The Work Program of Complexity: Resolving Complexity Cooperatively

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TRANSPARENCIES

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

(First Draft)

SAMPLE IM WORKSHOP PLAN

LAST MINUTE ADDITIONS AS TRANSPARENCIES

PART 1. THE WORK PROGRAM OF COMPLEXITY

THE WORK PROGRAM OF COMPLEXITY

THE WORK PROGRAM TO RESOLVE THE PROBLEMATIC SITUATION INCORPORATES INTEGRATIVELY THESE FOUR COMPONENTS:

- **DESCRIPTION of the Situation**
- **DIAGNOSIS of the Situation**
- **PRESCRIPTION (DESIGN) for a new Situation**
- **IMPLEMENTATION (OF THE DESIGN) in the Situation**

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THE WORK PROGRAM OF COMPLEXITY IS DEFINED IN TERMS OF FOUR OUTCOMES

OUTCOMES → / BEHAVIORAL ↓	DESCRIPTION	DIAGNOSIS	PRESCRIPTION (DESIGN)	IMPLEMENTATION
INDIVIDUAL	■ Limits ■ Triadic Compatibility ■ Small Displays		■ Requisite Parsimony ■ Requisite Saliency	
SMALL GROUP	■ Limits ■ Uncorrelated Extremes	■ Inherent Conflict ■ Structural Under-Conceptualization ■ Diverse Beliefs	■ Requisite Variety ■ Induced Groupthink	
ORGANIZATION	■ Limits ■ Organizational Linguistics ■ Vertical Incoherence	■ Forced Substitution ■ Precluded Resolution ■ Vertical Incoherence		
PROCESSES	■ Limits ■ Triadic Necessity and Sufficiency ■ Universal Priors	■ Success and Failure ■ Universal Priors		■ Gradation ■ Validation

LAWS OF COMPLEXITY, STRUCTURED VERTICALLY BY BEHAVIOR AND HORIZONTALLY BY WORK OUTCOMES cow145H

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CHRONOLOGY: THE WORK PROGRAM OF COMPLEXITY

- An Observatorium is prepared to educate the Implementers, and to allow for broad understanding and amendment, if required. ▸▸
- The DELTA Chart is applied in the organization to guide the completion of the work program.

4

IMPLEMENTATION
by the ORGANIZATION
assisted by the
OBSERVATORIUM

- An Options Field is produced, based on the Design Strategy, using the Problem Categories from the Problems Field.
- An Enhancement Structure and Resolution Structure are prepared.
- Three Options Profiles are prepared by independent small groups.
- A composite Options Field is produced in a plenary session.
- Activities, Milestones, and a DELTA Chart are prepared. ▸▸

3

DESIGN

by the GROUP

2

DIAGNOSIS
by an INDIVIDUAL
using Diagnostic
Algorithms of IM

◂◂ • The indexes of complexity are computed, to compare with those of other problematic situations.

- The analysis of structural data for problems enables them to be categorized by impact, activity, etc..
- An interpretation of the Problematique is provided and assessed.
- A Design Strategy Document is prepared.

1

DESCRIPTION

by the GROUP

◂◂ • A comprehensive educational White Paper is prepared.

- An IM Workshop Plan is prepared.
- The process must annul individual and group pathologies.
- The problematic situation must be described adequately.
- Using IM, at a minimum the following belief structures are created: Problematique, Problem Field.

STATUS OF ROLES AT VARIOUS POINTS IN THE WORK PROGRAM OF COMPLEXITY

Elapsed Time is measured from the time when the IM work is approved and funded. The Events represent the beginnings and ends of the first three Phases in The Work Program of Complexity. Following these Events, the Implementation Phase begins. R-WIP means relatively well informed person. L-WIP means less well informed person. Cow150H

	BEGIN DESCRIPTION PHASE	END DESCRIPTION PHASE	BEGIN DIAGNOSIS PHASE	END DIAGNOSIS PHASE	BEGIN DESIGN PHASE	END DESIGN PHASE
IM LEADER	Has read White Paper and Workshop Plan & will manage IM Workshop	Has received the products: Problematique, Problems Field, Attributes Field (optional)	Applies structural diagnostic algorithms, computes Indexes of Complexity, and develops interpre-tation for group presentation	Makes group presentation, amends products if needed, writes Workshop Plan and White Paper for Design Phase	Manages IM Workshop	Receives products: Options Fields, Option Profile for chosen design, DELTA Chart for Design Action; Interprets, then receives Work Breakdown Notebook and puts products in Observatorium
R-WIP (PERSON)	Has read White Paper and Workshop Plan & will attend IM Workshop	Is provided with materials showing the group's products	Not required.	Is provided with the new White Paper, and new IM Workshop Plan	Is provided with materials showing the group's products	Is provided with materials showing the products the group has produced
L-WIP (PERSON)	Not yet involved	Not yet involved	Not yet involved	Not yet involved	Not yet involved	Enters training to learn the products, and explores the observatorium for its learning values
ESTIMATE OF ELAPSED DAYS	15 days	25 days	26 days	30 days	35 days	45 days

		OUTCOMES for the SITUATION			
		DESCRIPTION	INTERPRETATION/ DIAGNOSIS	DESIGN	IMPLEMEN-TATION
BEHAVIOR	PROCESS	1	2	3	4
	INDIVIDUAL	5	6	7	8
	GROUP	9	10	11	12
	ORGANIZATION	13	14	15	16

BEHAVIOR--OUTCOMES MATRIX (Understanding The ***Work Program of Complexity***)
Focusing on Interactions Between Human Behavior and Work Outcomes

Shaded Boxes are Most Critical for the Outcome in the Column.
A box with a heavy border identifies the dominant actor(s) for that box.

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PRODUCT FLOW IN INTERACTIVE MANAGEMENT AS IT IMPLEMENTS THE WORK PROGRAM OF COMPLEXITY

From the **PLANNING PHASE of INTERACTIVE MANAGEMENT:**	THE **DESCRIPTION PHASE OF THE WPOC** MAY YIELD THESE PRODUCTS:	THE **DIAGNOSTIC PHASE OF THE WPOC** MAY YIELD THESE PRODUCTS	THE **DESIGN PHASE OF THE WPOC** MAY YIELD THESE PRODUCTS	THE **IMPLEMENTATION PHASE OF THE WPOC** MAY YIELD THESE PRODUCTS
WHITE PAPER (WHAT IS KNOWN AND IS NOT CONTROVERSIAL ABOUT THE PROBLEMATIC SITUATION)				
WORKSHOP PLAN WHICH INCLUDES: • Scope Statement • Context Statement • Success Level • Triggering Questions • Generic Questions • IM Staff • IM Roles • IM Software • Participant List • Site of Work • Schedule of Work	• Problem Set • Clarified Problem Set • Partitioned Problem Set, P1 and P2 • Voting Record on Important Problems • Weighted Voting Scores for Important Problems • Problematique • Problem Field • Problem Categories	• Problem Influence Score • Problem Activity Score • Six Problem Status Categories • Categories Problematique • Interpretation Session for Participants • Computed Values of the Five Indexes of Complexity	• Options Field, Matching the Problem Categories • Two or Three Options Profiles • Integrated Option Profile • Enhancement Structure • DELTA CHART • Resolution Structure • Plausibility Structure	•Obervatorium • Traiing Programs • Model Management Plan and Action • Work Breakdown Notebook

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ORGANIZATIONS

FIELD OF POSSIBILITIES FOR CONSIDERING COMPLEXITY IN ORGANIZATIONS

A. PRESENT CONTEXTS	B. CONTENT (KNOWLEDGE)	C. PROCESSES (BEHAVIOR)	D. OUTCOMES
■ The Focus Organization (us)	■ Recently-Locally-Generated	■ Normal	■ For Customers or Clients
■ External Constraints (Laws, Regulations, Finance, Competition)	■ Recently-Externally-Generated	■ Complexity-Oriented	■ Normal for the Organization
■ Internal Infrastructure	■ Organizational Memory	■ Other	■ Complexity-Focused for the Organization
■ External Opportunities (Customer or Client Possibilities)	■ Timeless (Globally-Generated)		■ Other
■ Articulated Future Organizational Vision	■ Other		
■ Micro-Infrastructure (Daily Working Spaces)			
■ Other			

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FOR JOINT DISCUSSIONS:

This Field of Possibilities is intended to stimulate thoughtful consideration of how *complexity is dealt with in organizations*, with recommended emphasis on the shaded components.

REQUIREMENTS

CRITICAL CONCEPTS SHALL BE INCORPORATED

- ☺ REPRESENTATION
- ☺ SITUATION
- ☺ SCIENCE
- ☺ SYSTEMS SCIENCE
- ☺ COMPLEXITY
- ☺ SYSTEM

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INTERACTIVE MANAGEMENT (IM)

WHAT IS INTERACTIVE MANAGEMENT ?

Interactive Management **(IM)** is a **system** of management invented explicitly to apply to the **management of complexity**. It is intended to be applied intermittently in organizations to enable those organizations to cope with ***issues or situations whose scope is beyond that of the normal type of problem that organizations can readily solve.***

MGW005H

WHY INTERACTIVE MANAGEMENT ?

The **development of IM** is based on the recognition that, **for coping with a problematic situation**, there is a need for **a group of people**, knowledgable of that situation, to tackle together the main aspects of concern, to develop a deep understanding of the situation under analysis, and to elaborate the basis for effective action; all these founded in a spirit of collaboration and commitment, within the framework of a serious and organized effort.

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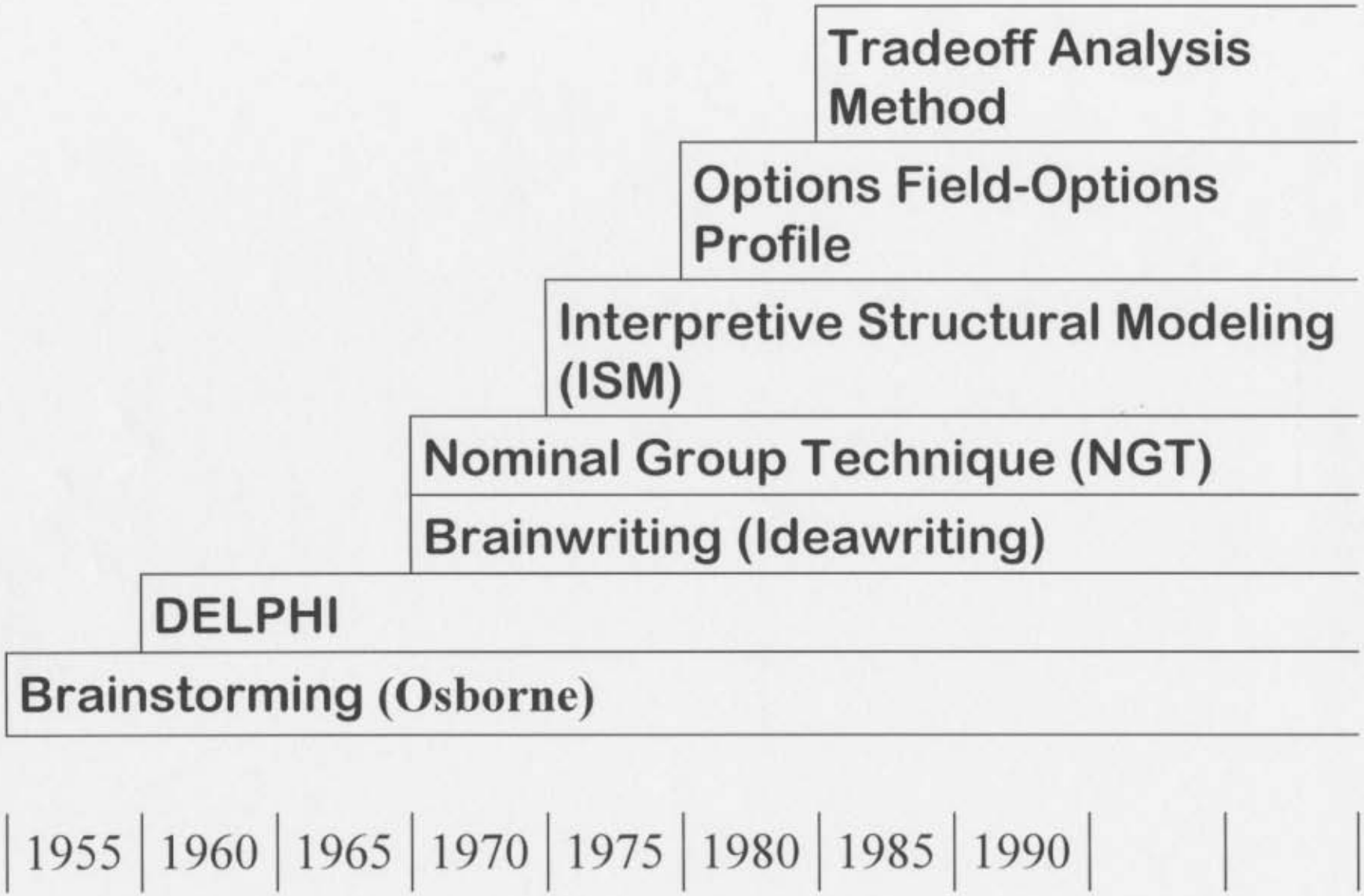

EVOLUTION OF CONSENSUS METHODOLOGIES

SOME CENTERS OF IM ACTIVITY (Now or earlier)

- Tata Consultancy Services, Hyderabad, India
- George Mason University, Fairfax,Virginia
- Instituto Tecnologico y de Estudios Superiores de Monterrey (ITESM), Mexico
- Christakis, Whitehouse, and Associates, Berwyn, PA
- Defense Systems Management College, Fort Belvoir, Virginia
- City University (London, England)
- National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California
- Florida Division of Forestry, Tallahassee, Florida
- Decision-Making Technologies, Dunrobin, Ontario, Canada
- University of Cape Town, Cape Town, South Africa
- Instituto de Administração, University of São Paulo, Brazil
- Ford Motor Company, Dearborn, Michigan
- National Railroad Passenger Corporation (AMTRAK), Washington, D. C.
- Fairfax County Park Authority, Fairfax, Virginia
- Americans for Indian Opportunity, Washington, D. C.
- Office of the Inspector General, Department of Defense, Washington, D. C.
- Schering-Plough Pharmaceuticals, New Jersey
- Chihuahua, Mexico, Planning Authority
- U. S. Food and Drug Administration, Washington, D. C.
- U. S. Department of Energy, Washington, D. C.

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INTERACTIVE MANAGEMENT (IM) IS DIFFERENT FROM ALL OTHER SYSTEMS CONCEPTS BECAUSE OF SIX FACTORS:

♦***BEHAVIOR.*** It incorporates the conclusions of research on human behavior, as **individuals**, in working **groups, and in organizations**

♦***LOGIC.*** It is founded in and enables the easy use of formal logic for organizing belief

♦***SCIENTIFIC.*** Its development is based in the scientific tradition:(a) hypotheses, (b) testing, c) analyzing, and (d) amending as needed

♦***MUCH TESTING.*** It has been tested in many locations by many different groups, working with many different subjects

♦***EMPHASIS ON COMPLEXITY.*** It is designed to apply **specifically** for working with complexity

♦***MEASURING COMPLEXITY.*** It provides five numerical indexes of complexity to show how a particular topic relates to other topics involving complexity

IMW038

UNIQUENESS OF IM

- It has **never** been discussed in the Harvard Business Review, or in any other management-oriented journal, in any authoritative way.
- It embodies a **powerful relational learning construct** called "Structural Thinking."
- It enables Structural Thinking, through its use of "Interpretive Structural Modeling", supported by **facilitation and a software package**.
- It is specifically oriented toward complexity, capable of being recognized through use of the Situational Complexity Index.
- It has **both** been thoroughly tested and validated, and it is highly-articulated.
- It is based in an **articulated science**.

HOW INTERACTIVE MANAGEMENT ENABLES INSTITUTIONALIZATION OF THE SENGE FIVE DISCIPLINES

DISCIPLINE	*INTERACTIVE MANAGEMENT ENABLING FUNCTION*
Building *Shared Vision*	The processes used in Interactive Management are all participatory and constructive. They provide the basis for the collective design of the shared vision. Videotaping of the participative activity provides a seen/heard record of the generation, clarification, organization, representation, and logic of the shared vision. This allows anyone to learn the shared vision and to comprehend its interpretation, as well as to offer any envisioned modifications to this vision. Written prose interpretation, based on the group products, enables a high-quality presentation of the shared vision to be documented for anyone's inspection.
Surfacing, Scrutinizing, and Correcting *Mental Models*	Detailed data from application of Interactive Management in many applications involving many different groups reveals that virtually all mental models are in conflict, and that none of them are "correct". The processes including the dialog enables incorrect presuppositions and suppositions to be drawn out, discussed, and amended. The disciplined participatory processes enable discovery by the participants of new information, reinforcement of correct information, and amendment or elimination of incorrect information. Documentation allows for inspection by others who may have particular expertise that could be introduced to enhance quality.
High-quality Dialog for *Team Learning*	Interactive Management processes focus, guide, and manage high-quality dialog. Data from past applications reveal the extensive learning that occurs from the in-depth investigations that are carried out participatively, using the Interactive Management processes.
Individual Development of *Personal Mastery*	Behavior of individuals in groups is generally unsatisfactory and undisciplined; and is subject to individual abuse. The disciplined processes of Interactive Management are designed to eliminate the many kinds of abuse that trigger undesirable behaviors. The examples set for individual participation in group effort promote the development of individual discipline, and facilitate the exercise of personal ability and knowledge in an acceptable mode.
Systems Thinking (the "Fifth Discipline" that integrates the other four disciplines)	The entire framework of Interactive Management is consciously designed to provide the benefits of integrative systems thinking. The total permeation of the impact of systems thinking not only makes the processes effective, but enables the participants to contribute to integrative system products that exceed in quality what any individual's knowledge would singly support. The types of representations that are part of the product of Interactive Management activity offer unique ways to present integrative images of complex issues, showing the impact of systems thinking on what otherwise would be a disconnected or misconnected set of ideas.

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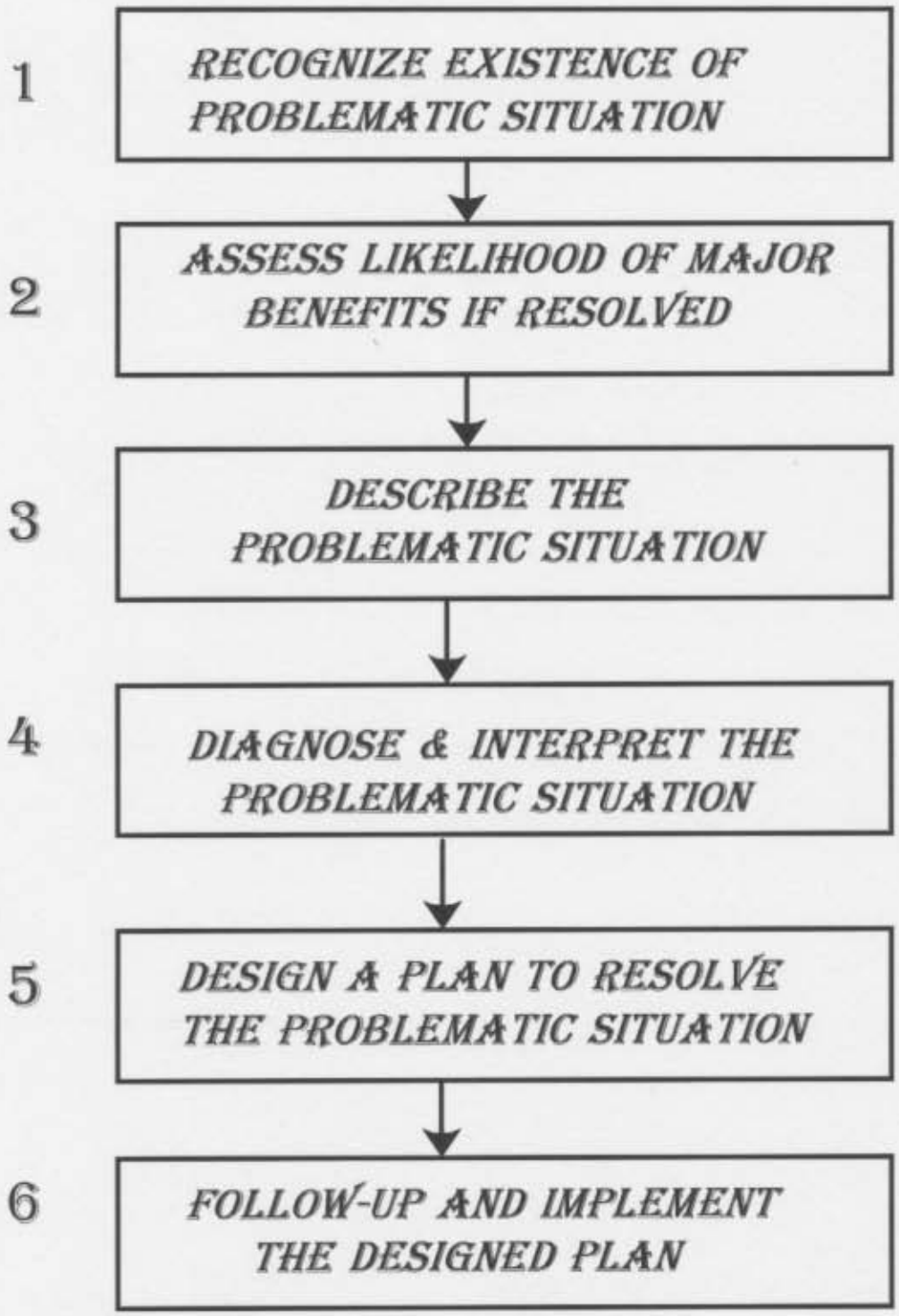

Figure 14. **THE SIX STEPS IN APPLYING INTERACTIVE MANAGEMENT**

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NOTES ON THE SIX STEPS IN APPLYING INTERACTIVE MANAGEMENT

STEP	NOTES
1. RECOGNIZE EXISTENCE OF A PROBLEMATIC SITUATION	CLUE: A persistently annoying situation has not been resolved, even after several attempts. There are many different views on what should be done.
2. ASSESS LIKELIHOOD OF GAINING MAJOR BENEFITS IF THE PROBLEMATIC SITUATION CAN BE RESOLVED	DECISION CRITERION: Many valuable benefits are envisaged, if the situation can be resolved (otherwise IM is not needed, and would cost too much to try in relation to the minor benefits).
3. *DESCRIBE* THE PROBLEMATIC SITUATION	DEVELOP the *Problematique* and the *Problem Field*.
4. *DIAGNOSE & INTERPRET* THE PROBLEMATIC SITUATION	COMPUTE values for the five *Indexes of Complexity* and compare them with historical values. ANALYZE the *Problematique*, and CLASSIFY the *Problems* Contained in it as Critical, Underrated, Overrated, Cyclic, High Activity, and High-Weighted. WRITE the *interpretation* and *diagnosis* with reference to the values and the analysis. ASSESS past results and amend, if needed.
5. *DESIGN* A PLAN TO RESOLVE THE PROBLEMATIC SITUATION	DEVELOP the *Options Field, Attributes Field*, the *Enhancement Structure*, and two or three versions of the *Options Profile* to enable design comparisons. CHOOSE one alternative *Options Field*, and DEVELOP the *DELTA Chart* as the plan for implementation.
6. FOLLOW-UP AND *IMPLEMENT* THE DESIGNED PLAN	*COMPLETE the Work Breakdown Notebook and ORGANIZE* to activate the *DELTA Chart* and to oversee the work.

IMW032H

EXAMPLE IM PRODUCTS (APPLICATION STRUCTURAL TYPES, WHICH ARE QUALITATIVE RELATIONAL DIAGRAMS OR MAPS)

- Problematique
- Field Representation
- Options Field (Triply-Structured Quad)
- Profile Representation (A Design Alternative)
- Enhancement Structure
- Priority Structure
- DELTA Chart
- Resolution Structure
- Intent Structure
- Curriculum Structure
- Plausibility Structure
- Tapestry of Quads
- Comparison Bar Charts
- Unified Program Planning Linked Matrices
- Others

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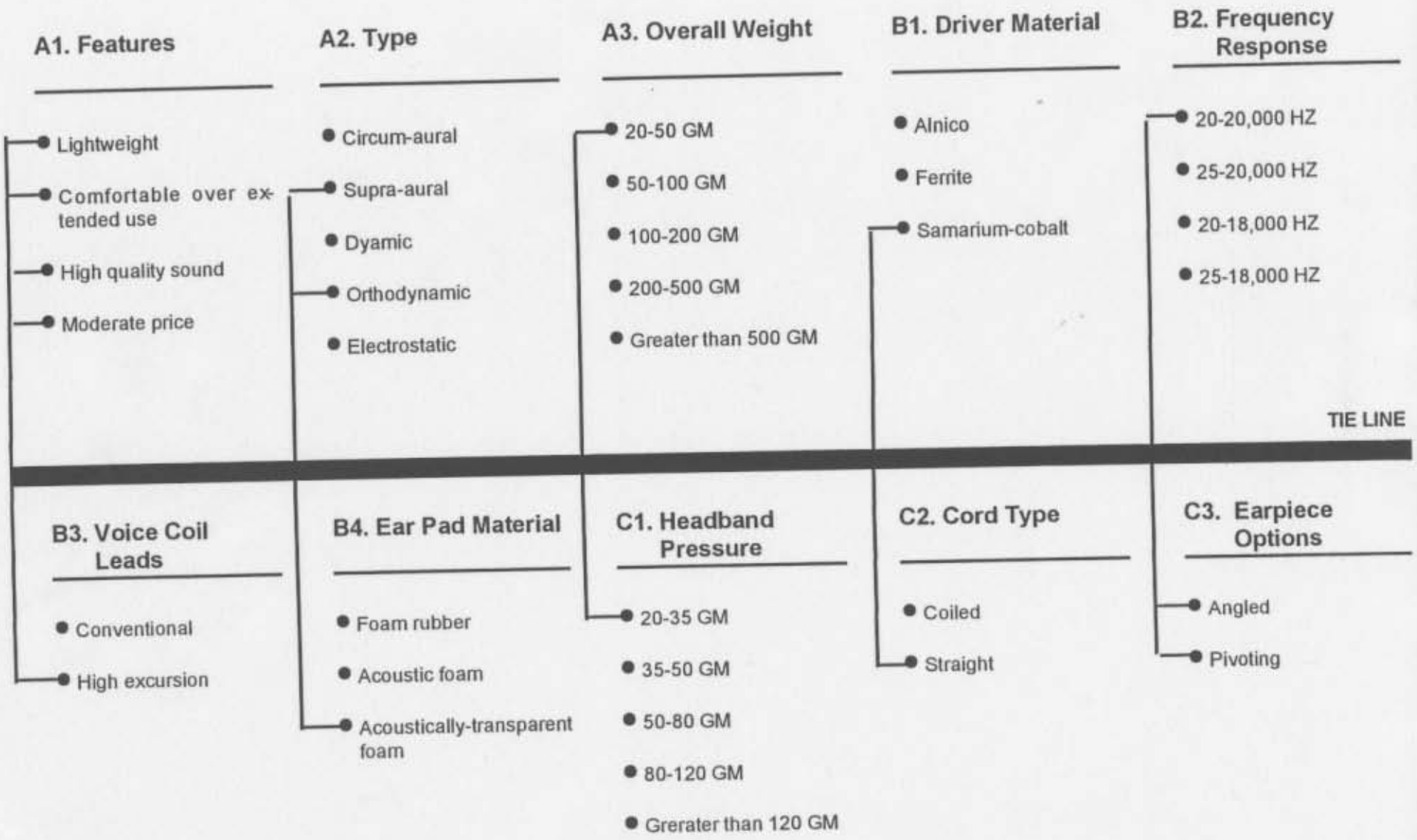
Once the design has been accepted, the observatorium is designed and established so that people can walk through a sequential learning experience, in which they gain both an overview and an in-depth understanding of the system that has been designed and which, most likely, will be prominent in their own lives. The observatorium is a piece of real estate, whose building interior can be loosely compared with that of the Louvre, in that it contains a variety of rooms, and facilitates rapid familiarization with their contents by the persons who walk through that property.



Second-Year engineering student's retrospective options profile for portable stereo system.

FIVE INDICES OF COMPLEXITY

- ☺ THE MILLER INDEX
- ☺ THE SPREADTHINK INDEX
- ☺ THE DEMORGAN INDEX
- ☺ THE SITUATIONAL COMPLEXITY INDEX, SCI
- ☺ THE ARISTOTLE INDEX

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IM OPTIONS FIELD (part 1 of 3). CHOOSE OPTIONS TO CREATE OPTIONS PROFILE.

A. PHASE SELECTED	B. OUTCOME SOUGHT	C. SUCCESS LEVEL	D. STEERING FACTOR
■ Planning Phase	■ Isssue or System Definition	■ Level 1	■ Context Statement
■ Workshop Phase	■ Alternative Designs	■ Level 2	■ Triggering Questions
■ Followup Phase	■ A Chosen Alternative	■ Level 3	■ Generic Questions
	■ Workshop Plan	■ Level 4	■ A White Paper
	■ Implementation	■ Level 5	■ A Workshop Plan
			■ A Workshop Report

(Selected Options could be ***highlighted and italicized***)

IM OPTIONS FIELD (part 2 of 3). *CHOOSE OPTIONS TO CREATE OPTIONS PROFILE*

E. IM ROLES

- Client
- Sponsor
- Broker
- Participant
- Wkshp Planner
- IM Facilitator
- Pattern Interpreter

E. IM ROLES (cont.)

- Report Manager
- Workshop Observer
- Facility Preparer
- Computer Operator
- Video Operator
- Display Arranger
- Recorder (Scribe)

F. IM PROCESSES

- Ideawriting
- Enhanced NGT
- ISM
- DELPHI
- Field Development
- Profile Development
- Tradeoff Analysis

IM OPTIONS FIELD (part 3 of 3). CHOOSE OPTIONS TO CREATE AN OPTIONS PROFILE

G. PRODUCTS SOUGHT

- DELTA Chart
- Problematique
- Enhancement Structure
- Intent Structure
- Priority Structure
- Resolution Structure
- Curriculum Structure
- Newly-Identified Structural Type

G. PRODUCTS SOUGHT (cont.)

- Options Field
- Problems Field
- Options Profile
- Attributes Profile
- Tapestry of Quads
- Comparison Bar Charts
- Unified Program Planning Linked Matrices (QFD-Like)

REPRESENTATIONAL TYPE

- Box-Arrow
- Field
- Profile
- Tapestry

RELATIONSHIP TYPE

- Influence
- Definitive
- Temporal
- Spatial
- Comparative
- Formal Mathematical

ELEMENT TYPE

- Problem
- Option
- Intent
- Activity
- Event
- Decision
- Logic

RELATION TYPE

- Hierarchical
- Cyclic
- Hybrid

TIE LINE

PRESENTATION STYLE

- Stage (Box-Arrow)
- Level (Box-Arrow)
- Tabular

CARDINALITY OF REPRESENTATION ELEMENT TYPES

- 1
- 2
- 3
- 4
- 5

CARDINALITY OF REPRESENTATION RELATIONSHIP TYPES

- 1
- 2
- 3
- 4
- 5
- 6

APPLICATION STRUCTURAL TYPE

- Problematique
- DELTA Chart
- Enhancement Structure
- Intent Structure
- Resolution Structure
- Priority Structure
- Curriculum Structure
- Options Field
- Problems Field
- Attributes Field
- Options Profile
- Tapestry

TIE LINE (continued)

OPTIONS FIELD FOR STRUCTURAL GRAPHICS, tmw014G

(Generic form, adaptable to different structural types. The chosen options would be highlighted and italicized.)

REPRESENTATIONAL TYPE	RELATIONSHIP TYPE	ELEMENT TYPE	RELATION TYPE
• ***Box-Arrow***	• ***Influence***	• ***Problem***	• Hierarchical
• Field	• Definitive	• Option	• Cyclic
• Profile	• Temporal	• Intent	• ***Hybrid***
• Tapestry	• Spatial	• Activity	
	• Comparative	• Event	
	• Formal Mathematical	• Decision	
		• Logic	

TIE LINE

PRESENTATION STYLE	CARDINALITY OF REPRESENTATION ELEMENT TYPES	CARDINALITY OF REPRESENTATION RELATIONSHIP TYPES	APPLICATION STRUCTURAL TYPE
• ***Stage*** (Box-Arrow)	• ***1***	• ***1***	• ***Problematique***
• Level (Box-Arrow)	• 2	• 2	• DELTA Chart
• Tabular	• 3	• 3	• Enhancement Structure
	• 4	• 4	• Intent Structure
	• 5	• 5	• Resolution Structure
		• 6	• Priority Structure
			• Curriculum Structure
			• Options Field
			• Problems Field
			• Attributes Field
			• Options Profile
			• Tapestry

TIE LINE (continued)

OPTIONS PROFILE FOR PROBLEMATIQUE, © 1994, John N. Warfield imw015G

(Highlighted and italicized options are those selected.) C:\MyFiles\INVN1999\Courses\ERNZENShortCourse\WorkPrograms-ResolvingComplexityCoop.wpd

REPRESENTATIONAL TYPE

- Box-Arrow
- ***Field***
- Profile
- Tapestry

RELATIONSHIP TYPE

- ***Influence***
- ***Definitive***
- ***Temporal***
- Spatial
- Comparative
- Formal Mathematical

ELEMENT TYPE

- Problem
- ***Option***
- Intent
- Activity
- Event
- Decision
- Logic
- ***Dimension (Validated Category)***

RELATION TYPE

- Hierarchical
- Cyclic
- ***Hybrid***

TIE LINE

PRESENTATION STYLE

- Stage (Box-Arrow)
- Level (Box-Arrow)
- ***Tabular***

CARDINALITY OF REPRESENTATION ELEMENT TYPES

- 1
- ***2***
- 3
- 4
- 5

CARDINALITY OF REPRESENTATION RELATIONSHIP TYPES

- 1
- 2
- ***3***
- 4
- 5
- 6

APPLICATION STRUCTURAL TYPE

- Problematique
- DELTA Chart
- Enhancement Structure
- Intent Structure
- Resolution Structure
- Priority Structure
- Curriculum Structure
- ***Options Field***
- Problems Field
- Attributes Field
- Options Profile
- Tapestry

(Chosen Options are Highlighted and Italicized.)

TIE LINE (continued)

OPTIONS PROFILE FOR OPTIONS FIELD, © 1994, John N. Warfield imw017G

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REPRESENTATIONAL TYPE	RELATIONSHIP TYPE	ELEMENT TYPE	RELATION TYPE
• ***Box-Arrow***	• Influence	• Problem	• Hierarchical
• Field	• Definitive	• ***Option***	• Cyclic
• Profile	• ***Temporal***	• Intent	• ***Hybrid***
• Tapestry	• Spatial	• ***Activity***	
	• Comparative	• ***Event***	
	• ***Formal Mathematical***	• ***Decision***	
		• ***Logic***	

TIE LINE

PRESENTATION STYLE	CARDINALITY OF REPRESENTATION ELEMENT TYPES	CARDINALITY OF REPRESENTATION RELATIONSHIP TYPES	APPLICATION STRUCTURAL TYPE
• ***Stage*** (Box-Arrow)	• 1	• 1	• Problematique
• Level (Box-Arrow)	• 2	• ***2***	• ***DELTA Chart***
• Tabular	• 3	• 3	• Enhancement Structure
	• 4	• 4	• Intent Structure
	• ***5***	• 5	• Resolution Structure
		• 6	• Priority Structure
			• Curriculum Structure
			• Options Field
			• Problems Field
			• Attributes Field
			• Options Profile
			• Tapestry

TIE LINE (continued)

OPTIONS PROFILE FOR DELTA CHARTS, © 1994, John N. Warfield, Cow016G
(Highlighted and italicized Options are those selected.)

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

First Draft, to be updated as time permits

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

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

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 --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 help from The Menninger Clinic)

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 Colubmus) 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 the Battelle research carried out during the period 1968-1974; this being done under a contract with Batttelle. 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 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, 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 to Riyadh, Saudi Arabia, to present a one-week workshop on Consensus Methodologies for the Saudi Arabian National Center for Science and Technology, organized through the US National Science Foundation.

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

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 at IBM-Rio de Janeiro) as part of its gift to the University. A workshop is held 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 ofVirginia, 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 having to do with medicine.

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 sponsorship of 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.

1988–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 symbol IASIS). Warfield is the Director of IASIS.

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 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 signed by scholars from several nations proclaiming the necessity for incorporating system design in higher education.

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 Tecnologico 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 the Provost 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) initiates a 3-year sponsored program at GMU to teach their 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 for publication. 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 that the publisher is not responsive.

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–Dr. Surinder K. Batra 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 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 Tecnologico 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 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**

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.

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 continued research, as they plan to incorporate Interactive Management as a key component of *Direct Engineering*™, 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 Engineering*™ 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 to be titled *A Science of Complexity*, hopefully to be written in 1999 and published in the year 2,000.

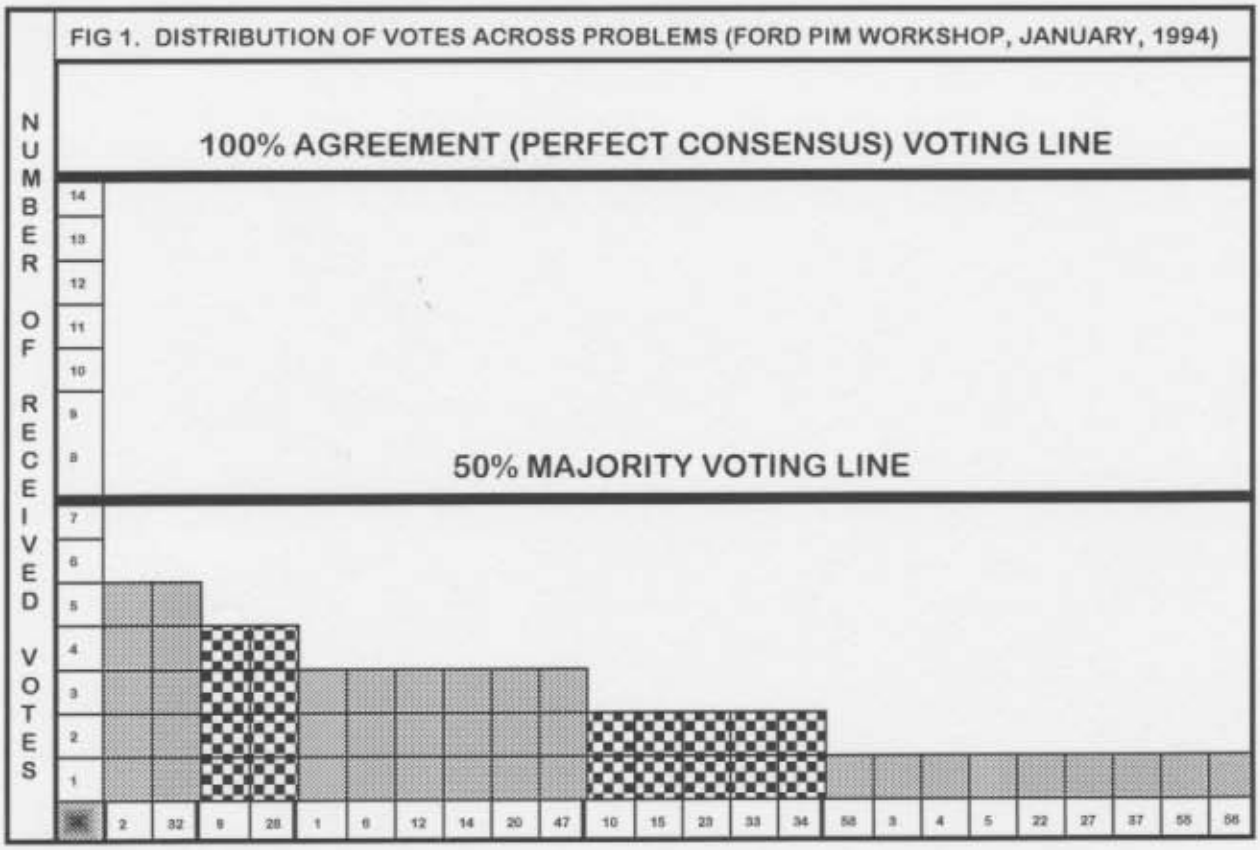


Figure 1 shows a bar chart of voting records for a project in which there were 14 participants. Each participant was asked to privately select 5 problems from a large set which that person thought were the 5 most important.

On this bar chart, the number of votes received is shown along the vertical axis. The problem number (e.g., Problem Number 2) is shown along the horizontal axis.

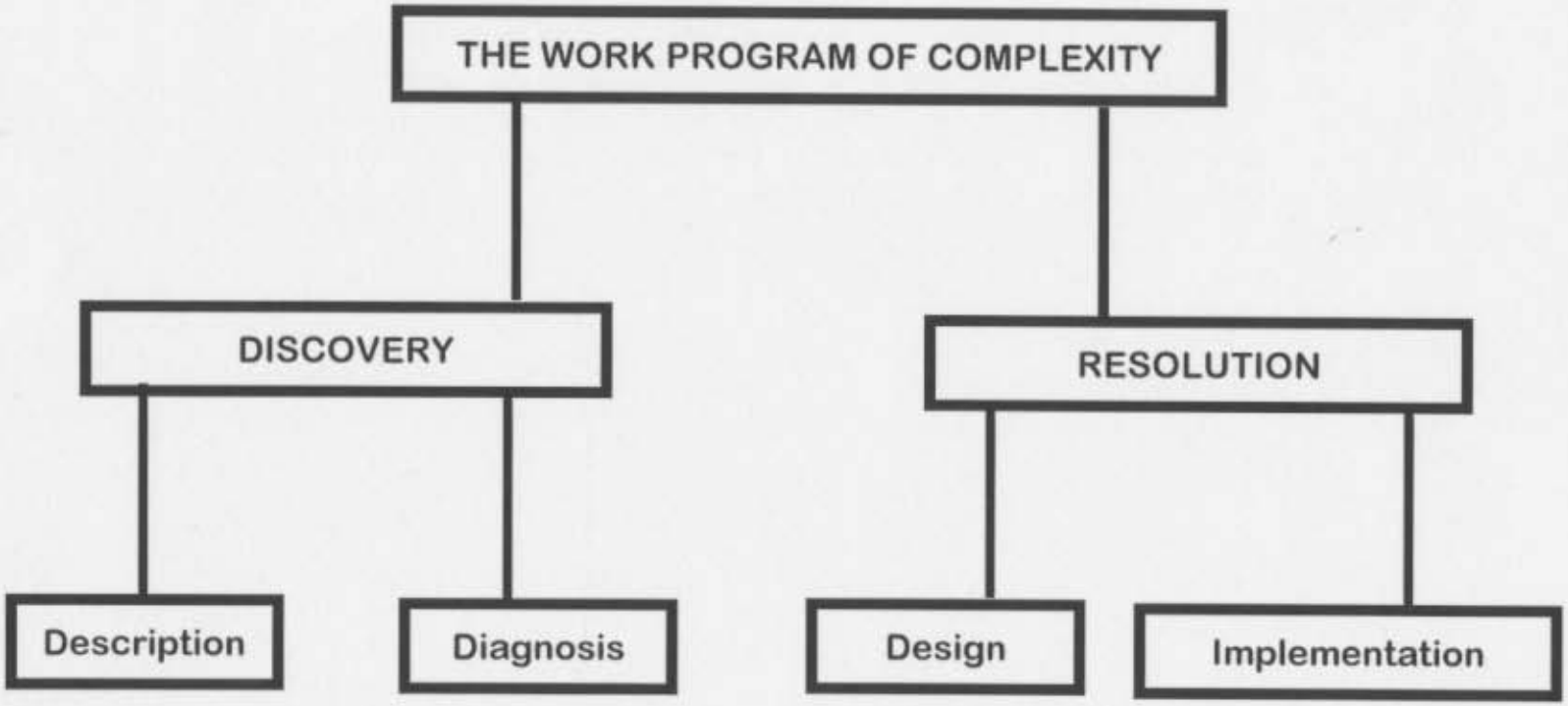
Any problem that received votes from at least 50% of the participants would show a bar that reaches or goes above the line labeled "50% majority voting line". Clearly no problem got even half of the possible votes, the maximum number being 5 votes, received by Problem 2 and Problem 32.

A total of 24 problems received votes. If everyone was in agreement, only 5 problems would have received votes, and each of them would have received 14 votes. The bars for these 5 problems would then reach to the line marked "100% Agreement (Perfect Consensus).

This Figure is a graphical portrayal of "Spreadthink".

STRUCTURE OF THE WORK PLAN FOR UNDERSTANDING AND RESOLVING COMPLEXITY

January, 1999—John N. Warfield



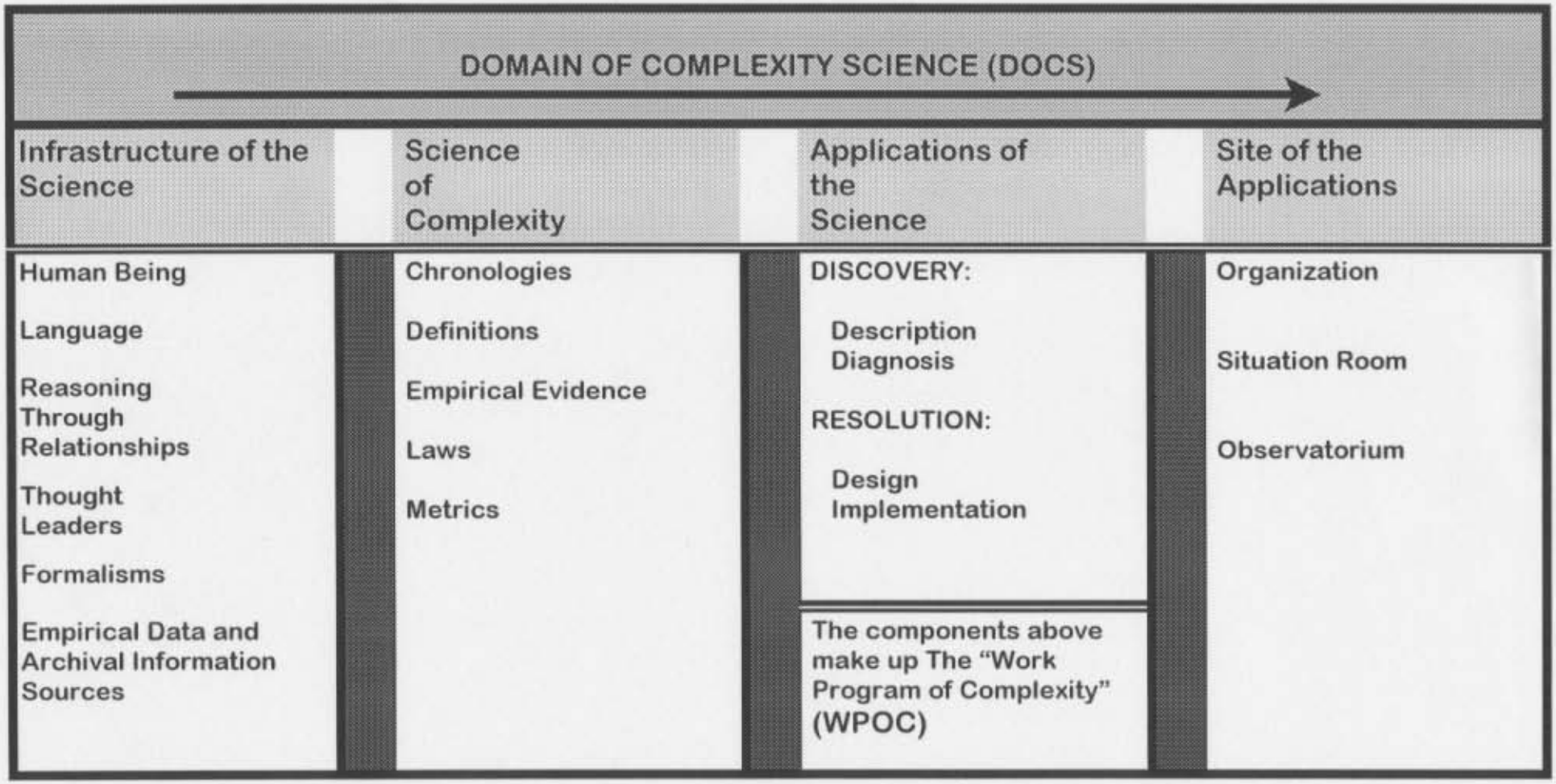
SECOND ORDER THOUGHT

IS

THOUGHT

ABOUT THOUGHT

(AS A PROCESS, NOT IN TERMS OF ITS CONTENT)



EMPHASIZING THE FOUR AREAS OF THE DOMAIN OF COMPLEXITY SCIENCE (DOCS) AND THEIR PRINCIPAL COMPONENTS

John N. Warfield, January, 1999

CONCEPTS INVOLVED IN DISCOVERY IN THE WORK PROGRAM OF COMPLEXITY

Part 1: Description

Context: The Problematic Situation

Unit of Analysis: The Problem

Products:

- **The Problem Set**
- **The Problem Field**
- **The Problem Profile**
- **The Type 1 Problematique**
- **The Type 2 Problematique**

These products form the basis for Part 2: Diagnosis of the Problematic Situation.

CONCEPTS INVOLVED IN DISCOVERY IN THE WORK PROGRAM OF COMPLEXITY

Part 2: Diagnosis

Context: The Problematic Situation

Unit of Analysis: The Problematiques

Products:

- **Classification of Problem Types**
- **Matching Problem Categories to Organizational Components**
- **Values of the Situational Complexity Index and the Aristotle Index**
- **Assessment of Relative Complexity of the Problematic Situation**

These products form the basis for the RESOLUTION Component of the WPOC.

SHEET MUSIC AS A LANGUAGE

- ✓ *Translatability*. It is unambiguously translatable into prose
- ✓ *Sensitivity*. It is designed to incorporate knowledge of human limitations
- ✓ *Training*. It requires some training in order to interpret what is said
- ✓ *Culture-Insensitive*. It is under- standable in most cultures
- ✓ *Time-Insensitive*. It retains meaning across the centuries

In short: As a language it is wonderfully-constructed to match the human being at the interface through space and through time. These features make it a template or prototype for languages to be used in communication of complexity.