# System Network Complementarity

by Anthony J.N. Judge (1)

« System » versus « Network »

The definition of « system » (like that of « structure ») is the subject of continuing confusion and often heated debate. It is not surprising therefore that the implication that « network » is in some way distinct from « system » tends to give rise to vigorous debate as recently occurred in Montreal. It is the math-based pure and applied sciences which are most disturbed by the possibility of any distinction. Clearly, in purely formal mathematical terms, both system and network consist of an interconnected set of elements. But once account is taken of the nature of
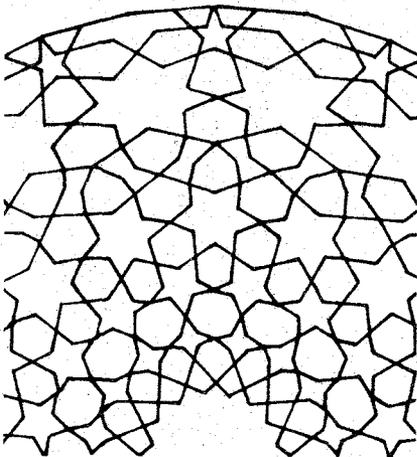
those elements, the manner of their interconnection and the properties of the resultant whole, then the distinctions between definitions of sytem and of network became confused especially where value-related questions are raised concerning the relative equitability of different social structures.

The question of interest may be less the distinction, if any, and more the connotations of the terms in contexts associated with international and organizational activity. The question may then be why is there a preference for « network » instead of « system » under certain circumstances. Consider the distinctions in the case of a road system / network, a telephone system / network or a concept system / network before reflecting on the case of an inter-

organizational system / network. Under what circumstances is there a negative connotation to either term ?

The Distinction in Practice

The following suggestions have been made as to how the distinction **tends to be made in practice.**

1. Systems tend to require more information for their description than networks, since flows must be described as well as structural relationships.

2. Systems are described primarily with quantitative information (which is both difficult and costly to obtain and has a short useful life), whereas networks may be described with non-quantitative structural information (which is more readily available at lower cost and has a longer useful life).

3. Systems tend to have a unique (or ultimate) controller regulating the state of the system as a whole, whereas networks tend to have a plurality of controllers (if any), with a relatively high degree of autonomy. (In other words, systems tend to be centralized in some sense, whereas networks tend to be decentralized or polycentric).

4. Systems tend to be associated with imposed structures or patterns (even if limited to the choice of the system boundary), whereas networks tend to be associated with emergent structures or patterns.

5. Systems tend to have well-defined boundaries (even if they are open-systems) whereas the outer-limit (or fine detail) of a network is ill-defined and not of major significance to its description.

6. Systems tend to have well-defined, stable goals or functions, whereas networks, if they have any, may have ill-defined goals, a plurality of goals (possibly fairly incompatible), or may change goals relatively frequently.

7. Systems tend to have a more limited tolerance of changes to their environment, whereas networks

tend to maintain a fair degree of invariance and coherence even in the event of highly turbulent transformations to their environment.
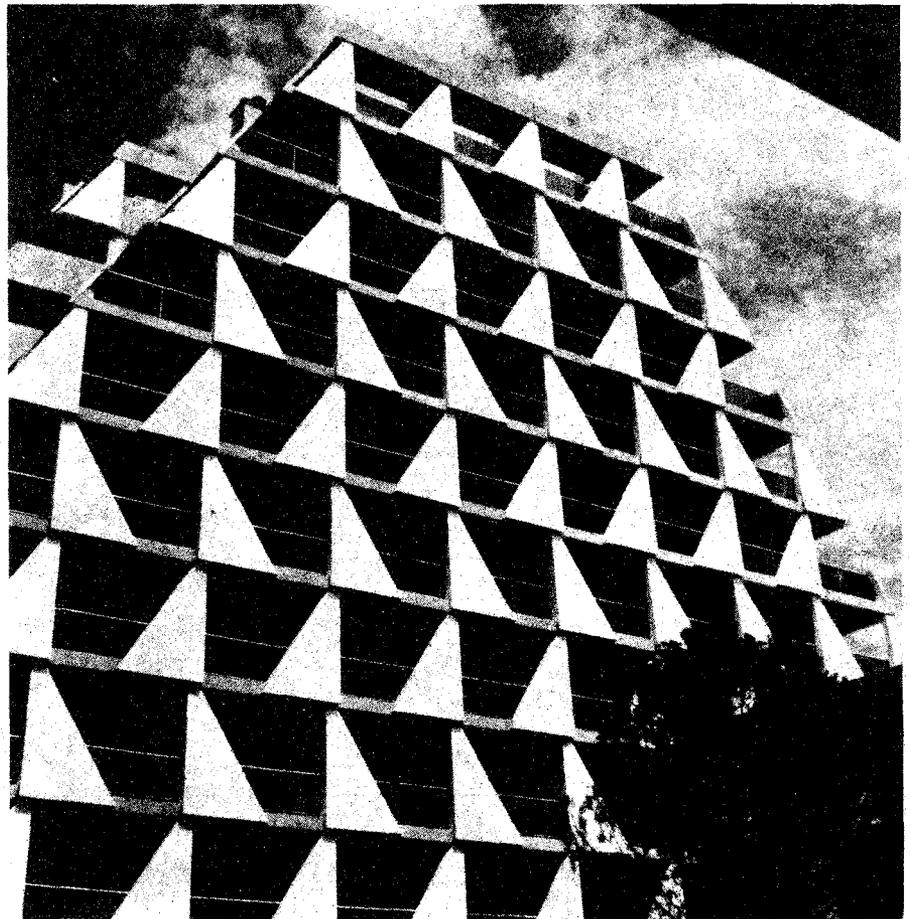
8. Societal system descriptions tend to be meaningful only at a macro-level to detached observers, whereas network descriptions retain their utility even when limited to the immediate environment of an involved participant at a particular node of the network.

9. Systems, and particularly their dynamics, tend to be difficult to represent, wherses complex networks can be represented with relative ease.

10. System components tend to have outputs, along relatively well-defined paths, resulting from (and predictable from) their inputs, whereas the nature of the outputs, if any, of the nodes in a network tends to be much less predictable, as is the pattern of nodes linked at any one time.
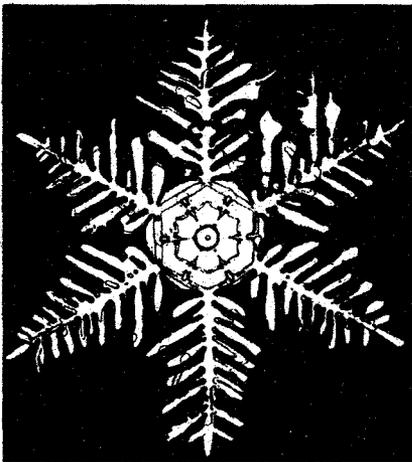
Complementarity

Rather than attempt to resolve the distinction between system and network, it may be useful to conceive of the two terms as being different but complementary conceptual approaches to a structure-process continuum. When a system perspective is used, in prac-
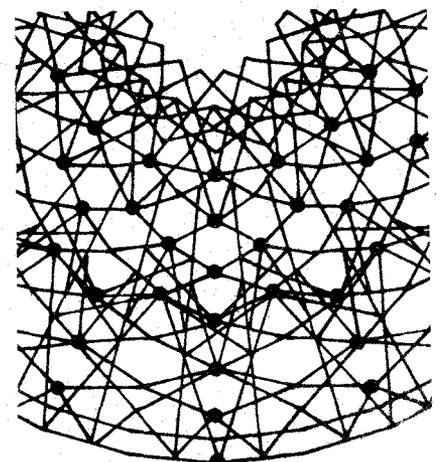
...ce the emphasis is on the properties and the characteristics of the whole conceived as a **set of interlinked processes** (over which a measure of centralized control is described). The structure supporting the processes if considered at all, is perceived and represented in terms of its gross features. When a network perspective is used, in practice the emphasis is on the properties and characteristics of the **continuous pattern of linkages** constituting the structure. The processes which may occur in the network, if considered at all, are perceived and represented in terms of the pathways through the network (the mapping of which constitutes the initial challenge). As the concern with processes builds up, the perspective shifts towards the system focus. Whereas concern with detailed representation of the structure shifts the perspective towards the network focus. The system perspective therefore tends to be used when the structure is assumed to be relatively simple and conceptually well-defined but where the complexity of the processes poses a challenge to conceptualization and representation. The network perspective, conversely, is used when the processes are assumed to be relatively simple and well-defined but where the structural complexity poses a challenge to conceptualization and representation.

Expressed in these terms, the **complementarity** of the two perspectives highlights the problem of description, analysis and policy-formulation in relation to society. A focus on the system process dynamics, as typified by the current approaches to world modelling, is obliged to eliminate structural (and especially fine structural) features to reach a level of aggregation which renders the analysis viable. A focus on the network of fine structure would presumably only be practicable if the complexity of process characteristics was highly simplified. Either filter can be employed, but both cannot yet be removed together and result in any practicable comprehensible investigation.   **AJ** ∎
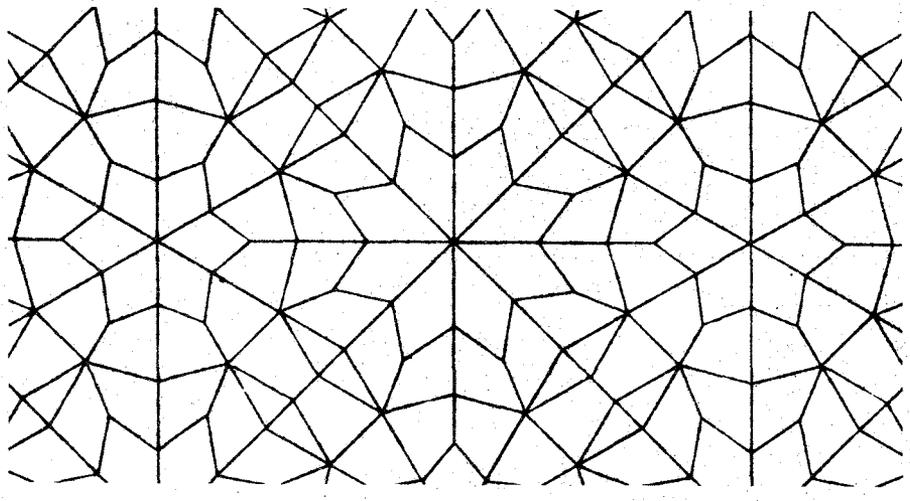
Footnotes

(1) The distinctions (in practice) between systems and networks were presented, with the accompanying tables, as background papers to the meeting on « Exploring the Network Alternative » (see pages 352-355 in this issue). They formed part of the introductory report to the session on « Complexity » during a meeting of the International Foundation for Social Innovation, March 1977, and as such accompanied the paper on « Organizational forms in response to complexity » (Transnational Associations, 1977, 5, pp. 178-183) and are referred to in the summary of the debate (see pages 369-372 of this issue). The text is appearing as part of : International organizat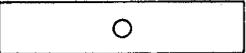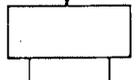ion netwo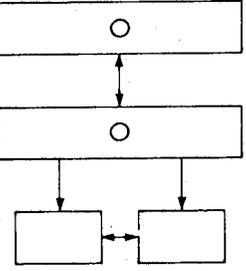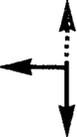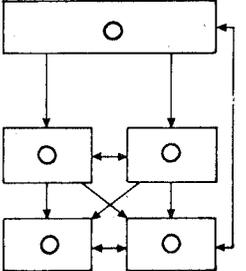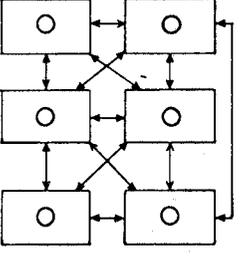rks — a complementary perspective. In : Paul Taylor and AJR Groom (Eds). International Organizations; a conceptual approach. London, 1978. The two tables, reproduced from John McHale. Management; the larger perspective (In : Challenge to Leadership; managing in a changing world. New York, Free Press. 1973), are the result of the integration of two different earlier efforts : in John McHale. The Changing Information Environment (In : Information Technology; some critical implications for decision makers, New York, The Conference Board, 1972), and in A.J.N. Judge. The World Network of Organizations (In : International Associations, 1972, 1, p. 18-22). The latter is an expansion of a table by Peter F. Rudge. Ministry and Management. London, Tavistock, 1968.

STYLE	DECISION MAKING PROCESS		LEADERSHIP		FUNCTIONAL CHARACTERISTICS	CENTRAL PROCESSES	ORGANIZED RELATIONSHIPS		PERSONNEL CHARACTERISTICS	RELATIONSHIP TO ENVIRONMENT	
	Type of Decision		Dominant Personality	Functions of Leaders			Intra-organizational	Inter-organizational		Social Environment	Problem Environment
TRADITIONAL STYLE	Affirmation of new custom	Transmission of heritage	Elders; wise, sacred	Voice of tradition; source of wisdom nurturer; guardian	Implicit concent / Intuitive accord / Agreement under obligation or coercion	Strength of tradition little awareness of alternatives	Coherent, stable traditional hierarchical structure	Traditional contacts; other organ. irrelevant; federations of organizations stable under supreme authority	People trained for highly specialized and limited functions / Little job mobility / Pyramidal authority structure with fixed procedures for access/appeal to higher levels	Component part of static society	Docile, isolated problems in an orderly environment
CHARISMATIC OR INTUITIVE STYLE	Proclamation of intuition	Magnetic, persuasive influencing	Enlightened	Prophetic, inspirational	Vertically oriented hierarchical bureaucracy	Judgemental character of intuition potential withdrawal of adherents	Emanations of the central intuition	Contacts initiated & maintained if they accept superiority of central message & help disseminate it.		Rejection of status quo; articulates change	Indentification of a new fundamental problem underlying previously isolated problems
CLASSICAL OR BUREAUCRATIC STYLE	Production of orders	Detailed directions	Aggressive, domineering	Directive; organizing	Organized by expertise / Written communications with 'fixed' decision rules and chains of command with centralized decision points	Specific standards set by top management	Procedural routinized linkages based on document transfer; jurisdictional disputes	Relations governed by policy of recognition in which superiority of the recognizer is considered implicit		Machine for managing extensive but uncomplex environment	Docile problem groups characterized by their number and variety rather than their complexity and interrelationship
HUMAN RELATIONS OR GROUP STYLE	Formulation of consensus	Shared	Sensitive, cultured	Permissive, non-directive, creation of 'atmosphere'; draws out	Horizontally organized by 'function' areas / Mixture of fixed decision rules and autonomous functional rules. / Shorter chains of Command with more decision points / Participation consent	Individual sense of responsibility; answerability to constituents	Fluid; informal based on mutual empathy	Ad hoc unstructured contacts; organization for project level collaboration; organization groupings raked by fear of 'organization'	Transitional form of organization sharing characteristics of stages 1 and 2 / Mixture of line and staff functions with corresponding organizational roles well defined - but flexibly adjusted to allow for more autonomy via both formal and informal access to higher levels of decision-making / Job mobility more confined to upper level organizational tasks - other workers tend to remain tied to stated work descriptions and rankings	Reflection of cultured democratic society	Dynamic interactive problems, the consequences of some solutions to problems constitute new problems
SYSTEMIC STYLE	Initiated by experts and evaluated by team	Initiated by experts and evaluation team	Expert, technician	Interprets system environment; clarifies goals, monitors change	Network type organization with mission or objective foci which set flexible decision rules / Information flow includes critical man/machine interfaces (e.g. systems analysts, programmers, and comptrollers) which feedback from bottom to top / More autonomous decision making / Team consent / Modified by team in response to local conditions	Conscientiousness of expert; corrective of goals; threat of non-survival of system	Interacting, constant evolution of new authority structures	Links between complementary or competing organizations committed to survival of same macro-system; dictated by cost effectiveness	Skills less tied to specific sets of tasks within organizations / Worker less tied to a single work situation: with developing competence and more flexible skills less attached to specific employing organization / Organizations tend to arrange work to develop capacities of people rather than use the capacities to accomplish work / Growth of serial careers - with multiple entry paths into different careers, etc.	Attuned to those features of its environment which might constitute a potential threat to its continued growth	Aggressive interactive problems; considerable strategic skills required for central planning
NETWORK STYLE	Participative with representatives of all concerned bodies	Outline directives	Network link catalyzers, generalist	Interprets psycho-social environment, clarifies goals and organizational complexes required; monitors change	More diffuse and geographically separated network type, with a high degree of adaptability and change in organizational configuration / Information and decision flows evolve in response to perceived needs rather than predefined and preset objectives or programs / Increased feedback at swifter rates enables previously autonomous decision-making to be integrated into whole system directions	Conscientiousness of those with network roles; counterbalancing objectives of organizational units; threat of non-survival of human society	Interdependent; dynamic emergence of cross-linking authroity centers of short duration	Interdependent; dynamic emergence of cross-linking authority centers of short duration, distinction between intra- and interorganizational links considered academic	As above - mix of diverse specialties flexibly adaptive to changes in task and policy directions / The managerial executive becomes the prime interface and coordinator of 'temporary' systemic clusters of specialized project groups - with multiple, mobile, and overlapping memberships / Ranking according to competence in flexible performance rather than by hierarchic position in organization	Attuned to those features of its environment which might constitute a potential threat to its continued activity and to those which might be threatened by its continued activity	Very aggressive interactive problems; centralized strategy abandoned in favor of decentralized response by a network of interdependent organizations

STYLE	FOCUS	ORGANIZATIONAL FORM	INFOR-MATION FLOW	CONCEPTION	ORGANIZATION		DURATION	MEDIA	DECISION MAKING PROCESS		
					Purpose of Design	Source of Momentum			Main Concerns	Goals	Degree of Consciousness
TRADITIONAL STYLE	Maintaining a Tradition			Historical institution	Preservation of status quo	Force of tradition	'Permanent' throughout a historical period	Mainly written	Recurrent items	Unquestioned, possibly implicit	Non-reflective
CHARISMATIC OR INTUITIVE STYLE	Pursuing an in-tuition			Spontaneous creation	Implementing in-tuition	Dynamism of intuition	'Permanent' for the lifetime of the leader and his his immediate disciples		Critical issues	Highly explicit	Spontaneous
CLASSICAL OR BUREAUCRATIC STYLE	Running an admin-istrative machine			Mechanistic structure	Maximizing effi-ciency	Leadership drive and allocated funds	Undefined duration		Efficient performance of voted programs	Objective and eval-uated quantitively	Conscious; calculated
HUMAN RELATIONS OR GROUP STYLE	Initiating and leading groups			Network of personal relationships	Maximizing personal satisfaction	Group synergism	Undefined short duration	Written Telephone Xerox Etc.	Elaborating group goals	Subjective and emer-gent	Articulation of feelings
SYSTEMIC STYLE	Survival of a system in a hostile environ-ment			System of flows of in-formation and materials, developed in response to opportunity	Maximizing survival potential and growth of system	Individual self-advan-cement through organ-izational unit success in achieving system milestones	For as long as is use-ful for owners and employees	As above, but sig-nificant introduction of computer use at each level speeds up feedback	Adapting system to changing conditions	Outlined centrally; defined and refined by decentralized executant units	Highly conscious of rational perspective
NETWORK STYLE	Adapting to emerging conditions			Dynamic evolving networks of personal and organizational units, living system or organization	Maximizing relevance to perceived problems	Stimulus of individuals and organizational units by new problems and possibilities	For as long as is useful in terms of problem relevance	As above, plus more extended use of interactive commu-nications modes, remote terminals, video conference techniques, etc., enabling widely dis-tributed decision centers to interact swiftly.	Maintaining balance between adapting to environmental change and creating a ful-filling environment	Defined interdepen-dently	Conscious balance between value and rational perspectives