

# WHAT MAKES AND DOES NOT MAKE A RESEARCH METHOD SYSTEMIC? SOME KEY CHARACTERISTICS AND MISCONCEPTIONS.

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## ABSTRACT

Three means to answer the question are taken by discussing: 1) four characteristics that make a method systemic, 2) four characteristics that make a method scientific but not necessarily systemic, and 3) seven characteristics that qualify a method as systemic for application to human activity systems. Some common beliefs about systems are presented and revisited in light of discussion of the characteristics.

## Key Words

Complexification, comprehension, holism, human activity systems, human inquiry, perspectivism, scientific method, scientific thinking, systemics, systems methodology, systems thinking.

## 1 INTRODUCTION

The purpose of this position paper is to discuss concisely in the limited space of the text a select set of characteristics, or criteria if you will, that may be used to decide whether, and in what ways, a research method for human inquiry is in fact systemic. To begin and in juxtaposition with the presentation of characteristics, I provide some data solicited about the idea of systems. I have placed some restrictions on such an exercise in that first the chief realm of interest shall pertain to human phenomena, persons, groups, and collectives of human beings, and human activity systems. Second, the

characteristics chosen are salient ones but by no means the only ones. Third, the subject matter concerns research methodology of the human sciences, that is, methodology of those sciences pertaining to and having something to contribute to explaining, understanding, and ameliorating human beings.

## 2 BELIEFS ABOUT SYSTEMS

To go beyond my own impressions of what features a method might have to be considered systemic, I asked a group of graduate student seminar participants at the outset of their course with me in "systems research methodology in organizations" for their ideas about what a systems method might mean. Their initial responses are presented in Table 1.

Although the responses, such as "focus on interrelationships" and "inputs . . . among them," seem clearly familiar to the more formalized definitions [6, 16, 18, 19, 23], other responses, such as "can't cut . . . two cows" and "synergy . . . its parts," allude to the distinction between sets and systems [24], and still others, such as ". . . visionary" and "outcome . . . something new," imply emergence and purposiveness [1, 3].

Certainly, I do not mean to delimit each response in Table 1 to one category, for each entry may allude to more than one quality of systemics, but I wish only to point out the variety of immediate a priori ideas one can obtain from an educated

audience about to launch into a serious study of systems methodology. Further, the nature and range of response can be instructive, critiqued, and debated in the beginning, so as to flush out and specify what one might expect of a research method to be systemic.

- Focus on interrelationships
- Inputs, processes, outputs, and relationships among them
- Understand how current problems were created by non systemic solutions
- Can't cut a cow in half and get two cows
- Study the whole through the analysis of parts—interdependence and grasping the whole
- Not necessarily linear—more than one way to get to a specific end
- Not only what exists, but also desired—visionary
- Outcome oriented—knowledge to bring about something new
- Synergy and total is more than the sum of its parts
- Influence, manipulation, and control as catalyst for individual and group—driving force

Table 1. The idea of "systems."

### 3 TO BE SYSTEMIC

To make the more direct entrance, there are four key characteristics of a systemic research method. These characteristics are (1) perspectivistic, (2) comprehensive, (3) holistic, and (4) complexificative.

#### 3.1 Perspectivistic

A systemic research method is perspectivistic in that it provides the researcher with more than one view, vantage point, dimension, perspective, and the like, of the system. The minimum number recommended is three. Prior theoretical developments and uses in mathematics, surveying and astronomical calculation have established on firm ground the

scientific basis in the behavioral, social and human sciences for the convergence of three points of view, instruments (data collection techniques), and sources of data, often termed triangulation; see for example [25, 29]. As an application of perspectivism, triangulation is a methodological principle for internal validity, cross validation, corroboration, and convergent validity in human inquiry [10].

This feature of a systemic method is pivotal in the systems theory literature, stemming from earlier formulations of a general theory of systems [5]. Over the latter part of this century, this characteristic shows up in various forms of systems research methodology, for example [3, 12, 28, 9, 21, 22].

#### 3.2 Comprehensive

To be considered truly systemic, methodology must be comprehensive. It must scope and cover the elements and their interactions throughout the system. That is, the inquiry must attempt a system-wide examination of the focus of inquiry. The methodology must include sufficient components to provide the fullest possible coverage of the system. To make the elements and interactions visible usually requires more than one data collection technique, one instrument, person, even more than one method.

This feature typically involves adoption of a theoretical conceptual framework to apply or overlay on the system, so to speak. Or alternatively, perhaps one could say to apply a lens [16], through which one can see, study, and evaluate the system. The emphasis here is inquiry that shall enable a macro to micro, even fine grain look at the system. Likely, the most well known example is Living Systems Theory and the process analysis methodology associated with it [23].

### 3.3 Holistic

In complementarity with comprehensiveness, emphasis on the more macro nature and possible though likely emergent properties of the system define this feature of systemic method. There is also more interest here for researchers to attend to the system as a whole entity in its context, that is the systems-environment interactions and co-evolutionary aspects of the system. Those elements and their interactions, which induce and define the wholeness of the system, must be made accessible through the methodology. But which forms of systemic methodology are better suited to the study of emergent properties of the system in contrast to its internal dynamics are not as yet well understood in the human realm. As illuminating a systems analysis might be, unfortunately the researcher cannot compromise the methodology to the intensive study of parts and delimited interactions in the hope of extrapolating the properties and behaviors of the whole system.

A research method(ology) that adopts the priority of studying the network in which the system is embedded, modeling system-environment relations, and detecting emergent properties are examples that accentuate the holistic feature of systemic.

### 3.4 Complexificative

Where the previous three characteristics tend to cover "breadth and depth," I view the more recently articulated complexificative characteristic to consider the idea of "density." Consequently, as the researcher's interest in studying a system involves increasing coverage of its complexity, there is a complexification of the methodology to enable the researcher to grasp a fuller comprehension of the system.

Systems may be described to be comprised of subsystems and belonging to suprasystems. Natural systems appear to have evolved to ever greater levels of complexity [18, 20]. Complexification appears to be an evolutionary phenomenon of the natural world with many aspects attracting scientific scrutiny [7].

However, in the context of this paper, by complexificative, I refer to methodological complexification that is an inherent characteristic of systemic research. Specifically, the complexification of methodology is the process of matching the complexity of the methodology to the demands and expectations of the researcher to comprehend the complexity of the system. It should come as little surprise therefore that researchers must strive to improve the sophistication of their methodology to study higher orders of complexity of systems. For method(ology) to be systemic, complexification must be built into the inquiry.

An illustration of complexification in systems methodology can be seen in Processing Systems Methodology [12], whereby successive steps of integration from micro to macro levels are required for the researcher to attain the fuller systems-wide comprehension of the human activity system under study. Other systemic methodologies, such as [4, 17, 23], more evidently have this potential to push the methodology toward higher densities.

### 3.5 Discussion

The four characteristics described share a common aim, that being to provide the researcher with a systems-wide comprehension of the system. This aim, as I see it, is the general purpose of systemic research that sets the family of systems research methods and methodologies off from other approaches to human inquiry.

These characteristics help one to grasp the underlying nature of the systemic paradigm for scientific research, which has been advanced in this century [3, 20].

Importantly, the four characteristics may provide basic criteria to evaluate whether a particular systems method(ology) so-called, whose theorists and methodologists claim systemicity, is in fact systemic, according to its practitioners. Surely such a set of criteria would be a worthy endeavor to examine the status of any contribution to systems research methodology. Further, it would give practitioners and innovators some sense of a minimally acceptable set of expectations to apply and advance, respectively, our means to study human beings and human activity systems from a systems orientation.

The extent to which human oriented research methods claim to be systemic, yet fall short of their ideals, is to be debated and judged as any other approach to research in scientific communities. Hallmark criteria of science, such as method validity, have scantily entered into the published literature involving a particular systems method(ology). The validity of the method may rest on the extent to which the researcher can substantiate claims that its implementation successfully met systemic criteria, such as the four discussed above.

But this aim of attaining a systems-wide comprehension is both a blessing and a curse. The idea of system is a conceptualization of the researcher, who strives to gain some sense of the reality of the system through the implementation of his/her methodological construction—ironically, the degree to which the inquiry successfully attains its own systemicity. However, such a methodological construction and its application impose their own limitations on what path the inquiry

takes, what data is obtained and observations made, and consequently what systems-wide comprehension one can attain. Faced with this puzzling and seemingly circular cybernetic relation, the researcher will feel trapped within this methodological paradox. Therefore, in inquiry one must remain ever vigilant against falling prey to his/her own untested assumptions and unsubstantiated theoretical concoctions. Furthermore, regardless of the extent and ways the system may become visible in forms one can comprehend and claim a systems-wide comprehension, one eventually must confront the matter of scientific interpretation, critique, debate, and consensus building among members of his/her science community.

#### 4 TO MISCONCEIVE SYSTEMIC

To clarify the meaning of what is and is not a systemic research method(ology), it is important to consider some earlier forms of research and their characteristics which mislead the researcher into thinking that a systems-wide comprehension can be attained through scientific inquiry. To parallel the four characteristics of systemic research in this regard, there are four misconceptions, one may term non systemic characteristics, that I shall discuss briefly. They are (1) analytic, (2) systematic, (3) disciplined, and (4) complicated.

##### 4.1 Analytic

Scientific thinking is often equated with analytical thinking [26]. But to break a whole into its parts and study the parts via carefully worked out rules and procedures for observation, measurement, data collection, and analysis may make the research method analytic and thereby in part scientific, but it does not make it systemic.

A clear illustration of the analytic feature of science is dissection of a corpse of a living thing to describe all anatomical parts and their physical connections among them. However, like fossils, geological formations, and photographs, a corpse is more a set than a system [24] and all attempts to comprehend the living system, in regard to its physiology and vitality, leaves the researcher to make inferences and sometimes wild speculations that must await subsequent study via a more systemic methodology to confirm.

#### 4.2 Systematic

Scientific inquiry requires a careful exploration and examination of parts and interactions to root out the relevant features, properties, functions, causes, influential factors, and changes of a system. This process is methodical. It is organized and executed in a stepwise fashion, which involves following a favored strategy for inquiry and many replications. The systematic nature of scientific investigation seems to hold both within a single investigation and for programmatic research spanning decades. Although a truly systemic research method is one that also is systematic in order to be scientifically acceptable, it does not justify the converse, that is to be systematic is to be systematic. Systematic nature of inquiry is a hallmark of sound science, but in itself does not make the methods used systemic.

A clear example of the systematic character of science is to follow a proven strategy that has yielded high returns in past research efforts. Such a strategy might entail moving systematically to determine those parts critical to a specific function in the system and eliminate those parts not critical to the specific function [13]. The strategy also helps to justify the research across a series of

investigations that aims to reveal a causal explanation of a phenomenon, an effective treatment for a condition, or a more accurate understanding of the functioning of a specific part of the system. Since such systematic efforts do indirectly contribute to an eventual system-wide appraisal, a method used to make its piecemeal contribution may be mistakenly identified as systemic.

#### 4.3 Disciplined

Researchers attempt to describe and apply their methods with agreed upon rules and procedures, which may be evaluated in regard to validity, reliability, and standardization for example. Such practices lead to the formalization of a research method with subsequent recognition among increasing numbers of researchers in a science community to accept it as a form of scientific method [10]. Another way to say it is that the method becomes an established form of disciplined inquiry. But discipline in one's practices of inquiry does not make the method systemic.

A method has various components like its design, plan, data collection, and data processing procedures. An outstanding example of the disciplined feature of scientific practice is following an established, proven, and reliable procedure that produces a finding directly relevant to testing the researcher's hypothesis. However, such adherence to the disciplined nature of scientific inquiry by execution of an established scientific procedure does not establish the systemicity of the method(ology).

#### 4.4 Complicated

Even though complicated and complex may be synonyms in everyday lay conversation, in systemic inquiry and other scientific contexts, they should not be

confused. A complicated method may imply some degree of trouble, incoherence, difficulty, irregularity, and disorder in the execution of the methodology, all of which may jeopardize the validity of the investigation underway. Many systemic methodologies are inherently complex for reasons which should be increasingly apparent over the course of this paper. Granted, many researchers engaged in systemic inquiry experience the methodology as complicated. But a complicated method does not make it systemic. With non systemic and systemic methods alike, complication is usually received as an unwelcomed visitor.

One of the challenges of human science oriented research is to construct methodologies from among compatible methods, techniques, and procedural components, without complication [10]. Nowadays, researchers accomplish this feat through the integration and execution of a research design and plan that capitalizes on the praxiological emphases of economy, efficiency, effectiveness, efficacy, and ethicality [14]. As every researcher knows and aspiring doctoral student soon learns, the complexity of the task should not be taken lightly.

Participant observation is an accepted part of many forms of research in the behavioral, social, and human sciences. It is an established approach for human inquiry evident in such manifestations as for example ethnography [15] and case study methodology [29]. Researchers engaged in participant observation experience the method as both complicated and complex, but for different reasons. Entering the field may be perceived as a complicated affair. Initial months may be confusing and often disorienting. The research questions that prompted the study in the beginning may be displaced by others that emerge as more relevant

and reflective of what is happening. The researcher must gain familiarity and comfort with the setting, establish a base of operations, form relationships with informers and those observed, sample places and occasions, and organize the time to both observe and make field notes. As the data accumulates about persons, places, and events—the substance of the future ethnography or case study report, respectively—the daunting complexity of it all poses a formidable challenge facing the researcher to organize, thematize, condense, synthesize, and write the research report. In other words, the skillful entry of entering the field and making observations as well as the writing of the research report may do much to qualify the research methodology as scientific, but they do little to characterize it as systemic.

#### 4.5 Discussion

The three key characteristics of analytic, systematic, and disciplined share a common aim, that being to provide the researcher with standards for scientific method. Researchers strive to apply human oriented research methods that meet these three characteristics to establish method validity—an internal consistency (integrity, cohesiveness) which is to some degree complex, for the investigator must apply know-how and sophistication to integrate such aspects of the anticipated inquiry as research question asking, research design, operationalizing constructs, sampling, research plan, data collection, and data analysis. However, the choice of the word “complex” does less to define a standard than to encourage researchers to seek means that are praxiologically advantageous.

In short, just because a scientific inquiry may be described accurately in terms of these four descriptors, it does not follow

therefore that the researcher may make claim to a systemicity of the method(ology). Systemic research assumes to be analytic, systematic, and disciplined as do other forms of scientific research. Doing research is usually experienced as complicated, but systemist researchers seek as much complexification as necessary to enable their inquiry, preferably without complication, in order to comprehend the whole system.

## 5 BELIEFS REVISITED

Three quarters through the graduate student seminar noted at the start of this paper (Table 1), I posed to my seminar participants the question once more. Their responses are listed in Table 2.

- Whole to parts and back to wholes through all the interconnections among parts in order to comprehend all the complexity—the emergent properties, interactions, and intricacies of the whole.
- Multiple perspectives on a problem; visioning the situation within a context; multiple step process that is iterative; looking at the "whole" rather than the parts; seeing connections and the impact each component has on the whole.
- Adding dimensions to organizational research in the areas (primarily) of culture and power relations.
- Holistic model; circular in nature; interrelationships between parts; positive and negative loops; interdependency between parts; permeable membranes; internal effects external (environment) and vice versa.
- Many concepts that involve a series of interrelated parts that when put together act as a whole.
- Gaining an understanding of the complex interactions and interconnections within an organization (in terms of people, resources, technology, etc.); exploring a "holistic" means for increasing participation/involvement from everyone and understanding boundaries that effect the flows of the system.

Table 2. The idea of "systems" revisited.

Comparing the two tables, we see a rise in expectations as to what constitutes systemic and a more sophisticated and careful look at the meaning of the idea of system. Applied to a research method, I think it poses a formal challenge to the systems research method(ology) currently in vogue to fulfill these rising expectations. But in principle, consider any systems method(ology) so-called in light of the systemic and non systemic characteristics presented previously.

Furthermore, the responses might raise caution for more circumscribed usage of a systemic method(ology) with human beings. This point leads me to consider additional characteristics central to applications of systems research methodology in human organizations.

## 6 SYSTEMIC IN HUMAN ACTIVITY SYSTEMS

Having entered the subject directly with prominent characteristics and indirectly with some misconceptions, the remaining portion of this paper is devoted to the more specialized attention researchers are giving to applications of systemic methodology in the study of human activity systems. This specialty emphasis refers to human collectives, particularly human organizations, such as institutions, schools, factories, business corporations, societies, associations, and the like, rather than singular human beings and their subsystems, i.e. personality, consciousness, bodily systems.

In addition to, but not in lieu of, the four general characteristics previously presented, there are paramount characteristics common to systemic methodologies for human activity systems that make them systemic. These applications are directed to the collective rather than the personal level of human activity. Some

established examples are Soft Systems Methodology [8, 9], Search Conferencing [27], Viable Systems Model [4], and Systems Design Journey [3]. Therefore the central endeavor in this last section of the paper is to address the question: What are these additional characteristics?

My preliminary answer to the question is that they are the (1) participatory, (2) trans constituency based, (3) cooperative, (4) collaborative, (5) trans disciplinary, (6) group centered, and (7) transformative qualities of a social group process that engage and enable the participants to attain a more systems-wide comprehension of their human organization.

Although I imagine more possibilities await the researcher to add to this list, this set of interrelated characteristics is exemplary of applications of systemic methodologies to human activity systems. As many of these terms may be rather self explanatory, the following paragraphs are very brief. I merely hope to provide some clarity of definition for discussion purposes.

### 6.1 Participatory

This feature means playing an active part in the process of inquiry. It is being a player and not solely a spectator of events. It means being a receiver, generator and contributor of communications which bind and bring about the group process.

### 6.2 Trans Constituency Based

The group executing the systemic method(ology) is composed of those most affected by the consequences of the inquiry. It means the principal stockholders of the focus of inquiry are represented, present to, and part of the group con-

ducting the inquiry [22]. Constituency based research teams build in one kind of perspectivism into the inquiry process. In these forms of research, boundaries between researcher and participant often blurs, even disappears. It also means a transcendancy of partisanship to become an effective member of the research team.

### 6.3 Cooperative

Competing interests are expected and must be confronted. Group cohesion must occur, else the inquiry process is stultified. Constructive forms of communication must prevail to foster more synergistic work of the team. It is the cooperative nature of the communications that encourage common understandings, group solidarity, and progress from one stage of the systemic methodology to the next.

### 6.4 Collaborative

In participatory, constituency based, and cooperative research, teamwork for the purposes of inquiry means that each member must discover effective ways to contribute to the team effort. The complementarity and fit among members fosters the collaborative characteristic of systemic inquiry.

### 6.5 Trans Disciplinary

As with the trans constituency based characteristic, trans disciplinary builds into the inquiry another form of perspectivism. Expertise from various knowledge domains makes for a more systemic methodology. It fosters access and use of resources not ordinarily available to mono and multi disciplinary teams [24].

### 6.6 Group Centered

Unlike many forms of human inquiry involving a researcher or team of



researchers making observations and collecting data from individuals, the more systemic forms focus on the group itself. The group often becomes the primary source of observations and data, although members at various times during the inquiry may "step out" to obtain data to bring back into the group process. This feature of working with the inquiry process as a group centered process is akin at the collective level to a researcher doing research on him or herself (e.g. autobiographical, autohistorical research, and the like) at the individual level. Self-study of an institution for the purposes of accreditation and internal organizational audits of various kinds may serve to exemplify some of the potentialities for the more group centered systemic methodologies.

### 6.7 Transformative

Importantly, the process of inquiry itself usually leads to a transformation of thought and often practice as well, whereby the views of the individuals participating and the consensual view of the group may be markedly different after the inquiry compared to entering into the inquiry. One can get a bit of this idea from relating this characteristic to Table 1 and later Table 2 in the graduate seminar. Whether one can account for the shift by the process itself is problematic, given the difficulty of establishing causality in a single group pre to post type comparison. Even though the root cause may be ambiguous, the participants no longer appear to be, in belief and often in practice, where they were at the start of the inquiry. Systems methodology tends to bring about a richer and more systems-wide comprehension, which typically means inclusion of many parts, interconnections, hierarchical and heterarchical subsystems, and system-environment relations not previously evident to the participants.

### 6.8 Discussion

From a study of the methods and methodologies available to apply in human organizations, for example [16, 19], it soon becomes evident, though little discussed in the systems research literature, that the vast majority of these characteristics emerge from applications of systems methodology in a democratic sociopolitical context, where these characteristics stem from core values and beliefs held by their participants. To the degree systems methodologies for human activity systems are applied in other sociopolitical environments leaves open the question as to the accuracy of these characteristics. On the surface, it seems implausible to expect effective applications in more autocratic and dictatorial forms of human organization. Further, to the degree a human organization professes to be democratic in theory, yet is autocratic in practice, it is unlikely to expect much from the implementation of a systemic methodology.

From another perspective, the seven characteristics, one might argue, are common to what one might expect in social group and teamwork type projects that pervade human organizations in the more democratized societies. Greater attention brought to action science [2], participatory action research [28], and related developments in methodology seem to bring one toward the more systemic features of methodology. But the aim of the action oriented forms of research is amelioration, liberation, and emancipation in the human organization. To improve the conditions and quality of human organizational life sets these forms off from other paradigmatic arenas for scientific inquiry [11]. The contribution of systemic methodology may be given over to such service, of course, as it can for the purpose of theory building and hypothesis testing; however, I view its

chief advantage and drive to be to help those so engaged to attain a more systems-wide comprehension of the system of which they are part. Other aims certainly may become relevant, however, this central aim and its associated characteristics are what makes a systems methodology for human activity systems systemic.

## 7 SUMMARY AND CONCLUSION

This paper took three entrances to answer the question. Initially I discussed some salient and somewhat overlooked features of a systemic research method. Next I described a number of outstanding misconceptions, which can help to clarify what is often mistaken to be a systemic method. Finally, I focused on a more specialized and recent set of methodological characteristics particularly important to the study of human activity systems.

In sum, there are outstanding general characteristics of research methods and methodologies as they are applied to the study of human phenomena and human activity systems that make them systemic, such as perspectivistic, comprehensive, holistic, and complexificative. The contrasts between systemic and non systemic characteristics help researchers to know when their scientific inquiries are one or the other, and what makes the difference. The specialized set of characteristics of research methodology that makes it systemic and relevant to human collectives emphasize trans communicative forms of human science research methodology.

To conclude, clearly all the characteristics discussed point to sound science in practice. But in practice all these characteristics are ideals. Whether systemic or not, a scientific investigation will be

analytic, systematic, disciplined, and complex to some degree and in some ways. Yet most scientific investigations do not attempt a systems-wide comprehension of the system under study. More often than not, a single inquiry can muster the resources to study only a small part of human phenomena. And using a non systemic approach to fulfill an interest in a systems-wide examination must by its very nature lead to an under-conceptualization of the system on the one hand, and an equally hazardous over-conceptualization by extrapolation from parts to an imagined system on the other hand. In most cases, it is left to those interested in the science community to integrate, synthesize, interpret, and debate a series of relevant investigations in order to come to a consensually agreed upon position as to the who, what, where, when, why and how of a system. Nevertheless, as the characteristics and exemplary methods and methodologies noted in this paper tend to illuminate, advances in systemic methodology are providing us with more means to strive for systems-wide comprehensions of the systems we study.

## 8 REFERENCES

- [1] Ackoff, R. (1981). *Creating the Corporate Future*. NY: Wiley.
- [2] Argyris, C., Putnam, R., and Smith, D. (1985). *Action Science*. San Francisco: Jossey-Bass.
- [3] Banathy, B. H. (1991). *Systems Design of Education*. Englewood Cliffs, NJ: Educational Technology Publications.
- [4] Beer, S. (1985) *Diagnosing the System for Organizations*. NY: Wiley.

- [5] Bertalanffy, L. von (1975). *Perspectives on General Systems Theory*. NY: Braziller.
- [6] Callaos, N. and Callaos, B. (1991). A systemic definition of methodology. *Systems Science in the 21st Century: Integrating the New Sciences of Complexity in Service of Humans and Their Environment*. Volume I. Pocatello, ID: International Society for Systems Science, pp.71-78.
- [7] Casti, J. (1994). *Complexification*. NY: HarperCollins.
- [8] Checkland, P. (1981). *Systems Thinking, Systems Practice*. NY: John Wiley.
- [9] Checkland, P. and Scholes, J. (1990). *Soft Systems Methodology in Action*. NY: Wiley.
- [10] Collen, A. (1994) *Human Science Research: Seminar Supplement*. Walnut Creek, CA: HSR Seminars.
- [11] Collen, A. (1995). The foundation of science. *Foundations of Science*, 1(1): 14-18.
- [12] Collen, A. (1996). Needed: a methodology for studying the interface and integration of communication processing systems? *Systems*, 1(1): 12-15.
- [13] Collen, A. (1996). Two generic areas of methodology for the application of cybernetics to human science research. In R. Trappl (Ed.). *Cybernetics and Systems '96*. Vienna: Austrian Society for Cybernetic Studies, pp. 461-465.
- [14] Collen, A. and Gasparski, W. (Eds.) (1995). *Design and Systems: General Applications of Methodology*. New Brunswick, NJ: Transaction.
- [15] Fetterman, D. (1989). *Ethnography Step by Step*. Newbury Park, CA: Sage.
- [16] Flood, R. and Jackson, M. (1991). *Creative Problem Solving: Total Systems Intervention*. NY: Wiley.
- [17] Forrester, J. (1969). *Principles of Systems*. Cambridge, MA: Wright-Allen.
- [18] Hall, A. and Fagen, R. (1968). Definition of system. In W. Buckley (Ed.). *Modern Systems Research for the Behavioral Scientist*. Chicago: Aldine, pp. 81-92.
- [19] Jackson, M. (1991). *Systems Methodology for the Management Sciences*. NY: Plenum.
- [20] Jantsch, E. (1980). *The Self-organizing Universe*. NY: Pergamon.
- [21] Linstone, H. et al. (1995). The multiple perspective concept. In A. Collen and W. Gasparski (Eds.). *Design and Systems: General Applications of Methodology*. New Brunswick, NJ: Transaction, pp. 177-242.
- [22] Mason, R. and Mitroff, I. (1981). *Challenging Strategic Planning Assumptions*. NY: Wiley.
- [23] Miller, J. (1978). *Living Systems*. NY: McGraw Hill.
- [24] Minati, G. and Collen, A. (1997). *Introduction to Systemics*. Walnut Creek, CA: Eagleeye Books.

- [25] Patton, M. (1990). *Qualitative Evaluation and Research Methods*. Second edition. Newbury Park, CA: Sage.
- [26] Tweney, R., Doherty, M., and Mynatt, C. (Eds.) (1981). *On Scientific Thinking*. NY: Columbia University.
- [27] Weisbord, M. (1992). *Discovering Common Ground*. San Francisco: Berrett-Koehler.
- [28] Whyte, W. (Ed.) (1991). *Participatory Action Research*. Newbury Park, CA: Sage.
- [29] Yin, R. (1994). *Case Study Research*. Second edition. Thousand Oaks, CA: Sage.

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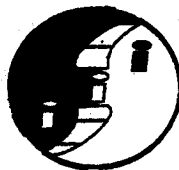
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