

CHRONOLOGY RELATED TO A SCIENCE OF COMPLEXITY, GENERIC DESIGN SCIENCE AND INTERACTIVE MANAGEMENT

Covering the period 1956 - 1998

Second Draft

J. N. Warfield

1956--Warfield publishes small monograph on *Systems Engineering*, which entered the Department of Commerce's information system (NTIS)

1957--Warfield publishes "How to Improve Systems Engineering" in *Aero Engineering Review*

1967--Warfield becomes "Review Editor" of *IEEE Transactions on Systems Science and Cybernetics*, assisting A. D. Hall III (the first Editor)

1968--Warfield leads a 2-year Battelle study of systems methodology to look for gaps.

1969-A. D. Hall III resigns as Editor of *IEEE Transactions on Systems Science and Cybernetics*, and Warfield becomes Editor. During his term as Editor, he will build up this journal to a quarterly publication.

1970--Battelle begins its Science and Human Affairs Program, with activity at all four of its labs (Columbus, Hanford, Frankfurt, Geneva). Warfield is selected to lead the Columbus effort. The "gold book" is published by Battelle (the strategic plan for the Program).

1971--Warfield and Hill publish "The DELTA Chart: A Method for R&D Project Portrayal"

1971--W. K. Linvill (Head of the Department of Engineering-Economic Systems at Stanford University) and Koichi Haruna (his 6-month student from Hitachi) come to Battelle for Linvill's sabbatical, where they become acquainted with Warfield's work

1971-Warfield initiates the Large City Design Project at Battelle to (a) study behavior in a group of experts who are striving to collaborate on a very problematic situation, full of complexity and (b) to see whether the experts can develop a plan to design a city for a million people as a way to establish a benchmark against which troubled cities can be compared

1971--DEMATEL (Decision-Making and Testing Laboratory) Project Begins in Battelle Geneva Laboratories

1972--Warfield presents "Participative Methodology for Public System Planning" at Purdue University

1972--Warfield and Hill publish *A Unified Systems Engineering Concept* as the first Battelle Monograph. It is distributed to 200 libraries by Battelle.

1972-IEEE Systems Science and Cybernetics Society merges with IEEE Human Factors Society to become the IEEE Systems, Man, and Cybernetics Society. Warfield resigns as Editor of the

IEEE Transactions on Systems Science and Cybernetics, to give the merged society an opportunity to choose a neutral editor for the merged journal.

1972 --Hill and Warfield publish "Unified Program Planning" in the *IEEE Transactions on Systems, Man, and Cybernetics* [This planning system would resurface in 1985 under the name "Quality Function Deployment (QFD)" and be attributed to Mitsubishi by two authors from Harvard and MIT respectively, writing in the *Harvard Business Review*]

1973-The Large City Design project ends, yielding only significant behavioral information about groups of experts (analyzed with consulting help from The Menninger Clinic (Topeka, KS)

1973--Warfield publishes the papers "Intent Structures", "Binary Matrices in Systems Modeling", and *An Assault on Complexity* as the second Battelle Monograph.

1973-Robert James Waller leads a project that uses ISM successfully at the University of Northern Iowa to enable the City Council to set and publish priorities for urban projects in Cedar Falls, Iowa; as required by law

1974--Warfield publishes several papers on "Interpretive Structural Modeling", and Battelle publishes Warfield's Battelle Monograph *Structuring Complex Systems*.

1974-Battelle completes the first version of Interpretive Structural Modeling (ISM) Software, to run on their Control Data Cyber Main Frame at the Columbus Laboratories

1974--The first group process using Interpretive Structural Modeling (ISM) with the Battelle software (used over telephone lines between Dayton and Columbus) is held at the Kettering Foundation, Dayton, Ohio, and is facilitated by Dr. Raymond Fitz of the University of Dayton.

1974--Warfield leaves Battelle to become a faculty member and Chairman of the Department of Electrical Engineering at the University of Virginia, Charlottesville

1976 Warfield publishes the book *Societal Systems: Planning, Policy, and Complexity*, with Wiley Interscience, which summarizes his Battelle research carried out during the period 1968-1974; this book being done under a contract with Battelle. It also shows the complete mathematics behind the ISM process.

1976-77--Warfield does research on how to lay out structural models, using computer algorithms, and develops and publishes "Crossing Theory and Hierarchy Mapping".

1978--Warfield attends an IEEE meeting in Tokyo, at which about eight Japanese papers are given on ISM. Also Warfield talks to the Industrial Policy Research Institute of Japan at the University of Tokyo on applications of ISM. While in Tokyo, Koichi Haruna tells him that Hitachi uses ISM to help sell computers, and is having good success doing so.

1979--Warfield contacts IBM Corp. to ask why they do not explore the use of ISM in their company. Their Director of Systems Planning (Mr. Abe Katz) visits the University of Virginia, and IBM begins to write software for ISM.

1979--Warfield is contacted by George J. Klir with a request to consider becoming Editor-in-

Chief of a new journal to be published by Pergamon Press. The vision for this journal is that it would be the journal that would link the major systems societies under a new federation of societies to be called the "International Federation for Systems Research", IFSR. The IFSR would be headquartered in Vienna, where the Austrian government has already agreed to provide funds for an office and sufficient staff to carry out the business functions of a federation that would initially include the Society for General Systems Research (SGSR, legally constituted in the State of Michigan, USA); the Austrian Society for Cybernetics (headquartered in Vienna); and the Dutch Systems Society (headquartered in Amsterdam). A legal document is in the works, and has been tentatively agreed to. Warfield agreed to become Editor-in-Chief, subject to two conditions: a) he would never have to become involved in any problems involving the financial aspects of the new journal, but could devote all relevant energy to building a quality publication, and b) all members of the three founder societies would pay for and receive the new journal automatically as part of their membership in their respective societies. Upon being assured that these conditions would be met, Warfield agreed informally to take up the editorship when the paperwork had been concluded.

1979--Warfield takes part in a series of workshops in India, where Unified Program Planning and Interpretive Structural Modeling are described and applied in several sessions. Dr. P. N. Murthy of IIT Kanpur is the academic host, and Mr. Faqir Kohli, Director-in-Charge of Tata Consultancy, is the administrative host. Lectures are presented in New Delhi, Bombay (now called Mumbai), Pune (at the Tata Management Training Center), and in Bangalore.

1980--Tata Consultancy Services starts a Systems Engineering and Cybernetics Centre in Hyderabad under the direction of Dr. P. N. Murthy, with urging from Mr. Kohli. The use of the Unified Program Planning system is a feature of the Centre. ISM cannot be used because of lack of software.

1980--Warfield leads a small group (Kawamura, Waller, and Warfield) to Riyadh, Saudi Arabia, to present a one-week workshop on Consensus Methodologies for the Saudi Arabian National Center for Science and Technology (SANCST), organized through the US National Science Foundation. The ISM part of the workshop uses the computing equipment and software at Battelle in Columbus, OH, connected via satellite and land lines to the Riyadh Palace Hotel.

1980--Warfield takes a one-year leave of absence from the University of Virginia and spends it with the Department of Management at the University of Northern Iowa, where he designs the "situation room" to be used for group work. Upon his return to the University of Virginia in 1981, construction begins on such a room, financed by the Dean of Engineering, for the purpose of offering services to clients and sponsors. The name "Interactive Management" is coined for a system of management aimed at mastering and resolving complexity, incorporating the ISM methods among others. The name DEMOSOPHIA (a conjunction of two Greek words) meaning "wisdom of the people" is chosen for the new facility.

1981--Warfield conducts a workshop in Bonn, Germany, on Consensus Methodologies

1982--The Center for Interactive Management starts operations at the University of Virginia in April, in the newly-constructed DEMOSOPHIA room designed by Warfield. Warfield is the

Director, and Dr. Alexander Christakis is the Associate Director.

1982--Warfield presents the presidential address at the Society for General Systems Research on the subject "Organizations and Systems Learning", which discusses issues relating to complexity and how organizations try to work with it. This address is published in the Yearbook of SGSR for 1982.

1982--Warfield conducts workshops in Brazil at the University of São Paulo, where the IBM Science Center in Brasilia has just installed ISM software (written in Portuguese at IBM-Rio de Janeiro) as part of its gift to the University. A workshop is held (in Portuguese) by University staff (led by James Wright) relating to Brazilian agriculture, where the new software is used for the first time

1982--Warfield reconstructs the ISM theory without the use of matrices (in order to try to make it accessible to people who do not know matrix theory), and publishes this version in a Wiley book edited by Prof. Olsen of Ohio State University.

1983--Warfield publishes the criteria used to select methodologies for systems design and also the principles of Interactive Management.

1983--In a dispute between the Dean of Engineering and the Provost at the University of Virginia, the Center for Interactive Management is closed, even though it had enjoyed sponsorship in its first year from the U. S. Forest Service, the Virginia Department of Forestry, and others.

1983--Warfield leaves the University of Virginia and takes a position with the Burroughs Corporation in Detroit, MI, to start a new program involving Burroughs sponsorship of software research with universities, whereby Burroughs would donate new equipment to universities in return for their writing "education software" to be owned by Burroughs. Grants were made to the University of North Carolina, Georgia Tech, the University of Tennessee, and the University of Northern Iowa.

1984--Warfield begins to study the structure of computer languages using structural analysis, and begins to write articles about the design of high-level computer languages.

1984--Warfield moves to George Mason University, to start a new institute to be financed by the new Center for Innovative Technology; to be called the Institute for Information Technology. Annual funding of about \$1,000,000 per year is expected, to support the growth of high-technology industries in northern Virginia.

As part of this arrangement, the Center for Interactive Management relocates from the University of Virginia with Alexander Christakis as Director. George Mason University finances the construction of a new DEMOSOPHIA room, to be used in testing the science and methodology.

1985--Warfield begins to publish articles relating to a science of design. Among the topics of this year's papers are the choice of frames for systems studies, and issues related to developing a design culture in higher education.

1986--Warfield publishes articles about education in generic design, and the Domain of Science

Model is introduced to guide the development and organization of the science of generic design.

1986. The Institute of Information Technology is lost by George Mason University in a political battle with the state. It goes to Virginia Tech, which receives two of the four newly-funded centers, the others going to the University of Virginia and to a Richmond-based institution.

1986--The Theory of Dimensionality is introduced, and the respective roles of micromathematics and macromathematics in systems studies and design is elaborated.

1987--The Theory of Dimensionality is further elaborated, and questions related to scale and discipline in systems design are discussed in publications.

1987-The Defense Systems Management College starts sponsoring work at the Center for Interactive Management at GMU, to get help in connection with the complexity involved in defense procurement and, in particular, with procurement of so-called smart weapons.

1987--Since the Institute of Information Technology has become an empty title, GMU agrees to a new name: The Institute for Advanced Study in the Integrative Sciences (with the acronym IASIS). Warfield is the Director of IASIS.

1987-Mr. Surinder K. Batra spends six weeks at GMU, visiting the Center for Interactive Management, to learn its processes. Warfield arranges to visit with Mr. Arthur T. Hall, in retirement from Bell Laboratories, living in Northern Maryland, because Mr. Batra is expected to be a major player in Tata's systems engineering center, located in Hyderabad, India.

1988-Ms. Yamuna Prabhu visits for six months. She had been directing a little theater company in southern India, but now she wants to learn how to work in Interactive Management. Following her stay, she takes a position with Tata Consultancy Services in Bombay. (Eventually she will leave this service, complaining of corporate male chauvinism, to start her own consultancy.)

1988--Criteria for a science of generic design and the language of design are introduced. Also the behavioral side of human activity is discussed with respect to the "magical number three".

1988-An Interactive Management Workshop organized by Dr. Alexander Christakis and Ms. Ioanna Tsivakou is held on the Greek island of Chios, for the purpose of developing a strategic plan for a new university: The University of the Aegean, with emphasis on "Developing a Design Culture in Higher Education". The "Chios Declaration" is prepared and is published with signatures of scholars from several nations, proclaiming the necessity for incorporating system design in higher education.

1988--After building up the Pergamon Press journal known as *Systems Research* as Editor-in-Chief over a period of eight years to a respected quarterly, during which time the two essential conditions were not met by the three founding societies (with the single exception that the members of the Dutch Systems Society paid for and received the new journal), and after numerous joint warnings from Warfield and from Pergamon Press that the societies would have to meet their responsibilities if they wanted the journal to continue, which they continued to ignore, Pergamon discontinued publication of *Systems Research*, and automatically Warfield ceased to edit the journal. [Eventually the Dutch Systems Society chose to publish a physically

smaller version of the journal for a few years. Then, after a few years, the British offices of John Wiley & Sons resumed publication under the editorship of M. C. Jackson. Not too long thereafter, due to the retirement of the founder and editor of *Behavioral Science*, there was a merger of *Systems Research* with the journal *Behavioral Science*, which had a much larger subscription base, to form the journal *Systems Research and Behavioral Science*, published by John Wiley and Sons.]

1988-Warfield's 1976 book, *Societal Systems: Planning, Policy, and Complexity*, is reprinted in soft cover by Intersystems, a California publisher.

1988 Ing. Roxana Cárdenas, Head of the Department of Systems Engineering at the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), contracts with GMU to deliver a sequence of short courses for faculty at ITESM, on the subjects of Interactive Management and generic design science. Professor Ben Broome of the Communications Department of GMU and Professor Alexander Christakis carry out most of this effort.

1989-In a dispute between Provost Clara Lovett and Dr. Alexander Christakis, Dr. Christakis decides to leave George Mason University. As a result of this, no further work is planned for the Center for Interactive Management, even though it had been very successful in gaining sponsor support during its brief lifetime, and its research volume had begun to increase at a rapid rate.

1989-The Defense Systems Management College (DSMC) contracts with GMU for a 3-year sponsored program to teach DSMC faculty about the generic design science and Interactive Management. Professor Henry Alberts of DSMC begins his long journey to redesign the US Defense Acquisition System, taking advantage of his TMAW refresher courses for program managers at DSMC.

1989-A first draft of a manuscript is prepared by Warfield: *A Science of Generic Design: Managing Complexity Through Systems Design*. The manuscript is submitted to publishers for their consideration. Eventually Intersystems, a California-based publisher of books on systems, agrees to publish the book in two Volumes.

1990-The two-volume set *A Science of Generic Design: Managing Complexity Through Systems Design* is published in soft-cover edition by Intersystems. Immediately persons seeking to purchase the book begin to complain to Warfield that the publisher is not responsive to their purchase orders. This situation will (unbelievably) continue for 2 years.

A soft-cover edition of a new manuscript titled *A Handbook of Interactive Management* is published locally by Warfield to send to reviewers. Based on a variety of comments returned, Warfield keeps updating the manuscript.

1990-Ford Motor Company, which has been using QFD for several years, initiates a small-scale project at GMU, with the ultimate intention of introducing the generic design science and Interactive Management into Ford. The sponsor is Dr. Scott M. Staley of the Ford Research Laboratories. Ford sponsorship will grow steadily until 1994, at which point the original goals had been achieved.

1992-- Having now received his doctorate at IIT in New Delhi, Dr. Surinder K. Batra leaves Tata Consultancy, and announces that he has started a Center for Interactive Management-India in New Delhi.

1993-Warfield finally loses patience with the California publisher, and signs an agreement for a hard-cover, one-volume, second edition of *A Science of Generic Design: Managing Complexity Through Systems Design* with the Iowa State University Press.

1993-Ing. Roxana Cárdenas, Head of the Department of Systems Engineering at the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) comes to George Mason University for a 6-month sabbatical. During this period she collaborates in upgrading *A Handbook of Interactive Management*, which is then accepted for publication by the Iowa State University Press.

1994-Both books are published in second editions by the Iowa State University Press: *A Handbook of Interactive Management* and *A Science of Generic Design: Managing Complexity Through Systems Design*. This agreement was brokered by Robert James Waller with a representative of the Iowa State University Press. But that person left the Press (for reasons unrelated to these books), after which time a new management took over.

1994-The final report is submitted to Ford Motor Company describing the successful achievement of the stated project goal: to transfer the Interactive Management Technology to Ford. By this time, Ford has learned to run IM processes both in Michigan and at their principal location in the United Kingdom.

1995-Ford uses IM to carry out the strategic design of its enterprise-wide information system. Twelve years later, this system will still be operating as designed in 1995, and Dr. Scott Staley who collaborated with Warfield, will be leading Ford's effort to design fuel cell vehicles..

1997-All of the copies of *A Handbook of Interactive Management* have been sold by the ISU Press; but a new management is in charge. They refuse to reprint the book because it is not in the main line of their agricultural publications. So the book goes out of print.

1998-Ford Motor Company provides a grant to GMU to support some continued research, as they plan to incorporate Interactive Management as a key component of Direct EngineeringT, Ford's TradeMark name for their systems engineering for automotive designs, aimed at keeping the company competitive for the foreseeable future. Warfield offers a short-course series for Ford engineers in Dearborn, and assists in planning a three-week project aimed at developing a plan whereby Direct EngineeringT will support the Ford GAP project: a project aimed at reducing the world-wide number of Ford "platforms" from about 32 to about 14.

1998-With the aid of the Ford grant, Warfield plans and offers a set of 12 "Complexity Lectures" as part of the Johnson Center's fall offerings, open to all who are interested, on or off campus . These lectures presage a planned book tentatively to be titled *A Science of Complexity*, hopefully to be written in 1999 and published in the year 2,000.