JOHN WARFIELD'S WORK AND RELATED TOPICS

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INTRODUCTION

This document provides an overview of the work of John N. Warfield. It includes a discussion of how his work has been incorporated in some other organizations and how it has been applied by some other people.

Numerous people have evinced interest in this work. In the absence of an overview document, each interested person has to look at many documents to get a feeling for the scope and for how the parts of the work are related. In the absence of an overview document, it is quite difficult to assess the work or to see how it may relate to the work of others.

In presenting this overview, its key aspects are identified first. Then the various parts are identified as lying within certain "conceptual programs" which are identified. A single "inclusion structure" shows how the various parts of the work are perceived as being organically related.

To provide clues to how to look for further depth, indications are given of other organizations and individuals who have touched this work in some way. Several books are identified that incorporate some of this work.

A list of Warfield's publications is given. Each one is assigned an index number. These numbers are used to show how the publications relate to various highlighted topics. This should help interested students or researchers to locate additional information about these topics, going beyond what can be done in this overview.

SOME KEY ASPECTS OF THIS WORK

The work relates to five key aspects which are: human effectiveness, complexity, systems science, avenues to application, and received doctrine.

Focus on Human Effectiveness

Most of Warfield's work is aimed at enhancing human effectiveness. Especially it deals with doing this in organizations and doing it in group activity.

Complexity

The work focuses on enhancing human effectiveness in dealing with the ever-growing complexity of modern life.

Systems Science

The academic category called "systems science" is viewed as the primary category within which this work falls.

Design and Management

Design and management are seen as the two primary application areas to which this work applies. The work centers on the development and application of a science of generic design within the general frame of systems science. The primary environment and process approach to using the science of generic design is called Interactive Management.

Received Doctrine

Received doctrine about (a) management, (b) design, and (c) what constitutes science is not automatically accepted. On the contrary, all received doctrine is subject to reconsideration.

CONCEPTUAL PROGRAMS

The following five "conceptual programs" provide an umbrella for discussing most of Warfield's work.

- Motivation drawn from observation and study
- Interactive Management
- Science of Generic Design
- Educational environment and methods
- Analysis of data accumulated from group work

Motivation Drawn from Observation

Appendix 1 lists topics noted from various publications that deal with current events. These topics are organized under several categories. Most of the topics relate to unfortunate situations that seem to involve bad design, bad management, or a combination of these. Typically the topics arise at different times, so the individual who notices them does not necessarily

get a sense of any commonality among the topics. By seeing the titles together, one may get a feeling that something significant is happening in society that warrants attention, and that these topics individually are examples of that significant set of events.

This recognition of commonality may serve as a motivation to try to provide corrective measures across the set of events instead of dealing with each one locally and individually.

Interactive Management

The name "Interactive Management" (IM) was chosen in 1981 to apply to a carefully defined conceptual scheme for testing in practice how people could work together in carefully defined ways and in a specially-designed setting, in order to enhance their capability to manage complexity.

A Center for Interactive Management (CIM) was designed and put into practice. The work of CIM was carried out at first at the University of Virginia in the period from April of 1982 to June of 1984. Then CIM continued its work at George Mason University in the period from October of 1984 to June of 1989.

The work of CIM related to serving clients from a variety of areas. Approximately 60 clients were served during the time period mentioned.

The scientific basis for the work of the CIM is the Science of Generic Design (SGD). This work was carried out during the period 1968-1989, first at Battelle Memorial Institute in Columbus, Ohio; then at the University of Virginia; and finally at George Mason University.

Many people and organizations became interested in this work during the period 1968-1989. Some of them will be identified later in this document.

Many of the applications in which the SGD was tested were carried out and reported by CIM staff in cooperation with clients. The primary people involved in the CIM staff were John Warfield, Alexander Christakis, David Keever, Benjamin Broome, and William Wood. Among the many clients who collaborated in the CIM environment were Henry Alberts and Robert McDonald. A number of students were very helpful in this work.

A student of Interactive Management will need to review especially the following concepts that are prominent in the CIM operations:

- The SIGMA-N Concept, generally invoked in CIM as a SIGMA-5 Meeting
- The DEMOSOPHIA, the name given to the physical environment (a specially-designed situation room and support anteroom) for carrying out Interactive Management
- The key role distinctions involved in establishing context, conducting process, and creating and organizing content in relation to a complex issue
- The production of Application Structural Types by a group to describe and interpret complex situations and to develop and display designs for changing those situations

A Science of Generic Design

A Science of Generic Design (SGD) was developed during the period 1968-1989. Most of the organizational work on the SGD was done in the period 1976-1989. This work provided the scientific basis for the practice of Interactive Management. Also it provided the means for system design to be carried out as part of the IM activity.

A Domain of Science Model was constructed to provide a firm definition of what constitutes a science and how a science relates to its applications. This model was used to discipline the development and presentation of the SGD.

In carrying out applications of the SGD through IM, data were collected as a natural part of the work necessary to arrive at the information needed to manage complexity. These data now permit assessment and evaluation of both the SGD and IM.

The three major components of the SGD are the Foundations which steer Theory, the Theory which steers Methodology, and the Methodology which is used to carry out Applications.

<u>Foundations.</u> The major ideas relating to the Foundations of the SGD are the following:

- The Universal Priors (the human being, language, reasoning through representations, and archival representations), which are asserted to be part of the foundations of any science

- The Idea as the Unit of Analysis and Synthesis, which permits the SGD to be generic, since ideas are fundamental to all human activity

- The Triple Basis for the SGD (whereby the SGD rests on an appropriate integration of anthropological, formal logical, and technological bases)

- The Eternal Referents (those standards established for use in physical sciences, which lack counterparts in other sciences), and the necessity to finely hone and carefully integrate language as a means of approaching the quality of communication attained through the eternal referents for those sciences that lack them

- The Cosmic Partition (in which the universe is partitioned into three parts in order to permit sustained reference to the universe when abstracting particular situations from the universe for study)

Theory. The major ideas involved in the Theory of SGD are the following:

- The human being, as explained in terms of bounded rationality, unshakeable cognitive burden, and association with a virtual world of the individual

- The situation, in the sense that situational analysis replaces the older concept of problem definition, and situational change replaces the older concept of problem solving

- Dimensionality, in which the situation and proposed change alternatives are described in terms of dimensions, and in which older ideas of dimension and dimensionality are extended considerably

- Methodology that is Open at Scale, which requires that methodology not be constrained to any particular system scale, so that what is learned can be applied both to very large systems and to very small subsystems in a consistent language and communication style

- Escalation of complexity, which shows how complexity escalates and why this requires that the methodology be open at scale

- Criteria-based development, which demands that criteria be developed and applied to assess all aspects of all parts of the SGD and used as guides for evaluation, comparison, and improvement

- Laws and Principles of Generic Design, which lay detailed theoretical bases for acceptance or rejection of proposed methodologies

- Formal logic, which takes advantage of over two millenia of thought to enhance means of reasoning and representing, thereby leading to documentation of high quality

Methodology. The following are the major contributions to Methodology in the light of Foundations and Theory:

- Criteria for Methodology and Role Selection, related largely to the detractors from and enhancers of human activity

- Consensus Methodologies, forming a set of seven mutually supportive methodologies chosen through the criteria coming from Theory, and including three methodologies developed by Warfield [Interpretive Structural Modeling (ISM, 1973), Options Field Methodology (OFM, 1978), and Options Profile Methodology (OPM, 1978)]

- The Stopping Rule showing when and why, in a particular situation, the application of a particular methodology can be concluded

Educational Environment and Methods

The work on educational environment and methods emphasizes mainly these matters:

- Need for a Design Culture in higher education

- Framebreaking and Remodeling (a terminology due to Chris Argyris) in higher education, especially as a key to developing student design capability

- The nature of the Great University (founded in the three objectives for education given by Ralph Barton Perry, and embedded in a framework of Leibniz's Principle of Reason)

- The combined use of SGD and IM as the basis for system design or redesign (including the design or redesign of educational systems)

Analysis of Data Accumulated from Group Work

Group design using SGD involving numerous groups, each having different concerns, and each troubled by a complex issue that affects their lives and focuses their work, has produced accumulated data that are sufficient to yield significant conclusions about group work and design. Analysis and interpretation of the data show that no matter what the issue and no matter which group is involved:

(a) The diversity of belief among members of the group concerning the relative significance of the factors important to the issue will be high, the members being on average closer to total disagreement than to total agreement

(b) The likelihood that deep logic and sizeable logic cycles will be found in analyzing the issue and in creating designs approaches certainty

(c) The deep and cyclic logic that is uncovered in group work never surfaces in ordinary discourse, even though it is critical to understanding situations and developing effective designs

(d) The combination of diversity that is closer to perfect disagreement than to perfect agreement and depth of logic that exceeds in size the capacity of human short-term memory (and which is not produced or applied in observable attempts to deal with complexity by other means), strongly supports the need for the processes described as the Methodology of the SGD

(e) Mathematical correlation of group initial assessments of complex situations with group final assessments, using the data developed in numerous IM applications, shows very substantial change of belief along with negligible correlation of initial and final belief. The only explanation is that substantial learning occurs during the processes of knowledge structuring carried out in a group mode during the IM work based in the SGD

AN INCLUSION STRUCTURE FOR THE WORK

Most of the foregoing ideas have been arranged in an inclusion structure, shown in Figure 1. In this structure, the organic nature of various components of the work is indicated in that elements at lower levels are included in elements at higher levels.

This structure may be useful to individuals who want to select some particular component for analysis or critique, while retaining an image of how that component connects organically to other parts of the overall knowledge scheme.

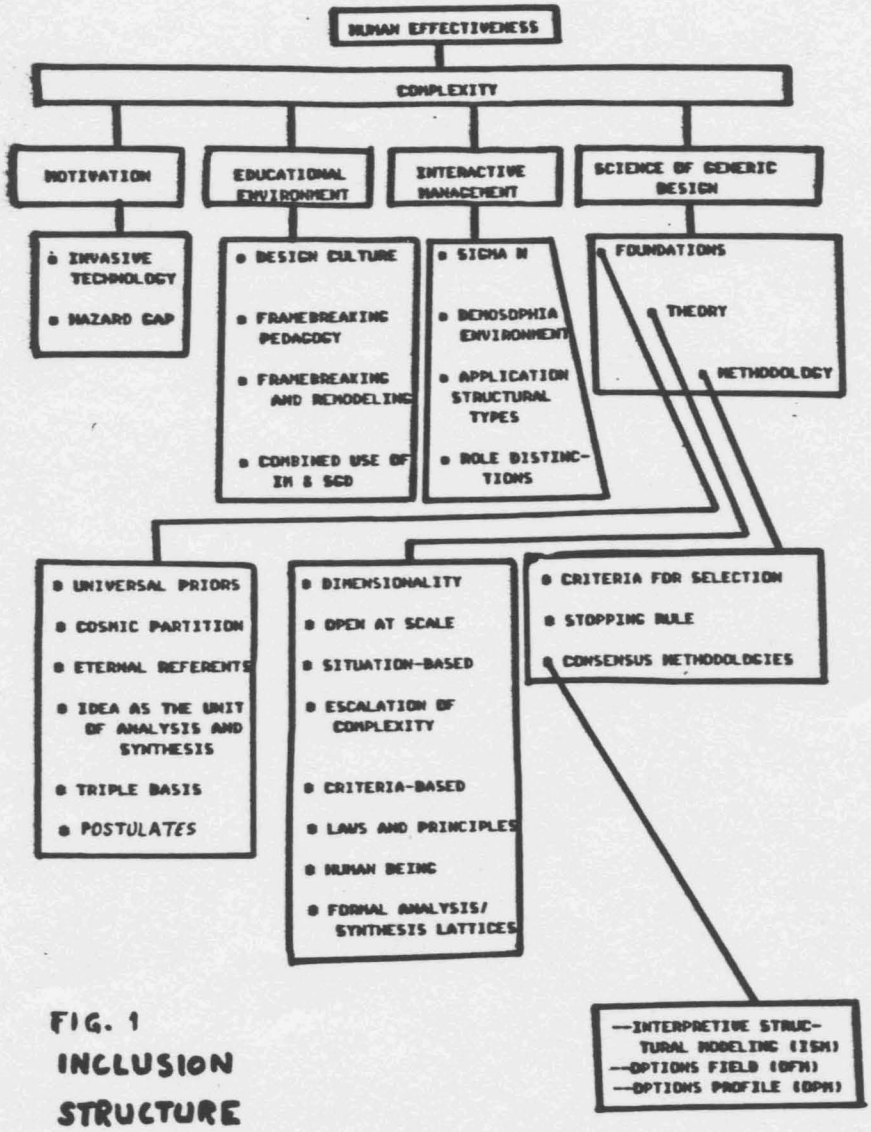

FIG. 1
INCLUSION
STRUCTURE

CONNECTED ORGANIZATIONS, INDIVIDUALS, AND PUBLICATIONS

Several organizations have adopted a few parts or a major portion of the foregoing ideas. In other instances, particular individuals have adopted parts of the foregoing in their work without constructing particular institutional components like the CIM. Several books have been published in a variety of languages that incorporate some or much of the foregoing.

Organizations and Individuals

The following organizations are involved in related work:

- The Interactive Management Unit at City University of London (Mr. Ross Janes, Senior Lecturer in the Department of Systems Science)
- The Southwest Fisheries, La Jolla, California (Dr. Izadore Barrett, Director, and Mr. David Mackett, facilitator)
- The Instituto de Administracao, University of Sao Paulo, Brazil (Mr. James T. C. Wright, Dean Ruy Leme)
- Tata Consultancy Services, Hyderabad, India (Dr. P. N. Murthy)
- University of Northern Iowa, Institute for Decision Making, School of Business (Dr. Robert Waller, Dr. William Wood)
- Defense Systems Management College, Fort Belvoir, Virginia (Mr. Gregory Wierzbiecki, Provost, and Prof. Henry Alberts)
- Niagara-Mohawk Power Company, Syracuse, New York (Mr. Jack Benson, Mr. Donald Godard)
- The Pentagon, Washington, D. C., Smart Munitions Program (Mr. Anthony Melita)
- The Defense Advanced Research Projects Agency, Washington, D. C., (Mr. Craig Fields, Mr. Brian Sosdian, Mr. Ray Chapman, retired)
- The Americans for Indian Opportunity, Washington, D. C., (Mrs. La Donna Harris)
- The Winnebago Tribe of Nebraska, (Mr. Reuben Snake, Chairman of the Tribal Council)

- The Center for Peaceful Change, Kent State University (Dr. Carl Moore)

- The University of the Aegean, Athens, Greece (Mrs. Ioanna Tsivakou, Prof. Costas Sophoulis)

- The Technology Transfer Centre, Council for Scientific and Industrial Research, Accra, Ghana (Dr. Robert Butler, Dr. Moses Ayiku)

Books

The following books were published by authors having no direct affiliation with Dr. Warfield. They treat various parts of the work described in the foregoing. These books are listed in chronological order of their publication.

1. Y. Sawaragi and K. Kawamura, **Participatory Systems Approach: Methods and Applications**, Tokyo: Daily Industrial Newspaper Company, 1982 (in Japanese).

2. N. Szyperski and M. Eul-Bischoff, **Interpretative Strukturmodellierung (ISM)**, Braunschweig: Vieweg, 1983 (in German).

3. Carl Moore, **Group Techniques for Idea Building**, Newbury Park: Sage, 1987 (in English).

4. Mehdi B. Razavi, **A Design for an Islamic Economic Analysis**, Mashad: The Islamic Research Foundation, 1987 (in Parsi).

5. Michael DeClaris (Ed.), **Systems Governance**, Athens: Sakkoylas, 1989 (in Greek).

6. Bihui Zhang and Li Da Xu (Translators), J. N. Warfield, **Societal Systems: Planning, Policy, and Complexity**, Wuhan: 1989 (in Chinese), originally published in English by John Wiley, 1976, and reprinted in 1989 in English by Intersystems of Salinas, CA.

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APPENDIX 1

CASE TOPICS

CATEGORIZATION OF CASE TOPICS BY AREAS

AREA A. SOFTWARE
AREA B. NUCLEAR ENERGY & SYNTHETIC FUELS
AREA C. ECONOMICS, FINANCE, AND TRADE
AREA D. BIG CORPORATIONS AND THEIR MANAGEMENT
AREA E. ETHICS
AREA F. GOVERNMENT
AREA G. DISASTER ANALYSIS
AREA H. MISCELLANEOUS DESIGNS
AREA I. EDUCATION
AREA J. COMMUNICATION/LANGUAGE
AREA K. TRANSPORTATION
AREA L. MISCELLANEOUS ANALYSES

AREA A. SOFTWARE

A-1. Struggling to Understand Manual-ese
A-2. SDI's Survival Formula: Reagan + Lots of Money
A-3. The SDI Is Based on Untrustworthy Software
A-4. Computer Literacy
A-5. The User Who Knew Too Much
A-6. AT&T Computer Network
A-7. Pentagon's Strategic Computing Project
A-8. Software Design
A-9. Computers, People, and the Delivery of Services: How to Manage the Management Information System
A-10. Is This Machine Thinking or Not?
A-11. Board Accredits Computer Programs
A-12. Expert Doubts Computer System for U. S. Missile Shield is Feasible
A-13. Management Must Solve DOD Software Problems
A-14. Software Aspects of Strategic Defense Systems
A-15. Overselling Technology: Suppose You Gave a Computer Revolution and Nobody Came?
A-16. The Information Age: Phantom of the Factory
A-17. AT&T Ties its Future to Nebulous Data Networking
A-18. Most Expensive Errors in Software
A-19. Physicists Studying SDI Aren't Dilettantes
A-20. Smart Doesn't Always Mean Better in Computer-Controlled Buildings
A-21. Buyer Beware: Software Plagued by Poor Quality and Poor Service
A-22. Bugs Come in All Sizes and Are Hard to Destroy
A-23. Gene Amdahl Fights
A-24. As Complexity Rises, Tiny Flaws in Software Pose a Growing Threat
A-25. Commerce Seeks Major Cut in PRC of McLean's Contract
A-26. FAA Computer: Doubts Arise
A-27. User-Friendly Persuasion
A-28. MANAGEMENT MUST SOLVE DOD SOFTWARE PROBLEMS

AREA B. NUCLEAR ENERGY AND SYNTHETIC FUELS

B-1. DISPUTE ON ARMS CLAUSE BLOCKS PACT FOR RELEASE OF DATA ON A-ACCIDENTS
B-2. REGULATION OF NUCLEAR PLANT CONSTRUCTION
B-3. THREE-MILE ISLAND
B-4. COUNTERFEIT BOLTS USED IN NUCLEAR UNITS
B-5. THE NUCLEAR FAMILY
B-6. SHUT 8 N-PLANTS, SCIENTISTS SAY
B-7. CHERNOBYL TOLL SEEN IN THOUSANDS
B-8. TENNESSEE VALLEY AUTHORITY STUNG BY CRITIQUES OF ITS NUCLEAR PROGRAM
B-9. A WHISTLE-BLOWER'S STORY OF THE TROUBLE AT T HE TVA
B-10. LAB CREATING A NEW GENERATION OF NUCLEAR ARMS
B-11. SYNTHETIC FUELS CORPORATION
B-12. *TEXAS NUCLEAR PLANT PROBED FOR VIOLATIONS*

AREA C. ECONOMICS, FINANCE, AND TRADE

C-1. PATENT OWNERS GAINING CLOUT
C-2. STUDY SAYS BAD MANAGEMENT HAD KEY ROLE IN BANK FAILURES
C-3. U. S. BANK IS OWED $2 BILLION
C-4. AMERICA'S HIGH-TECH CRISIS
C-5. BANK REGULATION
C-6. BEHIND THE BANKING TURMOIL
C-7. BUILDING A BETTER ECONOMIC MODEL
C-8. SOCIOECONOMICS: HUMANIZING THE DISMAL SCIENCE
C-9. FARM LENDER STILL TEETERING DESPITE ASSISTANCE PLEDGE
C-10. BELL LABS IS LONG ON GENIUS BUT SHORT IN THE MARKETPLACE
C-11. CHIP MAKERS SEEK FUNDS FOR PROVING GROUND
C-12. IMF, WORLD BANK TRADITION DATED
C-13. JAPAN'S RISING ECONOMIC POWER: U. S. FINANCIAL POWER EBBS, JAPAN'S RISES
C-14. UN AGENCY WILL SET UP GLOBAL SEED BANKS
C-15. GRADUALLY, IMPORTED FOODS ARE TAKING LARGER BITE OF U. S. MARKET

AREA C. Economics, Finance, and Trade (continued)

C-16. World Bank Role in Debt Crisis Grows
C-17. Stockman's Numbers Don't Add Up

AREA D. Big Corporations and Their Management

D-1. U. S. Bank is Owed $2 Billion
D-2. AT&T Computer Network
D-3. GE Changes its Strategic Planning System
D-4. Three-Mile Island
D-5. Trilogy Corp
D-6. Is The Big Corporation Its Own Worst Enemy?
D-7. Exxon's Flop in Field of Office Gear Shows Diversifidation Perils
D-8. Big US Corporations Launch New Wave of Cutbacks
D-9. Chip Consortium: Before Congress Antes Up
D-10. Bell Labs is Long on Genius, But Short in the Marketplace
D-11. Pentagon Bids Going to Team Players
D-12. AT&T Ties its Future to Nebulous Data Networking
D-13. Chip Makers Seek Funds for Proving Ground
D-14. US Official Raps Business Executives
D-15. Baldridge Joins Attack on US Firms
D-16. Honda deal with Argentina Stalls

AREA E. Ethics

E-1. The Slippery Ethics of Engineering
E-2. Boisjoly Hopes his Lawsuits Improve Engineering Ethics
E-3. NASA Wins Doublespeak Award
E-4. Engineers Playing an Increasing Role in Liability Lawsuits
E-5. New Book to Be Thrown at Corporate Lawmakers
E-6. Ethics and the Shuttle Disaster
E-7. Professionalism and Engineering Ethics
E-8. Professional Ethics Today
E-9. Ethics in the IEEE: Member Conduct Committee

AREA F. GOVERNMENT

F-1. THE TITLE IV-D PROGRAM IN NEW YORK STATE
F-2. THE CASE OF THE ENDWELL NARCOTICS RAID
F-3. LABOR-MANAGEMENT RELATIONS AND THE CIVIL SERVICE REFORM ACT
F-4. THE NEW YORK STATE POLICE MANPOWER DEPLOYMENT SYSTEM
F-5. DC COMMISSION LAUNCHES PROGRAM TO INFLUENCE DESIGN IN NEIGHBORHOODS
F-6. A CULTURALLY-SENSITIVE APPROACH TO TRIBAL GOVERNANCE ISSUE MANAGEMENT
F-7. NEXT WORD OF THE HOUR IN IOWA: ENTREPRENEUR
F-8. WE'VE TRIED FLASHY, NOW LET'S GO FOR THE BASICS
F-9. WHY WE NEED A TOUGH NATIONAL SCIENCE ADVISER
F-10. US INDUSTRIAL POLICY: THERE'S NO ONE IN CHARGE

AREA G. DISASTER ANALYSIS

G-1. THE FATAL FLAW IN FLIGHT 51-L
G-2. THE SERGEANT YORK GUN: A MASSIVE MISFIRE
G-3. THREE-MILE ISLAND
G-4. TRILOGY CORP
G-5. MAJOR LOSSES AND CATASTROPHES, 1970-1985
G-6. THE ST. FRANCIS DAM
G-7. JUDGE BLAMES FIRM, OFFICERS IN FERRY DISASTER

AREA H. MISCELLANEOUS DESIGNS

H-1. NEW PAY PHONES THAT READ CARDS BAFFLE CALLERS
H-2. VIRGINIA UNEARTHS STORAGE TANKS

AREA I. EDUCATION

I-1. Children Can be Critical Thinkers Early On, Study Says
I-2. Is it Really "Higher" Education?
I-3. High-Tech High Gets Promising Results
I-4. A Powerful Indictment of Relativism
I-5. A Diet Book for the Intellect

AREA J. COMMUNICATION/LANGUAGE

J-1. Focus on Nuances of Words for Effective Communication

AREA K. Transportation

K-1. How a Subway Project in New York has Led to Doubt and Dismay
K-2. National Airport: Transportation Nightmare
K-3. Hacking at National
K-4. Airport's Adversities

AREA L. MISCELLANEOUS ANALYSES

L-1. Design Case Analysis
L-2. Making Things Work
L-3. R&D Productivity: An Investigation of Ways to Evaluate and Improve Productivity in Research and Development
L-4. Giving Design Engineers More Time to Design
L-5. On Developing Case Studies to Assess Generic Design Science
L-7. Florida Developer Tries a Variation on Old Concept of a New Town
L-8. Factors that Threaten the Productivity of Organizational Task Forces
L-9. Troubled souls: Where We Went Wrong
L-10. A Bad Bill's Origin
L-11. Why Subsidize Importers?

APPENDIX 2

PUBLICATIONS OF JOHN N. WARFIELD

PUBLICATIONS OF JOHN N. WARFIELD

AUGUST 22, 1989

Books:

B-1. Knausenberger, G. E., and Warfield, J. N., Synthesis of Linear Communications Networks, (New York: McGraw-Hill,1958) (translation from German of the classic work Theorie der Linearen Wechselstromschaltungen by Wilhelm Cauer, orig. publ. by Springer Verlag).

B-2. Warfield, J. N., Introduction to Electronic Analog Computers, Englewood Cliffs: Prentice-Hall, 1959.

B-3. Warfield, J. N., Principles of Logic Design, Boston: Ginn & Co., 1963.

B-4. Warfield, J. N., Societal Systems: Planning, Policy, and Complexity, New York: Wiley Interscience, 1976 (reprinted in paperback by Intersystems publishers of Salinas, CA, in 1989; Chinese translation in progress, publication expected in 1989 or 1990).

B-5. Warfield, J. N., A Science of Generic Design, manuscript completed, publication expected in 1989 or 1990.

Papers:

1. Warfield, J. N., and D. L. Waidelich, "A Table of Steady-State Transforms", Univ. of Mo. Bull., Research Report No. 1, 1953.

2. Truxal, J. G. and J. N. Warfield, "Synthesis of a Dynamically-Variable Electronic Filter", Proceedings of the National Electronics Conf., 8, 1953, 419-426.

3. Warfield, J. N., "Little Known Facts About Big Computer Developments", Pa. State Univ. Engineering Review, Dec., 1953, 68ff.

4. Warfield, J. N., "Systems Engineering", U. S. Dept. of Commerce PB111801, 1956.

5. Warfield, J. N., "Optimum Diagnostic Sequences for Systems with One Faulty Element", Univ. of Ill. Control Systems Laboratory Report M-67, Feb., 1957.

6. Warfield, J. N., "How to Improve Systems Engineering", invited paper in Aeronautical Engineering Review, 16(7), July, 1957, 50-51.

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8. Warfield, J. N., "Switching Circuits as Topological Models in the Discrete Probability Theory", Transactions of the IRE PGEC-7(3), Sept., 1958.

9. Butler, K. J. and J. N. Warfield, "A Digital Computer Program for the Reduction of Logical Statements to Minimal Form", Proceedings of the National Electronics Conference, 1959, 456-466.

10. Warfield, J. N. and L. E. Weaver, "Cut-Product Approximants for Time Delay in Electronic Analog Computers", Proceedings Southwest IRE Conference, April, 1959.

11. Warfield, J. N., "Solution Manual for Principles of Logic Design", Boston: Ginn & Co., 1963.

12. Warfield, J. N., and G. M. Gooch, "A Precision Electronic Goniometer", Proceedings of the National Electronics Conference, 1965, 174-179.

13. Warfield, J. N., "Corrective Systems for Minimizing TACAN-DME Spurious Radiation", IEEE Transactions on Aerospace and Navigation Engineering 12, March, 1965, 89-90.

14. Warfield, J. N., "Synthesis of Switching Circuits to Yield Prescribed Probability Relations", 1965 Conference Record on Switching Circuit Theory and Logical Design, Ann Arbor, MI., Oct., 1965, 303-309.

15. Warfield, J. N. and T. Channel, "Spurious Signal Amplitudes in High-Frequency Transistor Mixers", Proceedings of the IEEE MAECON, Nov., 1965, 91-95.

16. Warfield J. N., and P. Lally, "Comment on 'Corrective System for Minimizing TACAN-DME Spurious Radiation'", IEEE Trans. on ANE, ES(2), Sept, 1966, 616-618.

17. Warfield, J. N., "Switching Networks as Models of Discrete Stochastic Processes", in Applied Automata Theory, J. Tou (Ed.), Chap. 4, New York: Academic Press, 1968, 81-123.

18. House, R. W. and J. N. Warfield, "What is System Planning?", Automatica, 5, 1969, 151-157.

19. Warfield, J. N., "Modulation Measurements--Theory and Technique", IEEE Transactions on Instrumentation and Measurement, IM-18, June, 1969, 139-144.

20. Warfield, J. N., and J. D. Hill, "The DELTA Chart: A Method for R&D Project Portrayal", IEEE Transactions on Engineering Management, EM-18, Nov., 1971, 132-139.

21. Warfield, J. N., J. D. Hill, et al, A Unified Systems Engineering Concept, Columbus: Battelle Memorial Institute, Monograph Number One, June, 1972.

22. Warfield, J. N., "Participative Methodology for Public Systems Planning", Proceedings of an International Symposium on Systems Engineering and Analysis, West Lafayette: Purdue University, Oct., 1972, 23-40; reprinted in Computers and Electrical Engineering 1(1), 1973, by invitation of the Editor.

23. Hill, J. D., and J. N. Warfield, "Unified Program Planning", IEEE Trans. on Syst., Man, and Cybern., March, 1973, 121-132.

24. Warfield, J. N., "On Arranging Elements of a Hierarchy in Graphic Form", IEEE Trans. Syst., Man, and Cybern., March, 1973, 121-132.

25. Warfield, J. N., "Intent Structures", IEEE Trans. Syst., Man, and Cybern., March, 1973, 133-140.

26. Warfield, J. N. and J. D. Hill, An Assault on Complexity, Columbus: Battelle Memorial Institute, Monograph No. 3, April, 1973.

27. Warfield, J. N., "Binary Matrices in Systems Modeling", IEEE Trans. Syst., Man, and Cybern., Sept., 1973, 441-448.

28. Warfield, J. N., "Constructing Operational Value Systems for Proposed Two-Unit Coalitions", Proceedings 1973 IEEE Conf. on Decision and Control, 204-213.

29. Warfield, J. N., "Developing Subsystem Matrices in Structural Modeling", IEEE Trans. Syst., Man, and Cybern., January, 1974, 74-80.

30. Warfield, J. N., "Developing Interconnection Matrices in Structural Modeling", IEEE Trans. Syst., Man, and Cybern., January, 1974, 81-87.

31. Warfield, J. N., Structuring Complex Systems, Columbus: Battelle Memorial Institute, Monograph No. 4, April, 1974.

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34. El Mokadem, Ahmed, J. N. Warfield, D. Pollick, and K. Kawamura, "Modularization of Large Econometric Models: An Application of Structural Modeling", Proceedings of the 1974 IEEE Conf. on Decision and Control, Nov., 1974, 683-692.

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36. Warfield, J. N., "Improving Behavior in Policymaking", Approaches to Problem-Solving, No. 1, Columbus: Academy for Contemporary Problems, August, 1975.

37. Warfield, J. N., "Totos: Improving Group Problem-Solving", Approaches to Problem-Solving, No. 2, Columbus: Academy for Contemporary Problems, August, 1975.

38. Warfield, J. N., H. Geschka, and R. Hamilton, "Methods of Idea Management", Approaches to Problem Solving, No. 4, Columbus: Academy for Contemporary Problems, August, 1975.

39. Warfield, J. N., "**Profiles of Metapolicy**", Proceedings of the 1975 Conf. on Cybern. and Society, Sept., 1975, 14ff.

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APPENDIX 3

INDEX TO HIGHLIGHTED TOPICS

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NOTE: "Publication numbers" refer to the symbols assigned in the accompanying document called "Publications of John N. Warfield", with page numbers in books shown in parentheses