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Review:

Can Nature Teach us Good Research Practice? A Critical Look at Frederic Vester's Bio-cybernetic Systems Approach

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Die Kunst vernetzt zu denken: Ideen und Werkzeuge für einen neuen Umgang mit Komplexität [The Art of Network Thinking: Ideas and Tools for a New Way of Dealing with Complexity.] Book by Frederic Vester (Language: German). Published by Deutsche Verlags-Anstalt, Stuttgart, Germany, 1999, (6th Edition, 2000), 315 pp., ISBN 3-421-05308-1, EUR 22.80. (Pocketbook Edition by Deutscher Taschenbuch Verlag (dtv), Munich, Germany, 2002, 348 pp, ISBN 3-423-33077-5, EUR 12.50)

This is a book review of a somewhat unusual sort. It aims to introduce to the readers of *JRP* a book that *ought to* have been published but never has--the English version of Frederic Vester's *The Art of Network Thinking*. I should mention that Vester himself proposed as title "The Art of Networked Thinking"; however, I prefer to speak of "network thinking." This sounds less awkward and it conveys the central idea well-- thinking in terms of networks. Unfortunately, there seems to be no completely satisfactory English translation of the phrase *vernetztes Denken* [pronounce: *fer-**nets**-tes **den**-ken*]. Its meaning is rather rich and includes notions of holistic (in the sense of integrated and global) thinking, of thinking in terms of multiple causation and dynamic interdependencies, in cycles rather than linear cause-effect chains, and so on.

The first hardcover edition of the German original appeared in 1999 and was sold out within months. By December 2000 it had been reprinted five times. In 2002, the Club of

Rome,[1] an international group of experts concerned with global development issues that became widely known in the early 1970s through its report on *The Limits to Growth* (Meadows et al., 1972), accepted an extended version of the book as a "Report to the Club of Rome." The report was then published as a revised paperback edition. Equally in 2002, this edition was chosen as "non-fiction book of the month" in Germany. Until his death in November 2003, Vester tried to arrange an English translation but found no interested publisher. No English translation is available to date. All the more it may be useful to present the book to the English speaking community, at least in the form of a brief review.

1. The Author

It is no exaggeration to say that in the German speaking countries, Frederic Vester (b. 1925, d. 2003) today is the personification of systems thinking. No other author has done more to popularize the idea of systems thinking or, as Vester liked to call it, *vernetztes Denken,* in these countries. Since the 1970s, Vester was a very successful author of widely-read books (e.g. 1975, 1976, 1983); video films;[2] radio- and TV-productions; cardboard and computer games,[3] among them the popular cardboard game *Ökolopoly* (Vester, 1984) and its computerized versions, *Ökolopoly PC-Version* (Vester, 1989) and *Ecopolicy* (Vester, 1997);[4] exhibitions[5] and other educational materials (among them his "windows books");[6] and finally, a commercial software package for professional use (Vester, 2004).[7] Most of his 17 books became bestsellers. They were translated into 11 different languages, but not, amazingly, into English. *Die Kunst vernetzt zu Denken,* his last book, summarizes his work of several decades in one easy-to-read volume.

Vester was a biochemist and recognized expert for environmental issues, energy and traffic planning issues, health issues, sustainable management, learning, and other areas that require adequate ways of dealing with complexity. If there is one author who can be singled out in the German speaking world for having brought to a broad public's attention the need for going beyond traditional disciplinary thinking patterns, it must be Frederic Vester. His characterization of the new quality of thinking required for dealing with the increasing complexity of our world, the postulate of *vernetztes Denken,* has become a household world that everyone understands immediately and intuitively, despite the difficult implications it often has in practice. It is hardly possible nowadays to find a political speech, a managerial declaration on strategy, a job offer or a proposal for an educational program that will not in some way refer to the importance of *vernetztes Denken.*

Vester was a member of the Club of Rome. He directed the Study Group for Biology and Environment (now, Frederic Vester GmbH) in Munich, an independent research institute that he founded in 1970. From 1981 to 1989 he was professor of Interdependence of Technological and Social Change at the University of the German Army in Munich; from 1989 to 1991 he was a visiting professor of business administration at the University of St. Gallen, Switzerland (then Graduate School of Economics and Business Administration), which in 1989 distinguished him with an honorary doctoral degree. He

also served as a consultant to major corporations such as IBM, Siemens, Daimler-Benz, Hoechst and others, as well as to governmental agencies and university institutes. His main consulting tool was his bio-cybernetic *Sensitivity Model* (Vester & Hesler, 1980), a computer supported approach to complexity management.

Despite his success, Frederic Vester has remained relatively unknown in the English-speaking world--a fact that is not easy to explain. I see two major possible explanations: (a) Vester did not write in English. Only a few of his academic publications have appeared in English; among them a report on an application of the Sensitivity Model and an essay that I invited him to prepare for the journal *Systems Practice* in 1988, which may still be of interest to those looking for a short introduction to his approach in English (Vester, 1988). (b) Vester's writings do not take up, or at least refer to, the methodological developments of systems thinking that have taken place since the late 1970s in the Anglo-Saxon literature.

2. The Book's Message

The core message of Vester's book can be summarized in one sentence: *The art of network thinking can be learned.* The book demonstrates that it is indeed possible to devise simple but effective conceptual tools to this end, as well as sophisticated computer-supported tools. The other good news is that adequate ways of dealing with complexity--in the book's language, with complex networks of interdependencies--do not necessarily require us to handle ever-larger amounts of data. It is an error to think that by continuously increasing the already prevalent information overload, that is, by adding more data and more precision to the way we analyze complex issues, we will do much better in handling complexity. Rather, Vester argues, good results depend on our capabilities of *reducing* the information overload.

In a preface to the book, Ricardo Díez Hochleitner, former President of the Club of Rome, describes this core concern of the book well:

> Do we have the right approach to complexity; do we really understand what it is? Man's attempt to learn how to deal with complexity more efficiently by means of storing and evaluating ever more information with the help of electronic data processing is proving increasingly to be the wrong approach. We are certainly able to accumulate an immense amount of knowledge, yet this does not help us to understand better the world we are living in; quite the contrary, this flood of information merely exacerbates our lack of understanding and serves to make us feel insecure... Man should not become the slave of complexity but its master (Díez Hochleitner, 2000, p. 7).

For Vester, the key to achieving such mastery lies in recognizing the essential patterns that shape the interaction of crucial aspects (critical variables) of networks, so that one can then focus on a reduced set of data that capture these patterns. Network thinking as

Vester understands it is as much a quest for reducing the need for data, and thus for practicability, as it is a quest for more holistic modes of thinking; or, perhaps more to the point, it is the art of combining the two concerns within one and the same framework.

The aim of the book is to help both professionals and lay people in achieving exactly that: becoming more holistic thinkers while at the same time learning to reduce data overload or the apparent need for ever more data. Ambitious as this aim may appear, the author does not struggle to develop his ideas--the book summarizes the ideas and insights of thirty years of work on the subject, and that shows. The book is therefore of interest to a large audience of political decision-makers, corporate executives, policy analysts, organizational researchers, environmental experts, engineers, and many other groups of professionals. It should have equal appeal to the so-called general intelligent reader. Although Vester is a serious researcher rather than just a popular writer or even a guru, the book clearly benefits from his experience as author of many successful non-fiction books and educational products.

3. The Book's Content Summarized

The book's 18 (in the Pocketbook edition, 21) short chapters are well organized into four parts.

Part 1, "What We Should Avoid," explains the problem for which network thinking is the proposed remedy. Despite paying customary lip service to holistic and interdisciplinary thinking, decision-makers and researchers, both in the public and in the private sector, still tend to structure complex problems along administrative (bureaucratic) and professional (disciplinary) boundaries. They consequently devote much time and effort to collecting data and finding solutions for inadequately defined problems. Apart from the resulting data overload, the result is a hopeless attempt to understand problems in terms of "disrupted networks" and to react with "repair service behavior."

Vester's analysis is similar to, and partly draws on, the widely acclaimed empirical investigations by Dörner (1989) on *The Logic of Failure*. Dörner demonstrated that in dealing with complex situations, even well informed and educated decision-makers and researchers tend to repeat a number of typical "cardinal errors." For example, they ignore or underestimate the side-effects that an intervention may produce; they are oriented towards short-term solutions rather than long-term sustainability; they focus on eliminating isolated deficiencies, rather than on improving the viability of the whole network; they spend too much time and energy on collecting and analyzing relatively irrelevant data; they rely too much on linear extrapolations of recent short-term developments; they intervene in ways that may be irreversible, rather than taking care that unforeseen side-effects can be corrected; they underestimate the time lags that may occur between an intervention and expected effects and therefore tend to misinterpret the initial lack of response as a need for stronger intervention, resulting in an over-steering to which they then again overreact; and so on. All this is no news, but Vester provides a

well-written summary of the traps of insufficiently systemic thinking in the face of complexity.

Part 2, "What Our Situation is Calling for," introduces the conceptual basis of Vester's proposed remedy, a "bio-cybernetic" approach to network thinking. Eight basic bio-cybernetic principles help to understand the way successful systems thrive. They are bio-cybernetic, that is, inspired by the cybernetic capacities we observe in living nature, because for Vester, it is living nature that provides the most successful example of complexity management of which we know. For instance, negative feedback should dominate positive feedback loops, and the viability of the system should be independent of quantitative growth. Again, these cybernetic ideas are certainly not new, but Vester manages to explain them in a simple, lively manner and convincingly demonstrates their general validity and application.

Part 3, "The Sensitivity Model," offers practical tools for network thinking. They include surprisingly simple, yet powerful conceptual tools as well as software tools. Among the former are a basic sequence of conceptual steps for grasping a network's essential variables and the ways they interact, and then for judging the resulting behavior pattern against the background of the mentioned bio-cybernetic principles; the use of fuzzy logic (Zadeh et al., 1996), and most originally, the *Paper Computer,* an influence matrix for identifying and evaluating a system's critical variables. The matrix allows to calculate three approximate measures (called "influence indices") for the extent to which any variable: (a) influences other variables; (b) is itself influenced by them; and (c) is a critical leverage point for intervening into the system. I have used the Paper Computer concept during many years as a help for introducing the value of systems thinking to students of social planning, and have found it a useful, simple way to help them understand notions such as interdependence, sensitivity, and leverage points for systems interventions. To me, the Paper Computer represents a core idea of Vester's entire work. It explains why the author, far from merely preaching cybernetic thinking, has been so successful in reaching his readers: the conceptual tools he proposes are easy and cheap to use, yet generic and powerful.

From the Paper Computer, Vester also derives the already mentioned *Sensitivity Model* ®, which is the major analytical tool available today for professional practice of network thinking. It is a framework for systems modeling and assessment that has been applied in countless applications and which is now available as a computer-aided simulation and decision-support tool for the Windows XP platform (Vester, 2004). It consists of three recursive levels of analysis:

1. bio-cybernetic systems description (data collection and aggregation),
2. bio-cybernetic systems interpretation (understanding the network, e.g., in terms of the mentioned influence matrix or Paper Computer), and
3. bio-cybernetic systems evaluation (understanding the need, consequences, and risks of interventions).

Applying a bio-cybernetic perspective to each level of analysis is to ensure that we use our limited research resources in a well-aimed way and, at the same time, avoid the eternal risk of information overload: what matters is not that we achieve complete knowledge, but rather, that we learn to understand and appreciate those essential patterns of interaction that shape the structure and dynamics of the network in question. I think it is not exaggeration to say that, for Vester, *bio-cybernetic evaluation* is the key to learning from nature about good research practice. In the earlier-mentioned rare paper in English, he aptly summarized the major point (and inadvertently, also a major limitation) of his *learning from nature* approach:

> Cybernetic evaluation is not just interpretation but requires judgment appealing to a "higher court." Where to find this authority? Since the problem is "survival," I do not know a better one than the one and only system which has survived for billions of years and withstood the most unbelievable external attacks, i.e., nature (Vester, 1988, p. 407).

The book outlines the bio-cybernetic framework of Vester's simulation and assessment tool but does not include the software package itself; the interested reader will need to buy or lease it separately. Consequently, a certain sense of vagueness permeates this part of the book, as the author keeps referring to a software tool that readers have to *imagine* but cannot *see* and *try* for themselves. This does a disservice to Vester's cause. At least a demonstration CD-ROM should come with the book.

Part 4, "A New Path Towards Sustainable Strategies," concludes the book with a number of didactic, methodological and organizational recommendations. Based on his experience with concrete applications as well as educational projects, the author offers a number of considerations that can help us in putting network thinking to work on practical problems. The chapters of this Part focus on special requirements for developing and using software tools for bio-cybernetic analysis; for developing adequate strategies of evaluating its results; and for using the Sensitivity Model as a generic planning tool for achieving sustainable strategies in all areas of policy-making and complexity management. In the extended Pocketbook edition of 2002, three additional chapters discuss the application of Vester's bio-cybernetic approach to complexity management in the areas of genetic engineering, nuclear energy, and medicine.

4. Appreciation

Like a few other books on systems thinking, this one is (in the best sense of the word) a basic, *paradigmatic* book. It explains the nature and relevance of network thinking in a language that avoids jargon and which is accessible and relevant to the general intelligent reader as well as to specialists of many fields. Its tone remains sober and down-to-earth throughout, without ever becoming obsessed with modeling or becoming merely managerial in its outlook. The book is thus apt to appeal to readers who might not care for the technocratic flavor of Beer's (1985) *viable system diagnosis* or for the managerial outlook of Senge's (1990) *fifth discipline*. Its orientation is thoroughly inter- and

transdisciplinary, yet always pragmatic and packed with everyday empirical observations and practical examples. In short, this book should be of interest to researchers, professionals, and decision-makers in many domains who are looking for an introductory text.

Of course, like any book, this one has its limitations, too. First, with a view to the aims of this journal, I wish Vester had discussed in more detail, and more systematically, what his approach means for the design of good research projects and research methodologies. For instance, what criteria could we derive for evaluating the quality of research proposals? A related question that I wish the book would address is how exactly researchers can use network thinking to enhance their personal quest for competence, perhaps in the way I have attempted this for critical systems thinking (Ulrich, 2001). Vester largely leaves his readers alone with such questions. This is all the more regrettable as his work clearly has a potential for giving many people--whether researchers and professionals or lay people-- a new sense of competence in dealing with complex problem situations. I suspect the most profound difference will be in how competent observers identify and bound research problems, but unfortunately, the book remains vague in this respect.

Second, I regret that network thinking as Vester conceives it remains tied to a mainly functionalist and naturalistic understanding of the systems approach. Methodological developments of the systems approach since the late 1970s have come to question the universal applicability of this strand of systems thinking and have made available to researchers and professionals a number of options. Vester's work does not seem to be aware of these developments. He hardly questions the limitations of his natural-science-based *learning from nature* paradigm, apparently unaware that it is not always beyond doubt when applied to societal issues. Is it, for instance, really true that a bio-cybernetic understanding of the way nature manages complexity tells us how we ought to intervene in complex social systems? Or, as a second example, is it not perhaps all too simple to assume that if only a sufficient number of us learn to master the art of network thinking, we will then also agree on the right solutions to the pressing issues of our time? The book is rather silent on this sort of questions. Personally I do not agree with Vester in this regard. I would argue that systemic thinking, if it is to guide us toward sustainable improvement of the human condition, cannot do without a humanist foundation spelled out in philosophical terms, as a basis for reflecting on the epistemological, ethical, sociological, and other issues that both sound research and good policy-making invariably raise.

On the other hand, to be fair to Vester, it is always a bit questionable to measure a book by issues that it does not mean to address. Vester's book aims to provide a summary statement of the ways in which bio-cybernetically based, functional systems thinking can improve our understanding and handling of complexity. Readers looking for a theoretical and philosophical discussion of the limitations of functional systems thinking, along with a consideration of alternative approaches to systems thinking, should not expect to find it in this book. What they can find is, rather, a down-to-earth, pragmatic, easy-to-grasp

introduction to conventional systems thinking, enriched by Vester's specific bio-cybernetic perspective.

My appreciation for Vester's work, then, is based on the observation that it does well what it intends to do, rather than on considerations of what I might wish it would do additionally. The fact that *vernetztes Denken* has become a household word proves how successful Vester has been in arguing his case for network thinking. This, along with the fact that the book offers some proven conceptual tools for learning and practicing the approach, renders it relevant to researchers, professionals and policy-makers in a great variety of fields, along with interested lay people. It can only be wished that English speaking readers, too, will some day be able to get a first-hand access to *The Art of Network Thinking.*

As for my personal bias towards a more philosophically based, critical kind of systems thinking, I see no reason why network thinking, insufficient as it is as a stand-alone approach, could not be usefully combined with critical notions of systems thinking. In my professional and teaching practice, I have never found network thinking to be incompatible with my own critical systems heuristics (CSH). Rather, I tend to think that efforts (based on Vester's network thinking) to understand the *complexity out there*, and efforts (based on CSH and other critical approaches) to do justice to the value-laden and conflictual character of societal decision-making, should go hand in hand.

No one approach can do it all. I certainly associate with the systems approach ideas and hopes that are quite different from Vester's; but that does not invalidate his understanding of the systems approach. In any case, I share with him one essential ambition--namely, that we should try to develop and use systems ideas in ways that can give ordinary people (including ordinary researchers, professionals, and decision-makers) a new sense of competence in dealing with the issues of our time. Vester's book contributes to this endeavor, and that is what makes it valuable.

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Endnotes

1. See http://www.clubofrome.org/.

2. See http://www.frederic-vester.de/filme.htm.

3. See http://www.frederic-vester.de/ecohistory.htm.

4. See http://www.frederic-vester.de/ecopolicy_engl.htm.

5. See http://www.frederic-vester.de/ausstell.htm.

6. See http://www.frederic-vester.de/fenster.htm.

7. See http://www.frederic-vester.de/Sensitivitaetsmodell.htm.