John Naughton, "Ashby's Law of Requisite Variety", Edge, 2017, https://www.edge.org/response-detail/27150 [21/4/2022, 23:11].

[12] Stefan M. Maul, "Walking Backwards into the Future - The Conception of Time in the Ancient Near East", Given World and Time. Temporalities in Context, T. Miller, Budapest/New York 2008, pp. 15-24, http://archiv.ub.uni-heidelberg.de/propylaeumdok/1378/1/Maul_Walking_Backwards_into_the_Future_2008.pdf.

[13] Zorislav Shoyat, "When Are We Now? a short hitchhiker's guide to the time", Zagreb, 2012/2016, ISBN 978-953-59029-0-4.

[14] Robert L. Carneiro, "The transition from quantity to quality: A neglected causal mechanism in accounting for social evolution", Proceedings of the National Academy of Sciences, 2000, 97/23, pp. 12926-12931, doi:10.1073/pnas.240462397, https://www.pnas.org/doi/pdf/10.1073/pnas.240462397.

[15] John Elfreth Watkins Jr., "What May Happen in the Next Hundred Years", The Ladies Home Journal, Dec 1900; Vol. XVIII,, No. 1; pg. 8, https://www.personal.psu.edu/staff/t/w/twa101/whatmayhappen.pdf [21/4/2022, 18:27].

[16] Rutger Bregman, "Human kind – A Hopeful History", Bloomsbury publishing, London 2020, ISBN 978-1-4088-9893-2.

[17] Zorislav Šojat, "From Dew Over Cloud Towards the Rainbow - Ecosystem of the Future: Nature — Human — Machine", Intelligence in Big Data Technologies - Beyond the Hype, Chapter 1, Advs in Intelligent Syst., Computing, Vol. 1167, Springer Nature, 2020, Singapore, ISBN 978-981-15-5284-7.

[18] Stafford Beer, "The Intelligent Organization" https://www.youtube.com/watch?v=7COX-b3HK50 [14/6/2020, 17:19].

[19] Stafford Beer, "World in torment – A time whose idea must come", Kybernetes 22, no. 6 (1993): 15–43, https://ia601606.us.archive.org/11/items/World_in_torment-Stafford_Beer/World_in_torment-Stafford_Beer.pdf [24/5/2020, 21:13]

[20] Stafford Beer, "Fanfare for effective freedom – Cybernetic Praxis in Government", Third Richard Goodman Memorial Lecture, Brighton 14/2/1973, https://www.scribd.com/document/2310055/Fanfare-for-Effective-Freedom-Cybernetic-Praxis-in-Government-Beer [24/5/2020, 21:08].

[21] Zorislav Šojat, Karolj Skala, "The Rainbow: Integrating computing into the global ecosystem", MIPRO 2019, https://www.researchgate.net/publication/333378758_The_Rainbow_Integrating_Computing_into_the_Global_Ecosystem [15/6/2020, 9:00].

[22] Zorislav Šojat, Karolj Skala, "The dawn of Dew: Dew computing for advanced living environment", MIPRO 2017, https://www.researchgate.net/publication/318690476_The_dawn_of_Dew_Dew_Computing_for_advanced_living_environment [15/6/2020, 8:58].