

Only Connect!

Part II: An Annotated Selection from the Literature on the Breadth and Scope of Systems Thinking

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Abstract

What other activities and techniques exist that are of interest to system dynamicists? Are there possibilities for system dynamics itself to contribute to them? These questions have been of interest to the authors for some time and now the 1994 System Dynamics Conference is helping to advance the debate. This paper tries to help things along.

We consider two areas of interest: the problem structuring techniques of 'soft' operational research and the wide range of systems thinking concepts employed in the systems movement. Both involve valuable ideas and experiences. Both have a more European-orientated perspective, in contrast to the mainly-US viewpoint of system dynamics. In this two-part paper we therefore offer a selection from the literature of the two as well as brief annotations.

The first paper (*q.v.*) deals with 'soft' OR. In this second part we consider 'systems thinking'. Although this term seems to have been appropriated by the system dynamics community it can be interpreted very differently. We therefore try to convey the breadth and scope of the intellectual and practical endeavours that define the systems movement and explore the range of holistic ideas that people have found useful in thinking about and acting in the world.

Of course, this is only our own selection but our aim is to encourage connections between these areas of activity. We have no doubt that they will be mutually beneficial.

Only Connect!**Part II: An Annotated Selection from the Literature on the Breadth and Scope of Systems Thinking****INTRODUCTION**

The motivation of this two-part paper is twofold. Firstly, it results from the current interest in the commonalities between the theory and practice of system dynamics modelling and those of similar approaches more widely discussed in the UK and the rest of Europe. These commonalities were first explored in detail by DCL^a and are a key theme of the 1994 International System Dynamics Conference to which both authors were invited as speakers. Secondly, this paper arose because of a survey of the system dynamics literature^b. After the discussion in Cancun concerning this paper, John Sterman suggested to DCL that a similar piece on soft OR or on systems thinking might be a valuable contribution to the system dynamics community.

Our intent is therefore to provide system dynamicists with the opportunity of exploring two literatures which we believe have much to offer. We refer to the written material on both problem structuring methods (PSMs) and to the broad range of activities that Europeans describe as 'systems thinking'. Those involved with this dual piece had initially intended to write a single paper but this has not proved to be a useful format. Although both literatures provide opportunities for valuable engagement, their natures are too different to be embraced within one paper without confusion. Instead, we have attempted our task in two parts, making a somewhat arbitrary division. In the first part^c, we consider PSMs. In the second part, the document that you are now reading, we consider systems thinking sources.

With this set of sources on systems thinking, although some of the points of interest for the system dynamics community have also been discussed elsewhere^{a,d}, we think that it is worth saying emphasising the reasoning behind this selection. The majority of system dynamicists are in the US and they have started calling their single subject 'systems thinking'. From the European perspective this usage can be bewildering, or look rather arrogant, or just seem ignorant of the wide range of techniques that shelter beneath the forgivingly expansive umbrella of that term. Additionally, the meaning of the term 'systems thinking' even as it is employed within the system dynamics field is very hard to clarify, ranging from the inappropriate to the virtually incoherent. Is system dynamics an element of systems thinking or vice versa? What is the relationship? Some seem to use the term to mean simply the qualitative and micro-world elements of system dynamics. Forrester, asked to clarify this very issue in a recent interview, proceeded from that premise and, by asserting the importance of rigorous simulation model building, achieved the logical deduction that 'systems thinking' is only an element of system dynamics. We take the view that this conclusion points up the unacceptability of that original premise.

We would advance the position that system dynamics is an element of the broad field of systems thinking.

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- α. Lane, D.C. 1993. With A Little Help From Our Friends: How third generation system dynamics and the issue structuring techniques of 'soft' OR can learn from each other. In *System Dynamics 1993: The role of strategic modelling in international competitiveness* (E.Zepeda and J.A.D.Machuca, Eds.), pp.231-244. System Dynamics Society, Boston.
This paper is more widely available as:
Lane, D.C. 1994. With A Little Help From Our Friends: How system dynamics and 'soft' OR can learn from each other. *System Dynamics Review* 10(2-3):1-34.
- β. Sastry, M.A. & J.D.Sterman. 1993. Desert Island Dynamics: An annotated survey of the essential system dynamics literature. In *System Dynamics 1993: The role of strategic modelling in international competitiveness* (E.Zepeda and J.A.D.Machuca, Eds.), pp.466-475. System Dynamics Society, Boston.
- γ. Lane, D.C. & J.Rosenhead. 1994. Only Connect! Part I: An Annotated Selection from the Literature on the Problem Structuring Methods of 'Soft' Operational Research. In *System Dynamics 1994: Exploring the boundaries*, this volume.
- δ. Lane, D.C. 1994. System Dynamics Practice: A comment on 'a case study in community care using systems thinking'. *Journal of the Operational Research Society* 45(3):361-363.

Yet usage of the term 'systems thinking' is spreading in the system dynamics community with an enthusiasm which verges on the hegemonic. The employment of this term to describe one single systems methodology is virtually to deny the existence of any other. If the term is used for only one discipline, those who employ it may be putting themselves in a mental prison, limiting - in an eerily Orwellian way - their ability to discuss and think about any other methodologies.

In this selection we have therefore tried to give a useful selection of sources which emphasise the breadth and the depth of the range of activities that, to us, constitute systems thinking. We deal with a range of system analogies and ontological views of systems. We illustrate the concerns with implicit and explicit political postures of different systems tools. And we give examples of the tools being used in practice. The primary emphasis is on the aspects which seem most clearly related to system dynamics practise - in particular group decision support - or those which contrast with the system dynamics approach in the most striking, challenging and illuminating way. Some historical works are included in order to provide a perspective on the evolution of the approaches.

The selection has the following structure. We start with the strand of systems thinking emanating from the biological analogies of GST (§1). We give early examples of the treatment of organisations as systems (§2). We consider the fields of cybernetics (§3) and 'hard' systems thinking (§4). We turn to the interpretive system ideas (§5) and the work concerning the political nature of all systems work (§§6 & 7). As these sections are associated with reasonably discrete areas of interest, a detailed cross-referencing is not given. Additionally, the breadth of this selection makes description very much harder than is the case with PSMs; a greater proportion of this selection is made up not of single articles but of complete volumes. We have not made the ludicrous attempt to 'condense' these rich works choosing, instead, to give a very brief comment on their content and relative importance (in our judgement). We should state again that the division of systems thinking from PSMs is difficult and artificial because of the areas of overlap. Some items are, in fact, repeated, though the differences in their annotations reflect the different emphases of the two bibliographies. We would therefore encourage interested readers to consult the sibling selection.

In the following sections we attempt to convey the range of intellectual activity and practical endeavour that defines the systems movement. The movement itself can be recognised by a commitment to holism rather than reductionism and to organizing knowledge in cognitive systems, structured frameworks expressing certain intellectual norms - simplicity, regularity, uniformity, comprehensiveness, unity, harmony, economy - that people have found useful in thinking about and acting in the world. Having said that, it must be accepted that the different strands that now make up the systems movement will use the concept 'system', and all the other important systems ideas, in different ways. In what follows, we identify seven strands of systems thinking which, it can be argued, have succeeded in bringing systems ideas together in unique ways and investing them with peculiarly powerful meaning for the purpose of understanding or intervening in the real world. We also give references to some works which are profoundly critical of the systems approach. We give no space to a tracing of the history of holism as a concept in philosophical and sociological thought. Similarly, there are no citations from the strand of systems thinking known as system dynamics (since this is a system dynamics conference), or to the areas of soft operational research which employ systems thinking (since this is treated elsewhere). In the main, collections of readings and general introductions have also been avoided. Further, most of our selection consists of authors from the Western European and U.S. systems traditions. Significant texts such as Bogdanov's Tektology (from Russia) and Kotarbinski's Praxiology (from Poland) will eventually have to be incorporated into the systems canon.

A final, and perhaps unnecessary, comment is that this selection is just that: a selection. It does not aim to be definitive or authoritative. It is a partial account of the literature of systems thinking and we mean partial in two senses. Firstly, the authors themselves are not impartial: the selection that we offer draws on our own knowledge and research interests. Secondly, in the space available, we cannot hope to do full justice to the enormous efforts that researchers have invested in this area. Nor can we directly contribute here to the discovery and mapping of the terrain shared by system dynamics, systems thinking and the PSMs of soft Operational Research. Our hope can only be that our paper might add to the exploration of mutually interesting areas by

supplying a crude signpost to possible destinations and connections. If it does so then it will have served its purpose. The exploration itself must continue elsewhere but we would commend it to our colleagues. With this paper, we can only - though perhaps rather aptly - connect.

§1 GENERAL SYSTEM THEORY

General Systems Theory, widely known as 'GST', offered a meta-methodology of holism which aspired to embrace different sciences and methodologies by discovering concepts, laws and models applicable to systems of all types. General Systems Theory is therefore an attempt to establish systems thinking as a discipline in its own right. It is crucial to note, however, that this claimed 'generality' of approach in fact employed biological analogies.

1. L.von Bertalanffy. 1968. *General Systems Theory: Foundation, Development, Application*. New York: Braziller.
A biologist by training, von Bertalanffy is justly regarded as the founding father of General Systems Theory having started to write and publish in the 1940s and 1950s. This is a collection of essays and makes a useful introduction to his work.
2. K.E.Boulding. 1956. General Systems Theory: The skeleton of science. *Management Science* 2(3):197-208.
A much quoted article the title of which clearly reflects the audacious aspirations for the subject. Economist Boulding offers a somewhat different way forward than that propounded by von Bertalanffy. He proposes a hierarchy of real world complexity that can be mapped on to different system concepts. He thus seeks to distinguish between the systems thinking needed to understand a clock from that needed to understand a flame, a bird and a nation.
3. J.P.van Gigch. 1974. *Applied General Systems Theory (second edition)*. New York: Harper and Row.
A readable attempt to show the relevance of General Systems Theory to management decision-making.
4. G.M.Weinberg, 1975. *An Introduction to General System Thinking*. New York: Wiley.
Perhaps the most influential of the specific introductions to General Systems Theory.
5. J.G.Miller. 1978. *The Nature of Living Systems*. New York: McGraw-Hill.
This huge tome investigates the operation of nineteen critical sub-systems across seven levels of living systems. Miller's ideas gave birth to Living System Theory (L.S.T.) which is currently the most productive area of research in General Systems Theory.
6. D.Berlinski. 1976. *On Systems Analysis: An essay concerning the limitations of some mathematical methods in the social, political and biological sciences*. Cambridge, MA MIT Press.
A scathing critique of General Systems Theory and the systems approach. A healthy one to bring you down to earth and to end the section with.

§2 ORGANISATIONS AS SYSTEMS

This strand of systems thinking seeks to understand organisations and societies in terms of their interacting sub-systems and relationships with the environment. Taking its initial inspiration mainly from functionalist sociology, it later absorbed aspects of General Systems Theory and cybernetics to form 'social systems theory'^e.

e . For a somewhat longer account of systems ideas and sociology and their connections with system dynamics, see:

7. C.Barnard. 1938. *Functions of the Executive*. Cambridge, MA: Harvard University Press.
In this early contribution, Barnard tries to understand organisations as co-operative systems and from this derive suggestions for their management.
8. P.Selznick. 1948. Foundations of a theory of organization. *American Sociological Review* 13: 25-35.
Applies structural-functional analysis, developed in sociology and anthropology, to the study of organisations.
9. T.Parsons. 1951. *The Social System*. Glencoe, Illinois: Free Press.
One of the most influential sociology books ever written. Parsons used an equilibrium-function model in his attempt to describe the processes by which the social system maintains equilibrium with its environment and integrates its diverse processes to preserve its internal integrity.
10. A.K.Rice. 1963. *The Enterprise and its Environment: A systems theory of management organisation*. London: Tavistock.
A fully developed account of socio-technical systems thinking having many points in common with 12.
11. D.Katz and R.L.Kahn. 1966. *The Social Psychology of Organizations*. New York: Wiley.
Combines insights from social psychology, sociological systems theory (employing a mixture of mechanical, and biological analogies) and General Systems Theory into a systems model of organizations in an attempt to explain the factors which create and maintain a stable social system
12. W.Buckley. 1967. *Sociology and Modern Systems Theory*. Englewood Cliffs, N.J.: Prentice Hall.
Argues that systems thinking should take a more process oriented view.
13. F.E.Kast and J.E.Rosenzweig. 1979. *Organization and Management: A systems and contingency approach (third edition)*. New York: McGraw-Hill.
A very popular textbook expounding the contingency theory perspective.
14. D.Silverman. 1970. *The Theory of Organizations: A sociological framework*. London: Heinemann.
Vigorous, analytical attack on the organizations as systems approach. Sobering stuff.

§3 HARD SYSTEMS THINKING

At its most unsophisticated, hard systems thinking unites the idea of holism with a natural scientific approach, dealing with the world as if it is a system. Hard system thinkers seek to model their (realist) system of concern with a view to optimising its performance in pursuit of some predefined goal.

15. C.W.Churchman, R.L.Ackoff and E.L. Arnoff. 1957. *Introduction to Operations Research*. New York: Wiley.
The earliest, and by no means unsophisticated, textbook on operational research containing many systems ideas.
16. A.D.Hall. 1962. *A Methodology for Systems Engineering*. Princeton, N.J.: Van Nostrand Co.
Arguably the definitive text on the systems engineering methodology.

Lane, D.C. 1994. Social theory and System Dynamics Practice. In *System Dynamics 1994: Exploring the boundaries*, this volume.

17. S.L.Optner (ed). 1973. *Systems Analysis*. Harmondsworth: Penguin.
A collection of papers explaining what systems analysis is about.
18. H.J.Miser and E.S.Quade (eds.). 1985. *Handbook of Systems Analysis Vol.1: Overview of uses, procedures, applications and practice*. Chichester: Wiley.
Heavily derived from the experiences of the RAND Corporation (you have been warned) this volume explains the sort of systems analysis developed and used at the International Institute of Applied Systems Analysis (IIASA). However, it contains an unusual density of common and uncommon sense on how to practice relatively conventional analysis and stand a very good chance of being helpful - through knowledge of the technical repertoire, sensitivity to the organisational politics, etc.
19. P.Keys. 1991. *Operational Research and Systems*. New York: Plenum.
A modern summary of the development and nature of hard systems thinking.
20. I.Hoos. 1972. *Systems Analysis in Public Policy: A critique*. Berkeley: University of California Press.
A critique of the use of hard systems thinking in the public domain and the limits of such 'hyper-rationalism'.

§4 CYBERNETICS

Cybernetics is the science of "communication and control in the animal and the machine" (Wiener) or of "effective organization" (Beer). Its primary concern applied to management is with the structure of organisations and information and control systems.

21. N.Wiener. 1948. *Cybernetics: or control and communication in the animal and the machine*. New York: Wiley.
The book that announced the birth of the science of cybernetics.
22. Ashby, W.R. 1956. *An Introduction to Cybernetics*. London: Methuen.
A mistitled book - it is not an introduction, but it does contain many crucial insights, not least Ashby's ideas on requisite variety. and what are possibly the first causal loop diagrams.
23. S.Beer. 1979. *The Heart of the Enterprise*. Chichester: Wiley.
24. S.Beer. 1981. *The Brain of the Firm*. Chichester: Wiley.
25. S.Beer. 1985. *Diagnosing the System for Organisations (2nd Ed.)*. Chichester: Wiley.
Since the late 1950s, Beer has been responsible for the development and application of management cybernetics, including a recursive view of systems, and the highly significant 'viable system model', or VSM. His experience in Chile is widely misunderstood and still offers valuable lessons to be learned. Item 26 is a popularised form of the content of the other two.
26. R.Espejo and R.J.Harnden. 1989. *The Viable System Model: Interpretations and applications of Beer's VSM*. Chichester: Wiley.
A volume from two of Beer's acolytes with a self-explanatory title.
27. H.Maturana and F.Varela. 1980. *Autopoiesis and Cognition: The realization of the living*. Dordrecht: Reidel.
The book that introduced the concept of autopoiesis (though the ideas can be traced back to a series of papers in the 1970s). An attempt to describe and explain the unique characteristics of which distinguish a living system from, say, a chemical plant. The fundamental notion of autopoiesis is that living systems are organized in such a way that

all of their components and processes together support those very same components and processes, so establishing an autonomous, self-producing entity. Not an easy read but worth it as autopoiesis is now seen as significant in organization theory and sociology, as well as in systems thinking.

28. J.C.Mingers. 1989. An introduction to autopoiesis - implications and applications. *Systems Practice* 2(2):159-180.
A more readable account of the main ideas of autopoiesis and a discussion of some of their ramifications.
29. N.Luhmann. 1993. Ecological communication: coping with the unknown. *Systems Practice* 6(5):527-539.
A brief statement from this highly influential German systems theorist from Universität Bielefeld. He proposes that rather than investing in knowledge with the (discredited) aim of controlling the environment, we must recognise the inherent uncertainties. He sees a combination of systems theory and evolutionary theory as offering valuable ideas for understanding the global system.
30. H.von Foerster. 1981. *Observing Systems*. California: Intersystems.
The beginnings of second- order cybernetics.

§5 SOFT SYSTEMS THINKING

Soft systems thinking seeks to extend the sphere of application of systems ideas to problem situations in which objectives are ill-defined and systems too complex to model mathematically. It puts human beings and ethical questions at the heart of the systems approach.

31. C.W.Churchman. 1971. *The Design of Inquiring Systems: Basic concepts of systems and organization*. New York: Basic Books.
early but comprehensive statement of the philosophical underpinnings of soft systems thinking.
32. Special issue: C.West Churchman - 75 Years. 1988. *Systems Practice* 1(4).
Includes papers by Ackoff, Ulrich, Mason and Checkland.
33. G.Vickers. 1970. *Freedom in a Rocking Boat: Changing values in an unstable society*. London: Allen Lane.
One of a number of highly readable books by Vickers which took a systemic view of the problems of society and which were an inspiration for soft systems thinkers, especially in the U.K.
34. J.Warfield. 1976. *Societal Systems: Planning, policy and complexity*. New York: Wiley.
Background to Warfield's widely used 'interactive management' methods.
35. R.L.Ackoff. 1981. *Creating the Corporate Future: Plan or be planned for*. New York: Wiley.
Brings together many of the best ideas of this very important theorist and practitioner of the soft systems approach.
36. Special issue: *Festschrift* to Russell Ackoff. 1990. *Systems Practice* 3(2).
Contains papers by Churchman, Beer and Friend.

37. R.O.Mason and I.I.Mitroff. 1981. *Challenging Strategic Planning Assumptions: Theory cases and techniques*. New York: Wiley.
This book shows how Churchman's systems ideas can be operationalised using the approach called Strategic Assumptions Surfacing and Testing (SAST). This is methodology the purpose of which is to expose policy to dialectical debate.
38. P.B.Checkland. 1981. *Systems Thinking, Systems Practice*. Chichester: Wiley.
A classic text which clearly differentiates soft from other types of systems thinking. It sets out perhaps the most generally usable of soft systems ideas in the form of Soft Systems Methodology (SSM). Both a survey of the philosophy and concepts underlying SSM and an account of the methodology itself are given.
39. P.B.Checkland and J.Scholes. 1991. *Soft Systems Methodology in Action*. Chichester: Wiley.
Further developments and applications of Checkland's soft systems methodology. The developments centre on the need to probe the power relations present in SSM-based interventions.
40. H.A.Linstone. 1984. *Multiple Perspectives for Decision Making*. New York: North Holland.
Seeks to augment the technical systems perspective with organizational and personal perspectives.
41. Special issue: Systems Thinking in Action. 1985. *Journal of the Operational Research Society* 36(9).
Various papers drawn from a 1983 conference. Gives an account of attempts to contribute to practical problem solving situations using the systems ideas of Eder, Checkland, Beer and others. Fifth Disciples take note of the title - and the date.
42. P.B.Checkland. 1992. Systems and Scholarship: The Need to do Better. *Journal of the Operational Research Society* 43(11): 1023-1030.
Provocative analysis of the "primitive" nature of the systems movement as seen by the author. He criticises the field for: poor exposition of the nature of defining system concepts; confusion regarding the ontological status of systems; employment of an immodest tone in some of the claims made for systems thinking. Highly contentious: read the Viewpoints section *JORS* 44(6) for the resulting mêlée. . .
43. D.C.Lane and R.Oliva. The Greater Whole: Towards a synthesis of SD and SSM. In *System Dynamics 1994: Exploring the boundaries*, this volume.
Argues that some of the process strengths of Checkland's SSM can be wedded to the behaviour deduction powers of SD. The authors try to form a synthesis which is theoretically consistent with the distinctive assumptions of the two methods. Of interest because of the attention given to establishing a form of 'soft' SD explicitly located within interpretive sociology.

§6 EMANCIPATORY SYSTEMS THINKING

A new area of interest for systems thinking which deals with ways in which systems approaches can be used in what would otherwise be coercive situations to assist less powerful groups. This might be labelled emancipatory system thinking.

44. W.Ulrich. 1983. *Critical Heuristics of Social Planning: A new approach to practical philosophy*. Bern: Haupt.
An important book which provides a good account of philosophical and sociological theories of interest to systems thinkers as well as introducing 'critical systems heuristics': an attempt to operationalise some of the ideas of Jürgen Habermas.

45. M.C.Jackson. 1985. Social systems theory and practice: The need for a critical approach. *International Journal of General Systems* 10:135-151.
Critiques of hard and soft systems thinking and the first explicit call for 'emancipatory' and 'critical' systems thinking.
46. R.L.Flood. 1990. *Liberating Systems Theory*. New York: Plenum.
Excellent ideas built around the notion that systems theory needs to be liberated before it can be liberating. Flawed in its actual delivery.
47. Special issue: Interpretive Systemology. 1991. *Systems Practice* 4(5).
This radical systems approach has been pioneered in Venezuela by R. Fuenmayor, H. López-Garay *et al.* It is concerned with disturbing our traditional ways of viewing and acting in social systems.

§7 CRITICAL SYSTEMS THINKING

Critical systems thinking is a relative newcomer to the systems fold and argument still rages about its exact nature. It seems to have stabilized recently, basing itself on critical reflection and social awareness, on complementarism and on an ethical commitment.

48. R.Lilienfeld. 1978. *The Rise of Systems Theory: An ideological analysis*. New York: Wiley.
Critical systems thinking before its time. An attempt to articulate the unstated ideology of systems approaches (including system dynamics).
49. Mingers, J. 1980. Towards an appropriate social theory for applied systems thinking: critical theory and soft systems methodology. *Journal of Applied Systems Analysis*, 7: 41-49.
Examines the specific connections between SSM and Critical Theory and concludes that although there were many similarities, SSM at that time suffers in comparison because it lacks a political stance and because it would tend to conserve and support rather than challenge the *status quo*.
50. M.C.Jackson. 1991. The origins and nature of critical systems thinking. *Systems Practice* 4(2):131-149.
An attempt to provide background information and details on the emergence of critical systems thinking.
51. Flood, R.L., and Jackson, M.C. (eds). 1991. *Critical Systems Thinking: Directed readings*. Chichester: Wiley.
A collection of readings and detailed commentary on critical systems thinking, consisting of papers by Flood, Checkland, Jackson, Keys, Oliga, Ulrich *etc.*
52. R.L.Flood and M.C.Jackson. 1991. *Creative Problem Solving: Total systems intervention*. Chichester: Wiley.
Attempts brief summaries of the work of Beer, Checkland, Ackoff, Forrester, Mason and Mitroff, and Ulrich and then uses ideas drawn from Habermas and Morgan to propose a guide for choosing between them. The new meta-methodology is called 'total systems intervention' and aspires to constant critical reflection. Audacious and widely criticised at many levels but robustly defended.
53. Tsoukas, H. 1993. The Road to Emancipation Is Through Organizational Development: A critical evaluation of Total Systems Intervention. *Systems Practice*, 6(1): 53-70.
A detailed, reasoned and carefully argued critique. Two numbers later, *Systems Practice*, 6(3) provides a threefold response, of various degrees of quality, from TSI advocates and Tsoukas' witheringly unconvinced restatement of his position. Interesting - and good fun..

54. M.C.Jackson. 1992. *Systems Methodology for the Management Sciences*. New York Plenum.
Seeks to give a comprehensive account of the organizations as systems, hard, cybernetic soft, emancipatory and critical schools of thought and of their different strengths and weaknesses.

