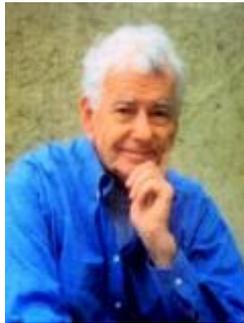


The Art of Interconnected Thinking: Frederic Vester's Biocybernetic Systems Approach

A Review of *The Art of Interconnected Thinking: Tools and Concepts for a New Approach to Tackling Complexity*, Munich, Germany: MCB Verlag, 2007

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ABSTRACT. The original aim of this review, first published in 2005 in the *Journal of Research Practice*, was to introduce English-speaking readers to a book that at the time had appeared in German language only. The book summed up the work of Frederic Vester, an author who since the 1970s had written a number of bestselling books on the need for changing our ways of thinking about complex systems. These books, along with TV programs, exhibitions, and didactic tools for schools that Vester produced, contributed much to the popularity of what in the German language area came to be called *vernetztes Denken*, meaning as much as „interconnected thinking“ or, more literally, „thinking in terms of networks.“ Two years after the publication of the review, an English translation of the book was published, based on a newer, extended edition of the German text. The present, updated and extended version of the review adapts its terminology to that of the translation, provides an adapted and somewhat more substantial introduction to its content, and also offers updated references and links to online sources for Vester’s work.

KEY WORDS: Frederic Vester, interconnected thinking, systems thinking, systems research, systems design, systems evaluation, systems management, environmental research, environmental design, environmental management, sustainable planning, applied systems thinking, applied science, research practice, complex systems, biocybernetics, sensitivity model, environmental education

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Introduction: Brief Idea History

This is a book review of a somewhat unusual sort. It was written in 2005 to introduce to the readers a book that *ought* to have, but hadn't, been published at the time — an English version of Frederic Vester's (1999/2002) *Die Kunst vernetzt zu denken*. „Vernetzt“ means as much as „linked up in networks,“ which is why Vester proposed as title of an eventual English version „The Art of Networked Thinking.“ The translator of the book chose to change the title to *The Art of Interconnected Thinking* (Vester, 2007). This may indeed be a better, if slightly less accurate, title; it probably sounds less awkward and it conveys the central idea well. There were other changes, both of terminology and content, with two new chapters added as compared to the reviewed original version of the book. In consequence, both the terminology and the content of the review (Ulrich, 2005) are now at variance with the book's English edition, a circumstance that the present, revised review is to correct.

Unfortunately, there seems to be no completely satisfactory English translation of the German phrase *vernetztes Denken*, which through Vester's work has become a household word in the German speaking countries. The phrase is largely akin to the English expression „systems thinking,“ although it tends to convey a meaning that is somewhat richer than just thinking in terms of systems; it includes notions of holistic, integrated and global thinking and methodology, of inter- and transdisciplinary rather than disciplinary

or even technocratic approaches to research and professional practice and politics, of environmental and cybernetic thinking, of long-term policy making and assessment, and so on. But of course systems thinking, if well understood, can also be understood to include all these mentioned notions; in addition, the English concept has a history of thought that includes a turn towards interpretive and critical approaches, a methodological development that is not part of the German tradition of „interconnected thinking.“ So, each of the two concepts may be said to have its advantages; both probably have also something to learn from the other side.

The first hardcover edition of *Die Kunst vernetzt zu denken* appeared in 1999 and was sold out within months. By December 2001 it had been reprinted seven 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 subsequently, in the same year, published as a revised paperback edition. Equally in 2002, this edition was chosen as „non-fiction book of the month“ in Germany. It has again been reprinted many times since then, the thus far last edition of 2012 being its eleventh impression.

Until his death in November 2003, Vester hoped to arrange an English translation; but much to his dismay, despite intensive

efforts that he had asked me to support (and I did), he could not find an interested publisher. He did not live to see his wish come true. All the more I found it meaningful, even after his passing, to present the book to the English speaking community, if only in the form of a brief review. Readers who meanwhile own or have read the English version of 2007 will no longer need my account of its content; but they may still be interested in the review's assessment of the book. It includes some partly critical thoughts that I had no reason to change; their intention is not to diminish the book's merits but rather, to take the book seriously.

The Book's Author

Since the 1970s, Frederic Vester (1925-2003) was a very successful author of widely-read books (e.g. 1975, 1976/83, 1978); 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, 2011);⁴ exhibitions⁵ and other educational materials (among them his „windows books“);⁶ and finally, a commercial software package for professional use (Vester, 2004/2014).⁷ Most of his seventeen books became bestsellers. They were translated into 11 different languages, but not, amazingly, into the English language. *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 almost everyone in the German speaking countries now 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 proposal for an educational program or even just a job offer that will not in some way refer to the importance of such thinking.

Vester was a member of the „Club of Rome.“ He directed the „Study Group for Biology and Environment“ in Munich, an independent research institute that he had 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 a 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 *Sensitivity Model* (Vester and Hesler, 1980), a computer-supported approach to complexity management about which I will say a little more later on.

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. Very 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 and which may still be of interest to those looking for a short English introduction to his biocybernetic approach (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.

The Book's Message

The core message of Vester's book can be summarized in one sentence: *The art of interconnected 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* (p. 25), 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 German edition of the book, which unfortunately is missing in the English edition, Ricardo Díez Hochleitner, former President of the Club of Rome, described 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. Interconnected thinking as Vester understands it is as much a quest for practicability, by reducing the need for data, as it is a quest for expanding the scope of inquiry and thus for more data. It is the art of combining the two concerns within one and the same framework, and the key is *pattern recognition* (p. 23f).

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 else, 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 productions.

The Book's Content

The book's 20 chapters are well organized into four parts.

Part 1, Things to Be Avoided, explains the problem for which interconnected

thinking is the proposed remedy. Despite customary lip service to holistic, inter- and transdisciplinary thinking, decision-makers both in the public and in the private sector still mostly try to grasp complex problems by structuring them along administrative (bureaucratic) and professional (disciplinary) boundaries and then accumulating and processing a lot of data on the thus-defined problems.

Apart from the resulting information overload, the result is a hopeless attempt to understand systemic problems by focusing on individual flaws and improve systems by what one may call a *patch-up approach* (p. 37) or „repair-service behavior“ (*Reparaturdienstverhalten*, Vester, 1999, p. 36). Empirical studies (e.g. Dörner, 1989) confirm that decision-makers indeed focus too much on isolated deficiencies that they want to eliminate, rather than on the viability of whole networks of variables, and that in addition they tend to repeat over and over again a number of other crucial mistakes in dealing with interconnected variables; for example, they spend too much time and energy on the collection and analysis of relatively irrelevant data; they rely too much on extrapolations of recent short-term developments; they intervene in ways that are unnecessarily irreversible (as if no mistakes could occur) and (after initial delays) tend to overreact; they are oriented towards short-term solutions rather than long-term sustainability; they ignore or underestimate side-effects; and so on. All this is no news, but Vester (pp. 31-48, esp. 37f) provides a well-written summary of the traps of insufficiently

systemic thinking in the face of complexity.

Part 2, What Our Situation Requires, introduces the conceptual basis of Vester's proposed remedy, a „biocybernetic“ approach to interconnected thinking. Eight basic “rules of biocybernetics” (p. 153-167) or, as I'd rather call them, *biocybernetic principles* help to understand the way successful systems thrive. They are „biocybernetic“ in that they are inspired by the cybernetic capacities we observe in living nature; for Vester, it is living nature that provides the most successful example of complexity management of which we know. For instance, negative feedback loops 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 interconnected thinking. They include surprisingly simple, yet powerful conceptual tools as well as software tools. Basic among the former is a standard sequence of conceptual steps for identifying and visualizing a network's essential variables and for studying the ways they interact (pattern recognition, p. 184), and for then judging the resulting behavior pattern against the background of the mentioned biocybernetic principles (*biocybernetic appraisal*, p. 185). More specific tools are the use of *fuzzy logic*

(p. 174f, 191 and passim; see Zadeh et al., 1996) and, most originally, Vester's own *paper computer* (pp. 189, 219f; an earlier but still helpful short account can be found in Vester, 1976/83, Ch. 8), an influence matrix for quantifying the interactivity of variables (i.e., how strongly they influence one another) and, on this basis, identifying a system's critical variables. To this end, the matrix allows calculating three approximate measures (called *influence indices* or *factors*, pp. 209, 220-224) for the extent to which any variable: (a) influences other variables, the active influence total AT; (b) is itself influenced by them, the passive or reactive influence total PT; and (c) is a critical leverage point (*control lever*) for intervening into the system, as measured by the AT/PT quotient. In addition, the mathematical product of AT and PT is calculated for every variable so as to assess its overall sensitivity, that is, „how far a component plays a role in the system at all, how strongly it is involved in events“ (p. 223).

I have used Vester's „paper computer“ or influence matrix model during many years as a didactic tool 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 of variables; influence factors and measures; positive and negative feedback loops; sensitivity; and control levers for systems interventions. The approach lends itself to individual as well as group application, both in training and in later professional or research practice. To me, the paper

computer represents a core idea of Vester's entire work. It explains why the author, far from merely preaching biocybernetically informed systems 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 a computerized version he named *The Sensitivity Model* (Vester/Hesler, 1980; Vester, 2004/2014). It is the major software tool available today for professional practice of interconnected thinking. The software has been applied in countless applications and is available as a *simulation and decision-support tool*. It facilitates thinking in terms of scenarios and *what-if* kind of *policy tests* that, if we are to believe Vester, even laypeople can carry out and interpret (p. 262). As a help for the results of such simulations, Vester refers back to the eight basic "rules of biocybernetics" explained earlier in the book, in Part 2 (pp. 153-167).

As a minor critique, as well as to explain why I cannot provide a more substantial account of the computerized model, I should mention that the book introduces the simulation tool but does not include it; that is, the interested reader will need to buy or lease the program and a user license separately. This does a disservice to Vester's cause. I would argue that at least a demonstration CD-ROM should come with the book.

Part 4, The New Way to 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, Vester offers a number of considerations that can help us in putting interconnected thinking to work on practical problems. The chapters of this final Part focus on special requirements for developing and using software tools for biocybernetic analysis; for developing adequate strategies of evaluating its results; and for using the Sensitivity Model as a generic planning tool so as to achieve sustainable strategies in all areas of policy-making and complexity management.

Due to the mentioned lack of access to at least a demonstration version of the software, a certain vagueness and sense of not learning much that would be new (in short, a certain sense of repetitiveness) creeps in here. Still, many a reader may welcome this final part as a readable summary of the book. Moreover, there is a welcome final chapter, "Looking Ahead," that is new as compared to the original German edition and provides an outlook on how the author sees the future development and application of his approach. Specific areas of application considered are „cybernetic environmental policy“ (p. 316f), „cybernetic security policy“ (p. 318f), „strategies to combat international terrorism“ (pp. 320-327), and „cybernetic medicine“ (p. 333-337). In addition, there is a short section on the

didactic value of simulation games such as *Ecopolity* (pp. 327-333).

As Vester concludes this chapter and with it the book, there is no alternative to facing the interconnectedness of the world, an effort that is still hindered by the prevalence of piecemeal and patch-up approaches and of „blinkered technological expertise without regard to overarching contexts“ (p. 337f).

We still have a chance. That chance consists in more and more people beginning to see the world as an interconnected, living system. ... „We cannot command nature except by obeying her,“ Francis Bacon once said. Today, ecology tells us he was absolutely right. Because anyone who does not play the game and play it properly, complying with the rules [of nature], will be thrown out. It is a process that nature has already used often to shed sub-systems that have got out of control. So it's not nature I'm worried about; it's us. (Vester, 2007, p. 339)

Critical Appreciation

Like 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 interconnected 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 about the technocratic flavor of Beer's (1985) „viable system diagnosis“ or 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 application, that is, to research and professional practice as well as to political and corporate problem solving and decision-making, one might wish that Vester had discussed in more detail, and more systematically, the implications of his approach for proper notions of good “interconnected” practice (i.e., practice in dealing with complex systems). It would also have been interesting to examine the ways in which biocybernetically informed systems thinking might enhance people's personal *quest for competence* in research and professional practice, as I have attempted to do it 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 interconnected 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 his natural-science based paradigm, apparently unaware that it is not always beyond doubt when applied to societal issues.

Is it, for instance, really true that a biocybernetic understanding of the way nature manages complexity tells us how we ought to intervene into 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 interconnected 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 biocybernetically 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 biocybernetic 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 interconnected 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 thus only be welcomed that English speaking readers, thanks to this translation, have now got a first-hand access to *The Art of Interconnected Thinking*.

As for my personal bias towards a more philosophically based and critical kind of systems thinking, I see no reason why Vester's interconnected thinking, insufficient as I find it 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 interconnected thinking to be incompatible with my own framework of critical systems heuristics (CSH, e.g., Ulrich, 1983, 1987, 2001). Rather, I tend to think that efforts (based on Vester's interconnected 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, can and should go hand in hand.

Although my understanding of the systems approach is rather different from Vester's, I share with him an 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 so valuable.

Notes (Links to online sources)

- 1) See: <http://www.clubofrome.org/>
- 2) See: <http://www.frederic-vester.de/deu/werke/videofilme/>
- 3) See: <http://www.frederic-vester.de/deu/ecopolicy/entstehungsgeschichte-von-ecopolicy/>
- 4) See: <http://www.frederic-vester.de/eng/ecopolicy/>
- 5) See: <http://www.frederic-vester.de/deu/werke/ausstellungen/>
- 6) See: <http://www.frederic-vester.de/deu/werke/fensterbuecher/>
- 7) See: <http://www.frederic-vester.de/eng/sensitivity-model/>

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