Moral or ethical heuristics, higher order autopoiesis and sophisticated digital tools

The fragile system-environment relation, blind spots, paradoxes and deparadoxication.

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1. Introduction

Moral communication is by Luhmann understood as communication, that carry with it indications of approval or disapproval or esteem and disesteem. Luhmann defines moral as first order observation related to personal action (Luhmann, 1992, 1996), and he has a skeptical assessment of the role of morality in the modern society in which he perceives the differentiated function systems as being amoral (Luhmann 1991, p. 86, 1996 p 35). In the article,"Ten Systems: Toward a Canon of Function Systems" Roth (2015) further argues why moral does not constitute a function system.

In the face of morality, ethics is defined as a reflection on morality in terms of what constitutes a moral position, based on second-order observations (Luhmann, 1996). The difference between morality and ethics provides the basis for an understanding of moralization (Luhmann, 1996).

Valentinov (2017) argues that there has been a modern proliferation of moral communication, and Carlton (2019) has tested this by Google Ngram Viewer, and found a significant rise in moral communication. Climate, sustainability and eco-critical awareness are becoming examples, and occasionally also the CSR and SDG debates turns out as moral communication: companies ought to take responsibility.

Roth (2014) defines organizations as programmable and reprogrammable multifunctional decision machines. Later, this approach has been unfolded in numerous articles also linking this understanding to the polycontexturality of the current organizations (Roth and Valentinov, 2020, Valentinov et al. 2019, Will et al 2017), the fragile system-environment relation and the social goals in the theory of the firm (Valentinov, et al, in press 2020).

Others have also grappled with organizations and their relation to a more sustainable society**.** Baecker does not normatively postulate the necessity or desirability of a changed society, but has been studying next society for many years (Baecker 2007 a,b,c,d; 2018). Baecker constructed a general form of capitalism and the firm (Baecker 2006) by using the notational language of the *Laws of form* (Spencer Brown, 1969).

Standing on Baeker's work (Baeker, 2006), Reichel (2017) uses Spencer-Brown (1969) to form an abductive heuristics of the form of the firm in the post-growth economy in which enoughness, limits and conviviality replaces return on investment, growth and consumption as systemic driving forces, and the management of a firm immersed in such a contexts, taking multivaluation, ethics and reciprocity into consideration.

In Reichel and Perey (2018) the concept of the antropocene is explained as a proposed geological epoch in which social systems significantly impact on Earth's geology and ecosystems, including anthropogenic climate change. The need for de- and post growth, which Reichel (2016) explains conceptually, is propelled (Reichel and Perey, 2018).

Reichel underlines, that the heuristics he builds (Reichel, 2017) is not what will happen, but what is consistent with Spencer-Brown's calculus of indication. Thus, he suggests the heuristics taken as an epistemic device for checking against unfolding empirical backgrounds in the reality of organizations and management.

In this perspective one may argue, that this kind of heuristics may be part of a moral communication, the good "firm in the post-growth Economy" versus the bad firm in the growth economy. However, as the article is very explicit and reflexive about its point of observation, it may be fair to characterize the heuristics as ethical rather than moral communication. It has a moral code, but takes a second order approach, and is not other-referential in terms of being moralizing, but rather it is self-referential in terms of creating heuristics for managerial self-observation.

This paper takes a slightly different perspective and elaborates on polycentric networks as a means for organizations to cope with the increasing complexity and precarious system-environment relation. This has been elaborated by Teubner (1993, 2011) explaining the concept of polycentric networks as higher order autopoietic systems, and Neumann (2011,2012) explaining the role of collaborative systems for polycentric networks to couple. In Neisig (2020) the concept of a shared semantic reservoir is explained as needed for the collaborative systems, and therefore for polycentric networks to couple.

This paper takes the conceptualization of polycentric networks a step further and goes beyond social systems. The research question is*: How may human, nature, digital and social systems couple in a circular economy (CE)? Or may they? And may a CE become more sustainable?*

The idea is to elaborate, not on the discussion on post- or degrowth society, but on how the circular economy, may depend on couplings of human, natural, digital and social systems. The concept of the circular economy (CE), is defined by Geissdoerfer et al (2017, p 759) as:

> *a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling*.

CE may be seen as a heuristic very similar to that of Reichel (2017), in which a moral code is inherited and turned into an ethical code – and thereby also an ethical communication. However, CE is not necessarily part of a de- or post-growth economy. Rather it tries to decouple economic growth and the nature. The heuristics on the CE has also (based on emerging examples) developed into heuristics on circular business models, some of which are very dependent on digitalization.

This paper will not dig into the discussion on the plausibility of the decoupling of growth and nature or the plausibility of a post- or de-growth economy. Rather, it sees, that the differentiated modern society has grown so complex, that to strive for or transform into a more sustainable way of organizing, heuristics as semantic tools (moral or ethical), as well as the development of highly sophisticated digital tools such as the use of data collection through RFID and IoT, as well as tools for big data analytics based on machine learning and AI, by the help of relational database management used for product lifecycle management seems to be needed to reduce the complexity.

The paper explains, how sophisticated heuristics and increasingly sophisticated digital tools, help semantics to develop into multifunctional semantics, that allows for the emergent reprogramming of organizations in which other than economic function systems (Roth 2014, Roth and Schütz ,2015) may increasingly be valuated in managerial decision-making, which may to an increasing extend be algorithmically supported. However, these heuristics and tools, may not solve the underlying fragility of the system-environment relation, which will be explained and elaborated.

The paper is structured into five sections. First, we have situated and accounted for the research question. In the following sections, we will, second, reflect on the relationship between nature systems and social systems based on Luhmannian thinking and relate to the heuristics of a CE.

Third, we reflect on digitalization of the CE as a way of coupling social systems, digital systems and the nature systems in order to strive for sustainability. Forth, we reflect on how this transformation may create networks of complex intelligent systems and human-technology-collaboration through polycentric networks of organizations tied together by collaborative systems based on advanced heuristics and shared semantic reservoirs. However, in the discussion and conclusion, section five, we argue, that collaborative systems get increasingly complex, but even though they are supported by big data and complex AI systems, due to the closed operation of systems, blind spots cannot be avoided. Therefore, we will see an eternal process of reducing complexity, by creating even more complexity as a spiral of paradoxes, that cannot be solved but only postponed by deparadoxication. We will see and eternal journey towards sustainability having no final solution.

2. Differentiation of the modern society and a circular economy - reflection on the relationship between natural systems and social systems based on Luhmannian thinking.

Several different approaches of understanding the relationship between nature and society have a system theoretical foundation. One example is research in "coupled human–environment systems" which for decades has been based on the perception, that social and natural systems are inseparable (Easterling and Polsky 2008), and research in and modelling of the dynamics of that kind of coupled systems has been funded by the U.S. National Research Council (e.g. National Research Council, 1999), and the U.S. National Science Foundation (National Science Foundation, 2008). Also, various such types of modelling were used by Meadow et al (1972, 2004) in their famous report: "The Limith to Growth" (Meadow et al,1972) and the follow-up thirty years later (Meadow et al 2004). Also, it is used by the UN Intergovernmental Panel on Climate Change (IPCC). Another type of understanding of the relationship is called Social Ecology, that aims to integrate various strands of ecological research establishing a more integrative transdisciplinary approach to studying humans' social interaction with their physical environment (Stokols, 2018).

However, what distinguishes such approaches mentioned above from Luhmannian thinking is that Luhmann underlines, that there is no *direct* coupling of society to any physical, chemical or biological entity (Luhmann 1997, p 114).

By a Luhmannian lens, this perception of direct interaction needs to be replaced by a concept of complex networks of structurally coupled systems. Material components (human bodies and their artefacts) do not belong to social systems, which are constituted only by communication. What ties material components produced by humans to social systems, however, is that they are all animated or created and reproduces by symbolic programs.

The modern society as described by Luhmann (1997) is highly differentiated social systems such as interaction systems, organizations and function systems only communication communicates. Polycentric networks are by Teubner (1993) seen as an emergent way of mitigating some of the effects caused by the highly differentiated nature of the modern society.

Theoretically, Teubner (1993) defines a polycentric network, as an emergent phenomenon, in which a 'dual' constitution of contract and organization appears in one institutional arrangement. If the dual attribution of action enters into the self-description of the social arrangement and is also used operationally there, then the network has constituted itself as an autonomous system of action via the constitution of new elementary acts. Networks are higher-order autopoietic systems, to the extent that they set up emergent elementary acts ('network operations') through dual attribution, and link these up in a circular fashion into an operational system (Teubner, 1993:49).

It is the dual pursuit of individual (organizational) and collective (network) goals, that Teubner portrays as a polycentric or multi-polarity characteristic of the unified network (Teubner, 1993:51). According to Teubner (1993:51) such networks have an advantage in flexibility and adaptation to disturbances as the hybridity of this dual constituency may vary over time, and the network can react as a whole, or the nodes can react autonomously.

However, this integration of a polycentric network requires new layers of abstraction e.g. collaborative systems, heuristics and shared semantic reservoirs (Neumann 2011,2012, Neisig 2020). Neuman et al (2011) and Neuman (2012) point to the need of a collaborative system for networks to couple, and Neisig (2020) argues, that for polycentric networks and their collaborative system to form; a shared semantic reservoir (heuristics, tools, language etc.) with a horizon spanning across the entire network also needs to emerge – which is not something that comes about easily. One of the attributes of a shared semantic reservoir and a collaborative system relates to its stiffness versus flexibility. The discussion about "stiffness versus flexibility" to react on the environment, conceptualized as the complexity-sustainability trade-off, was brought forward by Valentinov (2014) arguing that it may be rational for social systems to withdraw (or constrain) their internal complexity to maintain their sustainability in a given environment

The link between Luhmannian thinking and how social and nature systems may couple, however, is not obvious. Naruse and Iba (2008) acknowledge, that since Luhmann's aim was to build a general theory of society - a "social" theory, not a theory for the world as a whole - he treated the ecological communication in the society (Luhmann, 1986), but his analysis of ecology is not treated as a "system" but just as phenomena on the side of "environment" of social system. One may also argue, that the only way society may observe nature is through science as a function system. Luhmann's thinking has, however, influenced Social Ecology as a science. Based on Luhmann, as described by Haberl et al (2016), it is acknowledged, that the human body is not part of social systems but is the most immediate interface between the social and material realm, and that the artefacts created through the human body are material representations of symbolic structures and thus carry the symbolic realm within them.

Haberl et al (2016) refer to Luhmann (1997, p.114) stating, that society as a symbolic system is structurally coupled exclusively to the cognitive systems of the individuals who constitute the population. These cognitive systems and the social system are mutually interdepended in that the existence of one is the precondition of the other's autopoiesis. Here they further refer to Lippuner (2011, p 312) and state that, the two systems are mutually coupled because each uses the other as a means of selection (and thus complexity reduction) in the common medium of language.
Hence, society "acts" through the human body by way of a three-stage structural coupling: communication-conciousness-perception-body (Lippuner 2011, p. 311).

Thus, based on Luhmann, Haberl et al (2016) states, that there is a duality of society as a symbolic macro-structure and the individual as both the material "agent" and the possible source of conscious intervention, which is only successful if it is "selected" by the social systems, in that only the individual consciousness can "think" and only social systems can "communicate" (Luhmann 1997, p. 105).

Also, the Japanese scholars, Naruse and Iba (2008), have made an effort to set up a framework to understand the structural coupling of the ecosystems of the nature and the social systems, setting out for a theory of "ecosystem" as an autopoietic system, based on the concept of "autopoiesis" and social system theory. Their point of departure is the concept of "autopoiesis" as defined by Maturana and Varela (1972) originally proposed as a concept to describe living system and nervous system in biology. Autopoietic system is by Maturana and Varela (1972) defined as a unity whose organization is defined by a particular network of production processes of elements, and has three features: self-reference, boundary reproduction, and element as momentary operation.

Luhmann (1997, p.100) abstracted the concept of autopoiesis from biology and improved it as a general concept, used for social systems as autopoietic systems. In his theory, society is defined as the nexus of communication, and the system can reproduce communication by communication. The human mind is also considered as an autopoietic system, a psychic system, which is the nexus of consciousness, and the system can reproduce consciousness by consciousness – aligned with Maturana and Varela (1972).

Aligned with Luhmann's theory of society, Naruse and Iba (2008) suggest that elements of an ecosystem should be considered momentary operations, not individuals (equivalent to humans not being part of society). The particular network of production processes is that of a food chain and operation is the transference of substances. The code is: biological beneficial/not biological beneficial, and the medium is affordance. Compared to communication composed of the three-part selection of information-utterance-understanding, they suggest the three-part selection: food-ingestion-digestion.

In their paper, however, they do not come up with a suggestion for the structural coupling of social systems and ecosystems:

> "The relationship between function systems can be described with the concept of "structural coupling" in the autopoietic system theory ... For example, social system and psychic system are structurally coupled with the medium of "language". Economic system and political system are also structurally coupled with the media of "tax" and "national budget", and economic system and law system is coupled with the media of "contracts" and "property right".
>
> Think about this kind of relationship between ecosystem and social system, we have to consider the structural coupling of them (Naruse and Iba, 2008, p. 12).

One suggestion might be, that for the human body, (seen as part of ecosystems) the consumption cannot be reduced to just food, therefor the transference of substances is also much wider, and comes close to the concept of "Social metabolism" or "socioeconomic metabolism" as defined by González de Molina and Toledo (2014) as well as Pauliuk and Hertwich (2015), Inspired from Marx, González de Molina et al (2014: 87) writes:

> Karl Marx was the only one that succeeded in understanding the full meaning of the dual character of the human biological and social phenomenon, all of which was encompassed in his detailed and profound analysis of the process of labor. Marx laid the foundations for the future construction of a socioecological theory, which given the severity of the present crisis has become an urgent need and the main challenge of scientific reflection: "Labor is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature. He confronts the materials of nature as a force of nature, He sets in motion the natural forces which belong to his own body, his arms, legs, heads and hands, in order to appropriate the materials of nature in a form adapted to his own needs. Through this movement he acts upon external nature and changes it, and in this way he simultaneously changes his own nature (Marx, 1976, 283).

This shows, that the coupling between the human body seen as a living system and nature systems is through the process of labor. However, as already stated, based on Luhmannian thinking, there is no direct coupling of society to any physical, chemical or biological entity, and the human body, is also not part of the social systems. Only through language and symbolic communication the human bodies are structurally coupled to social systems, and in the modern differentiated society labor is communicated about by the function system of economy through the medium of money. The process of labor, however, mediates, regulates and control the metabolism between the human body and nature. This metabolism is the set of flows of materials and energy that occur between nature systems and human bodies as living and psychic systems structurally coupled with social systems.

Thus, large complex structural coupled social, psychic and natural polycentric networks (higher order systems) of systems are in play. However, the society as a social system is only able to understand these couplings through function systems such as science, education, media, economy, religion etc.

As stated in the introduction, this paper will elaborate on how the circular economy (CE), may depend on specific couplings of human (psychic system and body), natural, digital and social systems. The concept of CE is inspired from ecosystems, as all "waste" should become "food" for another process: either a by-product or recovered resource for another industrial process or as regenerative resources for nature (e.g., compost). This regenerative approach is in contrast to the traditional linear economy, which has a "take, make, dispose" model of production (Ellen MacArthur Foundation, 2015).

The "waste" should become "food"" metaphor implies a heuristic by which, it is better to reuse, if possible; repair if this help reusing, and only if this is not possible, then recycling is needed. Recycling means upcycle and reuse from the beginning. The last option ought to be using either bio or technical resources for energy production (McArthur Foundation, 2015).

Also, the CE-heuristic comes with five generic circular business models illustrating, how technical and biological elements may couple to the economic system. The five generic business models are (Accenture 2014, p. 13-14):

1. Circular Supply: supply chain features fully renewable, recyculable, or biodegradagle resources
2. Product lige extension: a) longer product lefecycles by repairing, upgrading, remanufacturing, or remarketing. B) revenue is generated ny extending life of product
3. Produce-service: a) Leasing or pay-for-use arrangements. B) Companies usually retain ownership and responsibility for maintenance of the product
4. Sharing platform: a) Increase the productivity of overcapacity or underutilization of owned goods. B) Peer-to-peer sharing
5. Resource Recovery: a) capture value of end-of-life products or production byproducts. B) includes traditional recycling.

Illustrative cases have been built in many different industries such as food, fashion, furniture, mobility, construction, farming etc., but also cities. The intension is to strive for CE getting mainstream. As the idea and notion of Circular Economy grows in its reach, it certainly creates a more powerful shared semantic reservoir usable for polycentric networks in many shapes to couple, and the circular business models may gain ground as heuristics for how to set up collaborative systems. All together it may facilitate the processes of creating the polycentric networks of organizational systems needed for a transition from linear to circular business models to take place. In so doing, not only organizations and the economy are reprogrammed, but so are all the large complex structural coupled social, psychic and natural polycentric networks (higher order systems) of systems involved in this transition.

3. Reflection on digitalization – coupling of social, digital and natural systems by creating networks of complex intelligent systems.

Making CE mainstream, however, requires more than shared semantic reservoirs and collaborative systems based on heuristics carrying moral or ethical communication to structurally couple organizations. Huge amounts of data need to be processed to enable such a transformation. Digitalization could be the enabling tool empowering organizations for such a transformation – and also creating coercion for changed decision premises in organizations. Data collection by RFID's (Radio Frequency ID's) and by the internet of things, may create data underlying the circular economy, and data integration, relational database management systems, product life cycle applications and systems and on top of that, big data analytics, machine learning, and artificial intelligence may assist organizations making the right CE choices. Algorithmic decision-making supporting human cognitive systems, may help structural coupling of complex social, psychic and natural polycentric networks (higher order systems) of systems, and create networks of complex intelligent systems and human-technology-collaboration through polycentric networks of organizations tied together by collaborative systems based on advanced heuristics and shared semantic reservoirs with an underlying moral or ethical premise.

However, as users may apply trust in more and more applications of big data analytics, machine learning, and artificial intelligence, blind spots may create unforeseeable consequences, and that is what we are going to address below.

Classical machine-learning system involved a single program running on a single machine, but as described by Jordan and Mitchell (2015), this is about to change:

> **"…**machine-learning systems are increasingly taking the form of complex collections of software that run on large-scale parallel and distributed computing platforms and provide a range of algorithms and services to data analysts…." (Jordan and Mitchell, 2015).

As the complexity of the machine-learning systems increases, machine-learning researchers try to formalize the relationships of resources, aiming to design algorithms that are provably effective in various environments and explicitly allow users to express and control trade-offs among resources (Jordan and Mitchell, 2015). However, to control these trade-offs is exactly what the Luhmannian theory of observation predicts as being impossible because blind spots are unavoidable.

Another aspect is that whereas current machine-learning systems typically operate in isolation, people often work in teams to collect and analyze data. New machine-learning methods may be capable of working collaboratively with humans to jointly analyze complex data sets, using humans to draw on diverse background knowledge to generate plausible explanations and suggest new hypotheses, and we may see new models of interacting machine learning, organizations as well as biological systems (Jordan and Mitchell, 2015).

This collaboration of man-machine (and nature) may be one of the greatest promises – and of great interest for management and organization studies, but also one that pushes the demands on human competencies in judging the big data analytics, machine learning, and artificial intelligence algorithms. How can we trust the algorithms? How can we test their results and consequences in large scale without running risks that are much larger than our ability to calculate? And how can we prepare for the dangers? This is a third alert for future research.

In the beginning of this paper, big data analytics, machine learning, and artificial intelligence was presented as a possible way of reducing complexity by getting tools for more and better abstraction. Big data analytics, machine learning, and artificial intelligence has also been presented as a tool for increasing productivity and to enhance the ability of levering environmental and climate knowledge, make wise CE decisions and much more.

However, as is also stated, big data analytics, machine learning, and artificial intelligence also seems to possibly create even more complexity, as more and more complex big data analytics, machine learning, and artificial intelligent systems may create emergent phenomena. Human confidence may not be able to predict such emergence and selection of trust as a way of reducing complexity may be challenged.

As a paradox, big data analytics, machine learning, and artificial intelligence seems to simultaneously decrease complexity and create even more complexity – and it may end up as a spiral as more and more complex big data analytics, machine learning, and artificial intelligence tools may be a strategy to deparadoxication of the ever existing and unavoidable paradox of knowledge, that are produced having no access to the external environment. In this way big data analytics, machine learning, and artificial intelligence tools are subject to the same paradox as science, and every production of knowledge, as also described by González-Díaz (2004):

> "..our knowledge and science have no way of anticipating each and every next event. Unanticipated, contingent irritations can always appear that can force new structural couplings. In the case of science, this requires the production of new knowledge. For that reason, paradox will be present as long as our knowledge system exists, and so will the need to resolve paradox by the system that Luhmann calls deparadoxication".

Our point is that this is exactly, what also is the case for the development of big data analytics, machine learning, and artificial intelligence tools for knowledge production: a never-ending spiral of paradox-deparadoxication.

4. Polycontextuality and blind spots of large intelligent complex structural coupled social, psychic and natural polycentric higher order systems of systems (networks) based on moral or ethical heuristics

In the article "East of nature. Accounting for the environments of social sciences", Roth and Valentinov (2020) argues for a polycontextual approach for striving towards sustainability:

If the Luhmannian vision is accepted, then ecological economics can be said to privilege the observational perspective of natural sciences. The unfortunate consequence of this privileging is the underestimation of a broad range of multidimensional sustainability risks which are foregrounded by the numerous alternative observational perspectives which are just as legitimate. (Roth and Valentinov, 2020, p. 1)

Based on Luhmann's notion of function systems Roth and Schütz (2015) have accounted for exactly ten function systems (politics, art, science, religion, law, education, health, economy, sport and media). Roth and Valentinov (2020) argues that in a polycontextural society the notion of environment needs to be understood in pluralis, as a multitude of social systems each bringing forth their own environment, and they suggest a scanning tool based on the ten Luhmannian function systems. They suggest a strategic scanning tool based on the ten function systems (Roth and Valentinov, 2020).

The risk and danger in not acknowledging the needs for such a scanning tool in a polycontextual society may be illustrated by the case of Huangbaiyu, a Chinese eco village based on Cradle-to-Crade principles (Neisig, 2014), which is one of "the schools of thought" related to the circular economy heuristic.

In China much farmland is lost to urbanization, factories and desertification. Therefore, the Government wishes to increase the effectiveness of the remaining agricultural land. With the eco-city in Huangbaiyu living standards of the approximately 1,400 people (400 families) should be improved, coal-burning reduced and peasants who had lived scattered throughout the valley, should be gathered in the eco-city in order to release more land for agriculture (May, 2008-2009).

However, many of the original ideas did not come true. E.g., none of the houses faced south as originally planned in order to become efficient for solar energy, because the building contractor changed orientation to fit Feng Shui. Inexplicably, the new houses also got garages, although none of the villagers could afford a car (Toy, 2006).

In Huangbaiyu most of the farmers complements their livelihood from the sale of maize, have small flocks of sheep or pigs, and small gardens for vegetables (Toy, 2006). The income farmers stood to lose with less room for additional crops did not appear to be part of the planners' calculations.

According to Shannon May, a U.S. researcher who has followed the project (May, 2007, 2008), the project was unsuccessful from the start. Her studies showed that whatever Huangbaiyu needed, it was not 42 new houses, let alone the 360 planned to follow. Even if the houses were more affordable and people's incomes increased, they would not want to spend the money on new houses. They would rather send their daughter to college or get surgery for grandmother or open a small shop. The project was based on a big assumption that people wanted a new house (Toy, 2006).

A multicontextual scanning tool as suggest by Roth and Valentinov (2020), would have revealed religious meaning for the orientation of housing, need for education and health as well as economic issues. In stead the project was narrowly focused on show-casing the ecological inspired Cradle-to-Cradle eco-village (which is in line with the CE heuristic).

In the article “Heal the world. A solution-focused systems therapy approach to environmental problems” Roth (2019) suggests that a better success with the higher goals of environmentalism could be obtained if environmentalists focus not on problems of capitalism and growth, but on those non-economic aspects of social life that can be grown instead, and Roth and Valentinov (2020) conclude, that:

> If contemporary societies are responsible for what we commonly refer to as ecological problems, then the solutions to these problems might require not ever-bigger natural-scientific efforts (Shah, 2020), but rather a shift of perspective to the environments of social sciences and a corresponding multienvironmental scanning that dislodges the problems while foregrounding the above opportunities that have not been clear before (Roth and Valentinov, 2020, p 6)

Also others have suggested to expand the dimensions to look for, when striving for sustainability, and develop more advanced “bottom lines”, e.g. expanding Elkington’s (1997) triple bottom lines to include accounting for all 17 UN Sustainability Development Goals (SDG) (Rendtorff, 2020) or as suggested by the OECD to not only account for GDP but using other indexes such as the Bette Life-index (OECD, 2020)

Acknowledging, that sustainability is about much more than climate and “footprint” reveals the vast complexity in striving for sustainability. Heuristics, tools, and shared semantics may be expanded to embrace more of the complexity, as illustrated by the Luhmannian based multienvironmental scanning approach (Roth and Valentinov 2020), the 17 UN SDG’s (Rendtorff, 2020) or the OECD Better Life index (OECD, 2020). Blockchain technology, big data and artificial intelligence may support keeping track of multiple parameters, broaden the perspective of collaborative systems, enhance human cognition and make organizations decision-premises multifunctional. However, as scanning approaches, tracking and analytical tools, shared sematic reservoirs, collaborative systems, decision-premises are improved to better comprehend and reduce the vast complexity; blind sports and paradoxes are unavoidable. Paradoxes are unsolvable because they are the unity of the marked and unmarked in any distinction (Luhmann, 2002: 88). Luhmann describes how any distinction can be paradoxified by crossing from the marked to the unmarked part of a distinction (which creates reentries), and deparadoxified by shifting observation to a position from which the unity may be seen – however shifting position takes time, and will always create a new distinction, that can be paradoxified. He describes the situation in the modern differentiated society:

> Functional differentiation requires polycontextural hypercomplex complexity-descriptions without unifying perspectives. Society remains the same but appears as different depending on which functional system (…) that descripes it. The same is different. (Luhmann, 2002: 89).

Among other authors who have treated the question paradox in Luhmann's theory is González-Díaz (2004), who expresses the handling of the phenomenon in the following way:

> ..cognition or knowledge of the world is impossible (because of the operational closure of the system), but absolutely necessary for structural coupling with the environment. For Luhmann, the most effective way to handle paradox is by making use of time and moving to a higher level of observation, much as Spencer-Brown does in his Laws of Form…. Systems have to deal with paradox not as a problem of logic or reasoning, but as a matter of the operations through which they can maintain both their differentiation from their environment and their internal differentiation as the complexity of their own organizations evolve. This means that the dissolution of paradox is necessary for the system's structural coupling with its environment. Structural coupling is a process which is carried out over time and is possible insofar the system is able to deal with paradox.

This means, that all the more or less moral or ethical based heuristics, tools, semantics, etc., that enables the process of moving to a higher level of observation, enabling new types of structural couplings, also over time creates "new environments" – and thereby new paradoxes. For Luhmann, the very existence and autopoiesis of a system is based on (the paradox of) the unity of the distinction between the system and its environment. Therefore, new paradoxes will be created as soon as new polycentric networks or higher-order systems emerge. Therefore, new ways of reducing the complexity by even more sophisticated methods that allows for more sophisticated structural couplings will end up producing a new complexity.

5. Conclusion

So what is the answer to the research question: *How may human, nature, digital and social systems couple in a circular economy (CE)? Or may they? And may a CE become more sustainable?*

As Luhmann underlines, that there is no direct coupling of society to any physical, chemical or biological entity (Luhmann 1997, p 114), the coupling may only be structural, by which systems shape each other's environment and depend on each other for their own autopoiesis. Only through the communication of function systems such as science, religion, education etc. society may get to reflect on its non-social environment. Seen from a Luhmannian interpretation, structural couplings with non-social systems may occur caused by the coupling of society as a symbolic macro-structure and the individual as both the material "agent" and the possible source of conscious intervention, which is only successful if it is "selected" by the social systems. Only the individual consciousness can "think" and only social systems can "communicate". The human body and social systems couple by way of a three-stage structural coupling: communication-consciousness-perception-body. As living organisms, the human bodies are structurally coupled to nature systems by the operation of the transference of substances through the process of labor, which in the modern differentiated society is communicated about mainly by the function system of economy through the medium of money. Through this structural coupling, the metabolism with nature is mediated, regulated and controlled.

What we see from a Luhmannian perspective is, increasingly complex intelligent systems coupled with social systems increasingly organized in ever more flexible polycentric networks tied together by shared semantic reservoirs and collaborative systems. The notion of a Circular Economy (CE) is one of several moral or ethical heuristics emerged by humans strive to mitigate risks from the increasing metabolism with nature, - and supported by big data, and artificial intelligence, shared semantics on new circular business models, CE may become mainstream.

However, even though increasingly complex systems are reducing the increasing complexity, still, each system has blind spots, - even very complex intelligent systems have blind spots. Risks and danger, power and coercion are unavoidable parts of this complexity. The strive for sustainability supported by sophisticated heuristics, collaborative systems, shared semantic reservoirs, and digitalization may reduce complexity, but only by creating a new complexity. As described the by Luhmann, functional differentiation requires polycontextural hypercomplex complexity-descriptions without unifying perspectives – or as described by Roth and Valentinov, in a polycontextural society the notion of environment needs to be understood in pluralis. Therefore, multifunctional and multidimentional scanning tools are emerging, expanding the notion of “sustainability”.

Therefor, the journey towards sustainability may be an eternal journey producing paradoxes, that according to Luhmann cannot be solved but only postponed in time by creating structural couplings, which may for a while create what Luhmann calls deparadoxication. This is needed in order not to be paralyzed. But it is an eternal process of reducing complexity by creating new complexity. It is an eternal spiral of paradoxes and deparadoxication, that has no final solution. This may seem very disillusioning for all the good intensions behind moral or ethical heuristics, higher order autopoiesis and sophisticated digital tools, but on the other hand, it may paradoxically also be an acknowledgement preventing disillusioning, when we experience that the goal is an ever-moving target.

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