Ethical Consequences of Systems Thinking in Industrial Ecology and their Relation to Environmental Philosophy

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Introduction

Since acting as an intermediary between experts cultures of technology and science and communicative everyday practice seems to be todays´obligation for philosophy, I shall draw in this paper primary ethical contents of industrial ecology and their relation to contemporary theories on environmental philosophy.

Industrial ecology has been developed by engineers and natural scientists (as the idea of sustainability has its roots in the context of renewable resources) and is hence regarded often just from this point of view. However, changing operations *and* attitudes towards the environment as a rational consequence of the ecological crisis is connected with a need to relate engineering skills with political and ethical sensibility. Likewise it seems the time for humanities to revisit ideas blamed for decades as reductionistic and opposed to the realm of purposes.

I intend to frame the ethical background of industrial ecology and of its practices which are usually accepted as they are. Accepting something as it is, means: the underlying assumptions, attitudes and values are tacitly sanctioned without ever being made explicit. As long as no difficulties occur this seems the easiest and most likely way to solve problems.

The first part of this discussion will encapsulate an overarching principle of industrial ecology: systems thinking. The following parts discuss three ethical consequences of this perspective with respect to different environmental philosophies, firstly in the field moral and operational significance, secondly within a political context and thirdly regarding communicative and corresponding activities of social agents towards nature. The conclusion intends to outline a common normative platform for industrial ecology supporters based on:

characteristics of the systems approach
- interdependency
- diversity
- complexity

and attached ethical branches
- responsibility,
- discursivity
- correspondence

1. Systems thinking and its scope

A system is described as a set of interrelating parts that internally perform functions which overcome their individual limitations. Typical systems are: industrial systems, ecosystems, and within them subsystems such as bioregional systems, communities, business sectors, etc. The “structure” of a system defines relatively stable established pathways as a result of continuous interactions between different sectors. The pathways (e.g. languages, cultural customs, economical routines, political decisions, social codes) design particular circumstances specific for that system. They act as patterns in relation to “functions” as “actions”. Functions modify the existing structures by constituting new pathways and these become established structures in time serving as templates for new action parameters and so forth.

Systems are non-physical; they denote abstract designs. Because of this, systems can serve as templates for corresponding sustainable actions. A system is less efficient at doing just one thing than a program, as a detailed plan or procedure, for solving a problem. But it is more efficient in the purposeful relation of performances.

Example: A recycling system might be less efficient in a particular case than for instance just to release the sewage into a fjord but it is more efficient establishing general waste reduction with a variety of positive attributes. From a programmatic perspective reducing waste by constructing a reprocessing plant for sewage, recycling the sludge and transform it into a usable by-product, is considered inefficient, far less direct and more expensive than just release the sludge. But from a systemic perspective, reducing waste by implementing a recycling system is more efficient, because it accomplishes many other things as well. While the systems route is long and indirect, programmes are designed for short term and direct problems.

Systems evolve by becoming more complex and more "intelligent". The most sustainable systems are those which are most complex and open. Systems manage resources. Complex open systems are relatively immune to loss of integrity, because resources that enter from outside are processed through and changed as a function of their complex design. This function can be called adaptability. Complex systems are more co-operative than simple ones since they have more and better possibilities to react on changes. The system then interacts with the system that provided e.g. the occasion of new resources, yet it maintains its distinctiveness; it is a new system evolved from its prior form, but modified by influence from the outside.

A metaphor: the emergence of industrialisation led to massive changes in almost every culture. Some cultures were just abandoned by the results of industrialism. Some cultures seemed to maintain their traditional practices and beliefs within a new context, others related to the industrial system and metamorphosed into novel, heterogeneous yet co-operative structures.

Today, with respect to the environmental crisis, many cultures are going through a new transformation process that reveals among other factors a shift from conventional industrial economies to environmental adjusted economies, that are: ***systematised industries***. According to this shift basic systems characteristics gain a wider influence than just being abstractions or planning tools but are connected inherently with values and norms.

The transformation from a traditional industrial economy that multiplies human muscle, via superindustrial production processes with the environmental crisis as an outcome, towards a knowledge-based economy expanding the human mind is accompanied by certain indicators.

The traditional industry used machines to transform primary resources into products. Imperatives were: resource exploitation, expansion euphoria, quantitative high production and consumption orientation, and hierarchic top down structures. The positive effects of traditional industrialisation processes showed increased living standards, better health conditions, technological progress and educational improvements. Disadvantages were pollution, land degradation, standardisation of products, work and human living conditions.

While decades of production industry began to face more and more natural limits. The superindustrial production is already marked by role-changes-breaks, hierarchical conflicts and a status quo desire that is not bearable any longer. Thus an industry working with flexible net-work structures, functional leadership, synergy, and heterarchy is desired to be created. It operates with human knowledge and integrates that knowledge into products and processes. Here the imperatives are connected with the use of "soft" resources: Understanding. Design. Systemic perception. Enterprises thus should promote the creation and use of knowledge. Governments, communes, and non-profits are challenged as well to look less on the hierarchical machines of the industrial age, and more to the social and natural interdependency of the post industrial society.

A holistic approach and a systemic perspective are the most significant characteristics of Industrial Ecology.

Firstly it is dedicated to systemic thinking because it relates strongly to ecology whose systems perspectives build upon three principles: individual elements of systems become specialised. As they do, the system as a

whole naturally becomes more internally diversified. And as the system becomes more internally diverse, it becomes more complex and its elements more interdependent.
However I am going to discuss the ethical implications of industrial ecology and one result of the systemic idea is here naturally an opposition towards a separation between industry on one hand and nature on the other. Instead the concept follows an ideal of "environmental balanced industrial complexes" and perceives an industrial system not apart from its surrounding systems but in interaction with them.
What are the ethical conditions for a successful co-operation of such heterogeneous areas?

Industrial ecology means maintaining resources in a sustainable way. Sustainability relates to ecological as well as to cultural conditions. Sustainability of cultural conditions regards the following main aspects:

- the ability of different participants to act on the basis of common set of goals, values and strategies
- a set of moral agreements and a platform to develop and perform actions
- political stability to grant the maintenance of these values, material as well as normative
- democracy in general
- public discursivity as communication among heterogeneous participants
- individual autonomy

In the following I will outline some of these aspects in relation to systems thinking and environmental philosophy and show their importance for industrial ecology.

2. The operational and ethical context. A feedback loop.

Many environmental problems in the past have been treated with programmatic means; avoiding pollution via building higher chimneys, carrying local waste to distant territories and escape from apparent environmental damages to recreation areas. The results of this “short-sighted philosophy” caused displacements of ecological problems from a local to a regional and finally a global level.
This breadth of environmental issues has produced a need, not only to revise industrial and technological procedures in particular but also to set up a global environmental debate discussing new rules for humanity towards nature. Unfortunately traditional philosophy does not embody theories, principles and norms for the new type of ethics that is demanded here. A novel approach has to differ from the conventional types of abstract deontics as well as from consequentionalistic and decisionistic ethics. We can neither stick to the Kantian narrow perspective of anthropocentrism nor agree on the post-Cartesian subject-object dualism any longer.
For the very obligation to meet environmental problems is it indispensable to consider the world as interrelated systems. Evidently too that the environmental situation today is extremely complex and widely determined by a human conflict of interests and duties towards other beings and surroundings. An additional difficulty is the problem to find relevant informations about facts and effects of human activities towards the natural environment. These challenges claim for ethical principles as mentioned above.
One opportunity to meet them is a concept called “macroethics” where systems thinking becomes the onset for a theory of environmental ethics. I begin briefly analysing the main ideas of this concept before turning to its operational applications in industrial ecology.
Apel, who coined the notion “macroethics”, bases his hypothesis on the fact that accumulated human activities damage the environment. Because of the collective character of their actions, humans should also share a joined responsibility. Briefly: Interdependency of actions claims for interdependency of responsibility.
The objectives for “macroethics” is emphasising the interconnectedness of different sectors and exposing *reasonable arguments* for the change of collective actions as response to the environmental crisis:

"The most difficult problem in this context appears to be changing our scientific technology and our market based economic system in such a way that their efficiency and power of motivation are not destroyed but rather put into service of a sustainable way of human life." (Apel, 1990, 225)

The problem is moreover, to agree on the goals humanity should strive towards. The goal of a system is to maintain the complete entity. Where is the human analogy here? Is the earth our "system"? The globe is widely immune against humans destructive power. Probably the perspective of evolution of life is crucial as a reference system. Yet, regarding evolution we refer to human development rather than to insects and micro organisms. Apel calls this a "prehistory of human history" (239). Consequently the only system we could refer to is our own species.
The *turn* towards systems thinking in Apels concept is not surprisingly a hermeneutical one, achieved by the interpretation of an intrinsic systems component. While investigating the epistemological content of "prehistory of human history" Apel states, that restructuring natural evolution as an overture for humans evolution is not merely connected with a view of nature as a pure object of value neutral cognition in the sense of natural science. On the contrary nature is regarded as a complement to humans and that with respect to the communicative potential of both.

"We treat natural beings here as something similar or analogous to human co-subjects of communication" (249)

Apel points out that even recognitions of natural sciences are not possible without a complementary anticipation of a communicative understanding in a wide sense. This type of communication provides an essential supplement to objectifying statements on nature. Thus the interdependency of human actions that creates responsibility is in Apel´s concept coupled with an anticipation of other living beings as co-subjects, strengthening the argument of experiencing connectedness from a phenomenological point of view.
As far as I see, humans cannot overcome the antithesis between human consumption and natures' exhaustion and the question of "weighting goods" will always play a main role in ethical debates. But one can say, that within this context it might become for instance a moral obligation to give good reasons for intervening the biosphere. This signifies already a form of advocacy for the environment as the "third party". If we recourse methodologically to an analogy from systems thinking its like taking another parameter in the system and try to perceive from this perspective.
What are the advantages of macroethics for us? It is firstly what creates the responsibility too. We are even if we depend on human reference systems thus not isolated and finally connected with the world via experiences and interpretations. It is secondly that if communicative relationships with the environment exist, it seems possible to balance the dilemma of demands and duties via deliberated actions. Thirdly, implications of macroethics permit to transfer theoretical principles into practical strategies like it is done in industrial ecology where the principle of responsibility is transformed to a precautionary maxim and applied in safety standards such as ISO 14000.
According to Apel an open public debate on environmental issues is the fundament for a novel concept of responsibility or co-responsibility. Public debates are of course dependent on a peaceful co-existence of different socio cultural forms. Today this can not only be granted by fixing equal rights for all human beings. Regarding the heterogeneity of cultures it is apt to respect cultural authenticity as a value along with favouring common goals, what appear similar to a system´s worth of diversity.
Apel points out that the democratic public discourse is an axiom for realising the principles of macroethics. Promoting ecological debates in such a way consequently requires democracy as the fundament for

sustainability. In the following part I will relate political conditions to systems thinking and demonstrate them crucial for industrial ecology as well.

3. Assumed political consequences

Environmental issues, as I emphasised before, are interconnected. The minimisation of ecological jeopardises thus can not be solved by single programmes or voluntary actions of individuals or groups. Obviously a co-operation of political, industrial and public activity is required.
While the role of industry can be expressed as to equip society with suitable means, the role of policy and government is (beside granting the availability of life essentials) to submit arguments that sway.
These arguments usually contain ideologies along with physical and social subjects. Democracy as a civil basis for sustainable development certifies, however that politicians have to give good reasons for their claims and/or actions in order to enable different agents to make autonomous decisions on that basis. A good reason is one that is capable of gaining confirmation from others as rational evaluators. According to Habermas one can distinguish between tree types of validity claims in discourses as fundaments for decisionmaking:

1. claim to truth (Wahrheitsanspruch), provable via empirics, concerning the sum of existing state of affairs.
   1. Case of vegetarianism: Global warming or the so called greenhouse effect is primary caused by carbon dioxide emissions from fossil fuels. Fossil fuel needed to produce meat-centered diet versus meat-free diet: 3 times more.

2. claim to correctness (Richtigkeitsanspruch), discussible via pro and contra arguments, concerning situations and interactions within the social world.
   2. Case of vegetarianism: Reasons for becoming vegetarian. e.g. the way in which the animals are kept, treated and slaughtered. Many people, assuming that animals have feelings and thus suffer, object these practices strongly and so stop eating meat as a matter of principle.

3. claim to truthfulness (Wahrhaftigkeitsanspruch), explainable via subjective decisionmaking, concerning individual experiences and attitudes.
   3. Case of vegetarianism: "I became a vegetarian because I believe that you should only eat meals whose sources you are willing to think about. I am not willing to think about a cow eating grass in a pasture while I was eating steak."

In order to vote for an argument one might give "good reasons" like certified facts or argumentative skills in case 1. (theoretical discourses) and 2. (practical discourses). In case 3. one cannot confirm a statement just through corresponding arguments but has to demonstrate it via consistent behaviour. If one asserts for instance to be vegetarian, eating beefsteak contradict this commitment. (Habermas, 1988,68)
Habermas states the principle that the validity of norms refers to the acceptance of all participants of a discourse. Or, as an imperative: only norms which outcomes would be tolerated by all participants, could gain general acceptance and hence social validity.
But Habermas describes ideal debates where all actors are treated equally and the question of power is none of importance. Despite this, real political discourses have to tackle with the roles of the participants and practical discourses cannot be liberated in the same way from social differences as theoretical ones.

"Thus the means of communication are often discouraged by the instruments of violence."(1988,116)

In fact, this is the point where another implication from systems thinking couples, described here with the term "diversity". The core is that discourses are performed *per se* by heterogeneous participants and yet hold a common structure of communication based on the ability to obtain network perspectives.
Criteria for discursivity with respect to diversity are:

- goal adjustments to overcome individual limitations. The potentiality of at least two heterogeneous participants co-ordinating their actions in order to succeed.
- communication as a mechanism for co-ordination. Communicative acts as connections for goal adjusted actions to integrate single performances in an action plan.
- realisation of the lifeworld as *context* for actions that provides by the same way *resources* for actions.

The acceptance of diversity as criteria for discursivity allows hence to start discussions from a systemic onset asking first after common goals and how single participants or groups may contribute to achieve them instead of arguing for individual claims. This balance also extends the frame for solutions.
For some philosophers the connection of Habermas beliefs with systems thinking might sound quite unorthodox if not sacrilegious. At least, I suggest to differ here between systems thinking and systems theory. The latter is in no way apt for ethics while the first is.
I emphasise a distinction of characteristics between both. Systems theory (or systems analysis) relates to a scientific attitude I would like to call "the solid course." The name connotes a method, that is rather distant from the plurality of genuine situations, but operates with empirical derived, descriptive data, brought into abstractions and transformed into plans or models. Its ontology and epistemology can be labeled as reflexive formalism: reality is independent of cognition but can be accurately represented in true descriptions. Systems theory is a natural scientists' tool. Systems thinking could however become an appropriate way for humanities. It relates firstly to phenomenology as expression of the human talent to put organisation into the world by analysing and systematising experienced phenomena. Secondly it relates to hermeneutics; human as a self-interpreting being tends to interpret the environs too. From the point of observation phenomena are described and analogised via abstractions or narrations. Finally, normative implications concern the value of world-understanding, connectedness and the tendency to create.
The shortcomings of systems theory such as lack of respecting subjectivity, the inability of accounting irrational behaviour and phenomena, and the inability to deal with basic value issues without a possible quantification of variables make this method insufficient for social and environmental problems. Systems thinking in opposition supports the tendency to define environmental interests in phenomenological or hermeneutical rather than in objective terms.
A retrospection to discursivity thus concludes: attaining Habermas´ discourses free of domination, diversity concerns firstly a logical condition as the variety of opinions to discuss about and secondly important ethical attitudes: tolerance, admiration of the variety of beliefs and willingness to find compromises.

4. An onset for communicative and corresponding actions

The former sections related to ecological problems and ethical consequences by way of reasonable argumentation. But the ecological crisis is less an intellectual than first and foremost a physical and emotional threat; the growing of health problems connected with environmental impacts, the feelings of dissatisfaction with the design of natural surroundings, doubts if there is enough space and food for humanity.
This creates, by the way, also two of the most significant criticism against the discourse ethics, the reminder that communication do not take place in a vacuum but in a life world and the remembrance that other beings are not experiences merely in a context of verbal communication and linguistic standards.
Dryzek comments as follows:

"Although it is easy to forget, our communications with one another can proceed only in and through the media made available by the natural world... Communicative rationality as generally stated (e.g. by Habermas) is not, however, conductive to harmonious relationships with the natural world. A first defect arises from its transcendent, ahistorical learnings. In practice, all ecological contexts are different, and individuals are likely to interpret and experience them in different ways. (1990, p.205, 203)

Thus the discussion of ethical criteria should consider individual states as well as rational statements. Illustrations and interpretations on the environs give important hints which are usually ignored in ecological debates. Due to this lack I discuss now perceptions and experiences of the "outer" nature as well as the vital experiences of ones own body, the "inner" nature and their connection to systems thinking..
Ones own body as a resource of experiences and the "self-feeling" in the environment includes for humans the acknowledgement that ones own well feeling is dependant on the condition of the ambience. Interdependency has been discussed already but the central point is here that different actors perform different actions what creates a common atmosphere. If all participants would act similar the network will decrease rather soon and each ambience mutates to conformity.
The quality of systemic complexity relates here to:

- different forms of human sensual perceptions of natural beings
- the acceptance of the equivalence of human rational, emotional and mental abilities
- the ethical claim to correspond with the environment in different ways

Once more, what are the benefits of an extension of the ecological discourse:
One is the introduction of an issue of subjectivity. There are several possibilities to realise ethical principles and this can be done not merely on a natural scientific basis but relates also to human experiences and creativity. The second is the insight that scientific knowledge is not enough to master the environmental crisis (on the opposite, the ecological crisis is in a sense a consequence of too extensive and optimistic utilisation of instrumental rationality towards ecosystems. Its effects reveal likewise the limits of empirical cognition when exclusively applied). I argue thirdly, that experiences of natural surroundings as non-verbal correpondence between co-subjects are an integral part of human existence and profoundly connected with respect for nature. Why this? Because they serve as counterbalances to the overestimation of utility principles. Without neglecting material needs for humans, they have other hopes towards their surroundings too. We do not only expect the world as willing to fulfil our needs but also our wishes. Otherwise we would have no ambition to live as humans. Self-preservation is the foremost aim of a living being - but for a cultural being (zoon politikon) ontology ("to live") is inherently tied with ethics ("how to live"). Homo sapiens always wanted the world to be useful *and* beautiful, a food and shelter reservoir and an aesthetic promise. Accepting finally correspondive nature experiences as values for the ecological debate would end the fruitless struggle between anthropocentrism and biocentrism and free the way for an integrated discourse on environmental ethics.

5. The three principles on a platform

Industrial ecology should expanse its concept to get more integrative. This is also very important because of industrial ecologies twofold purpose. Firstly it aims "ecological modernisation": develop procedures, design products and examine their functionality within technical and industrial processes in order to work out alternatives for conventional models of industry and technology. Secondly "structural ecologisation" should improve the frame in which these operations happen. It acts upon a *macro level* within fields like economy, sciences, politics and education. It bases on the idea to modify the perceptions and the interpretations of environ-

mental values in general and would manifest itself in daily life. It will work broadly and enduringly problem preventing. Therefore it does not enterprise to cure single symptoms but - in case of success - it changes the underlying technical, social, economical and political structures. This is essential because structural changes, even if they occur in a special sector, modify *de facto* the complete system.

The intentions of industrial ecology touch various areas such as: cleaner technologies, sustainable energy use, education and training, finance and investment, policy and regulation, green marketing, eco-design, life cycle assessment, and sector specific applications as for instance transportation, information exchange, agriculture and tourism.

The concept is held together by shared views and applications with regards to the maintenance of natural and cultural environments. The different areas support one or more aspects, some are particular concerned about technological and industrial improvements and adhere to the concept with a pragmatic approach while others are engaged in infrastructural support or theoretical issues. In principle, industrial ecology is pluralistic, it allows several different perspectives related to the specific areas.

In view of the distinctive, yet interrelated areas, it seems appropriate to design a common onset to relate. Focussing specifically on the systemic and ethical points mentioned above I shall trace in the following some patterns of such a platform.

Let us consider for instance four levels of precision. A notion is more precise than another if there is at least one interpretation of S that is no interpretation of E, but no interpretation of E that is not interpretation of S. I use here Næss´ "methodological vagueness" (Næss, 1989) for facilitating communication and acceptance of hypotheses and derived norms by emphasising the positive character of diversity of opinions associated with a high level of generalisation:

"Actually the function of the general norms is that of tentative guidelines... There are serious considerations which favour a certain vagueness and ambiguity in outlining normative systems. Instead of tentatively rejecting one of the norms or hypotheses in favour of a completely different one, it is often better to introduce alternative interpretations of the `initial point of departure´ wording."(1989, p.42)

Hence, the hypotheses on the first level have to be the most indistinct:

1. The globe and the biosphere are entirely immune against humans destructive power but neither our own species nor others are secure.
2. Humans and other species depend on their environments.
3. Humans are the perpetrator of the environmental crisis, but they are also able to find ways out of it.
4. Current attitudes and practices in technology and society are nowhere sufficient to master this task.
5. Different human cultures have to deal with different surroundings and have thus different goals
6. Humanity is able to learn from nature by observation and application of ecological procedures helping to improve interactions with natural surroundings.

Consequently, the assertive norms on the first level too:

1. Aim to maintain your species
2. Aim to maintain the survival conditions for humans and other living beings
3. Develop a constructive program to deal with environmental problems
4. Chose and attitude or procedure which is most likely to support environmental improvements
5. Advocate a dialog among different actors
6. Revise your nature perceptions

Central norms on level two are phrased to create a consensus via discourses among different positions, e.g.:

1. Formulate the essential physical needs to maintain humanity
2. Refrain from unnecessary depletion of surroundings

   or...

1. Find social conditions to sustain humans as humans
2. Announce strategies to give a voice to the “third party”

Level three consists perspectives of particular states and interest groups and concretisations e.g. for industrial ecology adjusted agriculture:

1. Strive for the best circulation of material flows in the supplying system. This relates to an establishment of metabolistic producer-consumer-waste-manager networks and matters all production activities even the pre- and post-production processes (as it is an industrial ecology's philosophy: “from cradle to grave”).
2. Work on bioregional and vegetarian food supply in order to minimise impacts on the environment.
3. Introduce ecological care for farmers (non-use of pesticides etc.), fabricants of semi-products, distributors, food stores and restaurants.

Level four refers to singular decisions in concrete contexts, e.g.:

1. Introduce “cuisine sharing” in the neighbourhood
2. Be a vegetarian

Although the examples just outlined may seem rather modest they might give an idea *how* to deduce connected solutions. It is my intuition that a successful response to the environmental crisis can be reached only via precising and practising the ethical principles of responsibility, discursivity and correspondence. This philosophy demands rather a wide range of perspectives, diverse suggestions from groups and individuals, and autonomous thinking than it bets in pressure and imperious restrictions for society on the one hand and technological idealism on the other.

Literature

Apel,K.O., The Ecological Crisis as a Problem for Discourse Ethics, In Øfsti,A., Ecology and Ethics. A Report from the Melbu Conference, Trondheim 1992

Ayres,R./ Simonis.U.E.(ed.), Industrial Metabolism. Theory and Policy, New York 1994

Bertalanffy, L.v., General Systems Theory, New York 1968

Dryzek,J., Green Reason: Communcative Ethics for the Biosphere, in: Environmental Ethics, Vol.12, Fall 1990, Denton, Texas

Emery,F.E.(ed.), Systems Thinking, Selected Readings, Harmondswoth 1969

Habermas,J., Moralbewußtsein und kommunikatives Handeln, Frankfurt 1983, engl. Moral consciousness and communicative action, Cambridge 1990

Habermas,J./Luhmann,N., Theorie der Gesellschaft oder Sozialtechnologie - Was leistet die Systemforschung?, Frankfurt 1973

Naess,A., Ecology, Community and Lifestyle, Cambridge 1985

Posner,M. (ed.), Foundations of Cognitive Science, Cambridge, Mass., 1989

Rescher,N., Cognitive Systematization. A Systems-Theoretic Approach to a Coherentist Theory of Knowledge, Oxford 1979