46.3.1

# TRANSDISCIPLINARY UNIFIED THEORY

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Complexity, Control, et ceteris paribus, Generalists, Interdisciplinarity, Isomorphies, Methodologies, Models, Multidisciplinarity, Regulations, Semantics, Specialists, Systemic Language, Transdisciplinarity

**Short contents list**



**Glossary**

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| **Control** | A man-made device aimed at the proper regulation of a function in some entity |
| **Cybernetics** | A discipline including the study of communication, information, regulation and control, automata and generally the behavior of complex systems |
| **Feedback** | The use of part of the output of a system as a new input modifying its behavior.<br>Feedbacks can be used or created for control |
| **Isomorphy** | A one to one correspondance between the structure of a model and the structure of the modelized entity.<br>Also, a one to one correspondance between models of different entities |
| **Lehre** | German word for theory, or science, used by von Bertalanffy |
| **Regulation** | Any natural constraint that maintains within limits of stability a function in a system through feedback - see control, feedback |
| **Semantics** | Used here as a tool for creating a good correspondance between language and meaning as free as possible of psychological or cultural distorsions |
| **System** | An entity, or a set of functionally interacting elements, acting as an integrated whole, clearly distinct from its environment. A model of such a set is also a system, in a formal sense. |
| **Systemics** | A shorter denomination for "Systems sciences", or "Sciences of complexity", introduced by Bunge. |

**Summary**

Numerous complex issues of the most varied kinds are energing in our evermore interconnected man-planet settings.
Such situations cannot be anymore managed by the piecemal and incoordinated interventions that result from growing chasms between multiple specialized disciplines. Accordingly, interdisciplinarity and multidisciplinarity should be complemented or, in cases, replaced by transdisciplinarity.

Transdisciplinarity in turn supposes the existence of a specific language of concepts and models, which should be understandable and usable by any specialist in need to collaborate with a variety of colleagues of other fields.
Such a language has emerged since 1950 as cybernetics and systemics (or so-called systems sciences or sciences of complexity). It is still becoming richer and better connected internally as it steadily acquires new conceptual tools adequated to the study of dynamic, simultaneous, multiple and interdependent interactions in complex issues.

## 1. Overview

Sometime ago, a good friend of mine, a retired electrical engineer, much interested in robotics and in "artificial intelligent systems", his personal Holy Grail, told me: "I really wonder about the usefulness of General Systems Theory. It is not offering any solution to any real problem".
This is of course a characteristic comment by a specialist in some "hard" discipline, most of which are still practiced using the classical scientific methodology inherited from the 19th Century.
The general approach of such specialists - be they engineers, physicists, chemists, and technicians of any denomination - is as follows:
1. We have a "problem". Historical examples are: How can we fly an aircraft (Wright Brothers); How can we fly an aircraft through the sound barrier; How can we construct a spacecraft that can escape Earth gravitation?
2. Our problem should be **solved:** for example, we would need some engine or rocket powerful enough to lift our craft against Earth gravitational pull, into outer space and keep it there.
3. We should experiment with different powders or fuels, until we discover one that fullfils our needs. This can be done either by trial and error, or creating some model, or using some technique based on known physical laws".
Such a methodology can also be applied to a large extent to biology and medicine. However, in this last case, experiment becomes technically more difficult, as total control over the experimental conditions is generally impossible; because there are no two identical living beings; and in the case of humans, because experiments are severely limited for ethical and practical reasons. In short, it is not anymore possible to strictly apply the famous "et ceteris paribus..." condition in cases and situations which are strongly bound to complex and widely variable environmental settings. In fact, we did enter the realm of high complexity.
Recently, it is becoming obvious that many concrete situations, even in physics, in chemistry and in engineering are not amenable to a simple causal and experimental methodology. A good example is the progressive pervading invasion of chaotic models or self-organized criticality in disciplines like meteorology, sismology, hydrology, or even chemistry (in the case of the Belousov-Zhabotinski reaction, for example, as shown by Prigogine) (see next section #10).
On the other end of the situations rainbow, demographic, economic, political and social phenomena are still less understandable using classical models.
"I can see that" says my friend the engineer. "But Systems theories still cannot produce solutions either. So what?".
This could remind us of a quite acute comment by Bela Banathy Sr.: "You cannot solve a problem, you can only manage it". It is the case if the problem is not merely repairing a motor, but making decisions, for example, about the construction of an hydro-power dam. In such a situation the manager-decider must take into account all the multiple technical, environmental, economic, social, etc... factors that should be harmonized. Moreover, managing problems - as best as possible - depends on available (and reliable) evidence, conflicting interests and ideologies, hidden assumptions, conjectural evaluation of future trends, disponible means for action, and, last but not least, what J. Warfield calls

underconceptualization by the situations's stakeholders, due to their prejudices, misinformation, etc...
Obviously, no specialized knowledge - i.e. about a specific small part of reality, fits the needs, because none contains information about the interplay of numerous different elements, factors and functions. In the words of I. Mitroff , our students are trained for it "solving Rubik's Cube variety", not for tackling real-world uncertainty and complexity (Mitroff, in his preface to H. Linstone's (Ed.) "Multiple perspectives for decision making").
In short, we need something else than the narrow deterministic methodology used to "solve" simple "problems" (i.e. amenable to linear and sequencial cause-effect relations, or statistical study). If we do not find out these needed new conceptual ways, our prodigious scientific and technical progress could well merely help us drown in self-inflicted mega-messes.
Such a menace is already clearly visible in an increasing host of new global problems, affecting hundred millions of people, or entire continents.
We observe however a growing trend to bridging between disciplines. It is possible to distinguish three stages in this process, which can be seen as a kind of progressive mental and conceptual immunological reaction of the human mind confronted with new types of intellectual tasks:

- interdisciplinarity
- multidisciplinarity
- transdisciplinarity

Let us have a look on these different methodologies .

## 2. lnterdisciplinarity

This expression should better be used only to describe a specific more or less integrative interrelation between two disciplines as for example bio-chemistry, astro-physics, medical radiology, or population genetics. In such cases, one discipline needs of the other, or brings new insights to the other. Any interdiscipline supposes an excellent knowledge of both intervening fields and, in some cases, mathematical models used as a formal lingua franca.
Any interdiscipline tends quickly to become a new speciality, a full discipline in its own right, leading to more and more fragmentation of an ever expanding knowledge.
Kenneth Boulding, one of the founders of the original "Society for General Systems Research" - now "International Society for Systems Science" - made the point jokingly, explaining that a specialist was somebody who knew ever more about ever less... "until he came to know everything about some nothing".
This is not of course to detract from specialization, without which the enormous technical and scientific progress of the three last centuries would have been impossible. It means merely that **we need something more** than specialization if we are to avoid growingly disconnected and at times contradictory or even dangerous action.

## 3. Multidisciplinarity

This is our second step.
Multidisciplinarity reflects the ever growing need for collaboration among many disciplinarian specialists for the management of complex situations, wherein numerous different - and many times more or less contrary or incompatible - aspects must be considered and somehow harmonized as best as possible, as in the case of the hydropower dam, for instance.
Unfortunately, most of the multidisciplinary meetings - specially those which must produce some critical decisions on practical projects - are merely confuse and confusing caucuses. In some cases, long debates even lead to deep and damaging misunderstandings among a

number of people using their own specialized language, frequently obscure for many of their co-participants.
Worse still, in some cases, this very obceurity is used to hide some personal or sectorial intentions or interests.
Even with the most serious and honest purposes, contradictions, incompatibilities, possible negative side-effects, etc... are frequently not perceived. Collective debates of this kind may leave the decision maker or makers, in a state of ignorance or doubt about any final and global resolutions to be taken, due to the lack of a really well connected and coherent view in space and time of the situation to be managed. The results can be - and many times have been - small, or great man-made inconveniences or catastrophes, commonly called messes by Ackoff.
Obviously there is still a need for some kind of more integrative views if multidisciplinary debates are to avoid such traps.

## 4. Transdisciplinarity

As a first comment, it seems important to distinguish an already existing, but still in the making, transdisciplinary language, from the hypothetized idea and construction of a global "transdisciplinary theory", in the eventual sense of an epistemological or - who knows - an ontological "theory of everything". With his structural differential, Korzybski clearly showed that any process of progressive conceptual abstraction is somehow evermore antinomic to precise descriptions and distinctions. For example, the highly abstract concept of "Life" is devoid of any precise connection with any specific living being. It is thus in fact located near the philosophical level and acquires some practical sense only when qualified (or quantified!) in connection with other concepts or with specific examples of living beings.
In a neat kind of counterpoint to Boulding's view of hyperspecialization, a "Theory of everything" may always be in danger of becoming a "Theory of nothing".
In fact, what has emerged from 1948 on (starting with Wiener's first book on Cybernetics), is something else: a growing set of growingly interconnected concepts and models, mainly about ways of interactions among elements and organization of complex situations and systems.
Accordingly, if we seek some transdisciplinarian synthesis, we can probably find it under the guise of a new interconnected language of concepts and models applied to a reasonably accurate description of complex wholes.
If we now try to pin down a proper meaning for transdisciplinarity, it is useful to quote some of the most experienced systemists of the last 40 years.
According to Rodriguez Delgado, the foremost Spanish systemist, transdisciplinarity is a global perception of the ultimate connection of all or many disciplines. From this perspective, not only science but all human activities appear as an unitary whole, part and parcel of the unity of universe. Unity and diversity do not appear as opposite concepts, but as complementary perspectives.
Peter Checkland in turn wrote - long time ago - in a quite practical perspective.- "What we need is not interdisciplinary teams, but transdisciplinary concepts; concepts which serve to unify knowledge by being applicable in areas which cut across the trenches which mark traditional academic boundaries"
As an example let us consider two adjacent concepts of very wide generality: regulation and control, both related to feedbacks.
Many natural entities possess regulators - also natural - of some of their functions. We ourselves are equipped with regulators of our blood pressure, our respiratory rhythm, the rate of our blood glucemy, etc...
Characteristically, when in good health, we remain quite unaware of these regulators and, until recently, we could not act upon them, save through some traditional Hindu or Chinese physiological techniques, for instance.

More or less similar regulators exist in practically all living beings, animal or vegetal. They are also at work more or less chaotically (see "In search of a new coherence" #7) or statistically in populations, in plate tectonics, in the solar cycle, in climates, in stock markets and many other complex settings.
Any regulation is the result of some feedback, positive or negative, or of a complex set of interacting feedbacks (Ibid. #3). This is very interesting for a proper study of regulations: Where are the feedbacks? Which types of feedbacks are at work? Which periodicities or regularities do they follow?, etc... We thus learn to ask ourselves good questions.
As to the notion of control, we should consider it a human made regulation, a constraint, used to maintain some function, generally of an also man-made artifact, within predefined limits. This was in effect the initial goal of Norbert Wiener during the 2nd World War: How to avoid the defocusing of anti-aircraft guns. Of course, any control is also based on some feedback or feedbacks. But in this case we have to **construct them**.

## 5. Practical uses of Transdisciplinary Language

L. von Bertalanffy's original programme of translation of knowledge from one scientific discipline to others remained - and still remains, up to a point - an unfullfilled proposal.
The English translation from German of his original concept of "Allgemeine Systemlehre" as General Systems Theory contributed to obscure his goal. What a true "General System" could really be, remains to date quite difficult to find out.
What we generally call "System" is in practice in every case a "model" of something we do perceive as a whole, organized from a great number of interconnected and interacting elements. Leaving apart the very tricky aspects of our perception of so-called "real" systems [See section "The road toward uncertainty": #6: The observer observed], our problem is to find useful descriptions - i.e. that somehow enhance our understanding, of interwoven structures and functions, which are the bread and butter of complex entities.
The basic tenet is then to find similarities between some specific structures and/or functions in different models of different systems. In other words, we should look for isomorphies, not basically among systems, but better among our models of systems. The best general example of an application of such a methodology is J. Miller's work on living systems, which amounts to a general taxonomy of structures and functions in practically all living systems at the 8 levels of complexity that he described. As a bonus this work is moreover truly heuristic in character through Miller's cross-level methodology of construction of hypotheses. [see "In search of a new coherence": #13].
The transdisciplinarian language of concepts and models - as attested by the above example - becomes thus the basic tool for Bertalanffy's "Systemlehre" (Systems science), i.e. a language of interconnected significant isomorphies of a more or less general usefulness. Such language is a bottom-up construction, through progressive interconnection of specific concepts and models. Bertalanffy himself wrote somewhere that there is nothing wrong even with metaphors, provide they are seriously founded, justified and, moreover, practically useful as short cuts in as wide as possible areas of scientific research.

## 6. A General Semantic Comment on Language Depreciation

It is easy to observe how meanings are constantly shifting in contemporary spoken and written languages.
New words are introduced to distinguish new objects or concepts, a process which is of course necessary and normal. We found for example the need to carefully distinguish "inter-", "multi-" and "trans-" disciplinarity.
But other effects can also be observed. Some words, terms, expressions or meanings seem to wear away in time. In other cases, meanings are not clearly distinguished and a word's signification becomes excessively fuzzy or even distorted or confused with another.

This could be specially damaging for the word and concept of "transdisciplinarity", if it would be confused as a substitute for "multidisciplinarity", or even worse for "interdisciplinarity"... as it sometimes appears to be done.
Similar problems have already surfaced for example with the very common confusion between "communication theory" and "information theory"; or between the notions of "isolated", "closed" or "open" when applied to systems.
Sloppy and inaccurate linguistics and semantics - more and more visible nowadays in some journalistic and even in scientific popularization - are very harmful for a sensible understanding of the scientific discourse among researchers, and still more so at Jane and John Citizen's levels.
We should be aware and watchful, specially when we are trying to establish proper and clear standards for intellectual exchange.

## 7. Conclusion

A Unified Transdisciplinary Theory still does not seem to exist. As an ever wider adaptability would be needed for the management of our evermore complex situations and systems, it is somewhat uncertain if it can be conceived in a definitive form in any future time, specially if conceived as a type of top-down all-embracing abstract construction.
It would be however unfair not to mention Don McNeil's very recent effort to "Construing Systemicity" , in which the basic prime mover of any form of organization is the general and kind of self-constrained energy field, leading to the appearance of a spiral and toroidal dynamics of forms constructions. Mc Neil's concept is a wide generalization of ideas tentatively developed by, for example, the french engineer Ch. Laville and the english biologist d'Arcy W. Thompson, both from older sources as E. Chladni of 1809 and C.L. Weyer of 1887!, quoted by Laville) [see "In search of a new coherence" #2]. Mc Neil also takes in account von Förster's observer's riddle.
Only time will judge about the wider value of this new insight!
However, as a result of 50 years of Cybernetics and Systemics, we have acquired something else, i.e. an expanding Transdisciplinary Methodology - reflected in a new language of concepts and models - that can be used as a research tool for complex or global problems that had hitherto remained outside the realm of the classical Scientific Methodology.
Both methodologies are complementary, <u>not opposed</u>. A specialist without at least a modicum of understanding of his/her place within the scientific and social community is in fact a prisoner in one's own ivory tower. Conversely, a so-called "generalist" without any understanding of the nature, conditions and general meaning of specific disciplinarian knowledge cannot contribute anything useful to that same scientific and social community, at any level.
Conceptual balance seems to be the golden rule.

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