SEVEN CHALLENGES

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ABSTRACT

Seven challenges are set forth for systems scholars and practitioners. Each of them is known to be feasible. If all of them are taken up collectively, the future of systems science will be bright. It is an open question whether members of the systems community will take up these challenges. The challenges are:

- To incorporate and apply the results of more than 2,300 years of study of second-order thought (i.e., thought about thought)
- To incorporate and apply the results from at least 20 studies of behavioral pathologies which, if not incorporated, will always affect adversely the quality of systems practice
- To contribute to the development of an essential discursivity in the language of systems science, without which no significant advances can be made in this science
- To recognize and insist on the application of available quality-control principles in modeling, in design, and in strategy development
- To use available metrics of complexity for purposes of comparison of different

Sent this copy to Ernesto Grün Nov 17 2002 problematic situations, and for interpretation of the metrics in applications

- To recognize and implement physical infrastructure requirements for working with complexity
- To gain the composite effect of accepting all these challenges, i.e., to enhance the conduct of effective systems practice, and to help establish and maintain systems programs in education that are demonstrably based in systems science

SYSTEMS SCIENCE AND HUMAN SCIENCE

Systems science lacks a clear image. But it must be evident to all with a strong interest in systems that systems science must be a human science; i.e., it must both incorporate what is known about human behavior that is relevant to systems practice and it must be applicable to resolve problematic situations of greatest importance to human beings.

Human science can be said to fall within three levels: macro, micro, and middle. Middle human science is defined as what must lie between the macro and the micro. Macro human science typically offers grand, universal, theories. They are too broad to be applied locally, and it is usually easy to see exceptions to the generalities. Micro human science typically involves numerical outputs that are too narrow in scope to be applied to most problematic situations.

Middle human science is a science of logic patterns, locally generated and interpreted, and being broadly applicable to many or most problematic worldly situations wherever they arise. But this aspect of middle human science, i.e., of what systems science ought to be, is seldom recognized. Yet the concept is supported by major areas of published research. With the goal of getting broader recognition for systems science, seen from this perspective, seven challenges are set forth for the systems community.

CHALLENGE NUMBER ONE:
SECOND-ORDER THOUGHT

To incorporate and apply the results of more than 2,300 years of study of second-order thought (i.e., thought about thought).

Second-order thought is thought about thought. No science can be conceived or developed without thought. Every science involves relationships among components that make up the vista of the science. How ironic that the work of Augustus De Morgan in developing the theory of relations continues to be ignored more than 150 years after it was published. De Morgan was not alone in contributing to thought about thought. Other contributors included (chronologically) Aristole, Abelard, Leibniz, Boole, Peirce, and Harary).

This work, in its most advanced form, now enables working teams to structure their thought, using the principles devised by those mentioned here, assisted by the Interpretive Structural Modeling process, converted into computer form. An example of an application in second-grade instruction was developed by Takahiro Sato of Nippon Electric Company, in collaboration with school teachers, showing the difficult nature of the teaching of fractions. These principles have been applied in hundreds of worldly problematic situations, but with few and notable exceptions they have *not* been applied to structure learning in higher education. The opportunity cost of not doing so must be extremely high.

CHALLENGE NUMBER TWO:
BEHAVIORAL PATHOLOGIES

To incorporate and apply the results from at least 20 studies of behavioral pathologies which, if not incorporated, predict low quality of systems practice.

In contrast to the study of second-order thought, which transpired over more than two millennia, the identification of human behavioral pathologies, as they relate to working with complexity, is essentially a set of twentieth-century phenomena. Some of the names of those scholars who have contributed to this branch of knowledge are H. Alberts, G. Allison, C. Argyris, R. Bales, K. Boulding, A. Downs, I. Janis, H. Lasswell, G. Miller, H. Simon, B. Tuckman, and G. Vickers.

Their results show the impact of behavioral pathologies at the level of the individual, the small group, and the large organization. Well-identified factors in human behavior that lead to very poor performance and broad-scale disagreements are well known. Yet the systems community, and many of its practitioners, seem to be unaware of the composite impact of these pathologies. They are seldom taught in systems curricula as an integrated and important component. But they are one of the principal reasons why systems science must be a human science, developed and applied by human beings for human beings.

CHALLENGE NUMBER THREE:
DISCURSIVITY

To contribute to the development of an essential discursivity in the language of systems science, without which no significant advances can be made in this science.

The language of systems science eludes discursivity. It is disparate in its appearances, and disconnected in its essence. Willingness to tolerate this kind of diversity in language is itself intolerable; because without it practitioners cannot evidence the broad applicability that systems science ought to represent. Moreover, the absence of discursivity, more than any other aspect, works against the incorporation of systems science in the curricula of higher education.

CHALLENGE NUMBER FOUR: QUALITY-CONTROL PRINCIPLES

To recognize and insist on the application of available quality-control principles in modeling, in design, and in strategy development.

Perhaps the most vital products of systems science are models; models of structure of problematic situations. Structure enables focus and facilitates group activity based on solid understanding. But far too many of the models put forth by theorists and practitioners alike eschew any semblance of overt quality control.

Of all the attributes one may expect from a model, consistency is probably the most significant. For problematic situations, it is almost never possible to prove completeness (for lack of a stopping rule), and consequently it is almost never possible to prove correctness. Even so, systems science would be largely useless without a capacity to develop models to organize human thinking. Hence the importance of consistency.

Three theorems (which may also be called "laws") are critical to quality control in model development. George J. Friedman has developed a theorem that explains why a modeling process that fractionates the model development into components will often produce inconsistent models. This defect would be true, even if all the components were individually consistent, for, as Friedman's *Theorem of Non-Assured Conservation of Consistency* shows, there is no assurance that a model found by interconnecting a set of consistent submodels will be consistent.

Harary's *Theorem of Assured Model Consistency*, on the other hand, offers a guarantee of model consistency, if the process of developing the model is done according to this theorem. Since the Interpretive Structural Modeling (ISM) process is based on his theorem, it guarantees model consistency if it is used to structure the model.

Ashby's well-known *Law of Requisite Variety* is important in design. If a consistent model of the problematic situation has been found, Ashby's Law enables the matching of design dimensions with dimensions of the worldly situation.

These three theorems alone are sufficient to carry model development a long way. Regretfully, there is little evidence that any of them are being used in most public system designs of the type produced through conversation in legislative bodies.

It goes without saying that there is a golden opportunity for practitioners of systems science to contribute greatly to the human condition by helping to assure that these quality-control theorems are applied in the design of institutions and public processes.

CHALLENGE NUMBER FIVE:
METRICS OF COMPLEXITY

To use available metrics of complexity for purposes of comparison of different problematic

situations, and for interpretation of the metrics in applications.

Complexity involves large-scale worldly situations. We mere mortals need all the help we can get in understanding and interpreting these situations. Moreover we are constantly bedeviled by those to whom only numbers are meaningful. I speak here of the positivists who, extending forward in time from the birth of positivism in Paris under the aegis of Auguste Comte, regularly want to apply numerical analysis and statistics, while rejecting all other means to demonstrate understanding including, amazingly, the application of formal logic which necessarily underpins all models in one way or another.

Two highly-renowned scholars offered excellent adjuncts to the use of numbers in developing understanding. These are Michel Foucault and Ludwig von Mises; the one a historian, the other an economist. Foucault spoke of problemization as a key to portraying history, while Mises coined the term "thymology" to represent "an offshoot of introspection and...a precipitate of historical experience."

Nonetheless, one should not avoid numbers if they can be helpful in developing understanding. The five metrics of complexity discovered so far have been found very helpful, because they enable us to compare different situations as to the level of complexity involved. Moreover they help us understand why a problematic situation is so difficult. The Aristotle Index, for example, enables us to see precisely why it is virtually impossible for a single individual to develop a thorough understanding of a worldly problematic situation, and how the combined work of a team of people with different perspectives can be organized into a tight logic pattern that reveals what is going on in that situation better than any solution of any differential equation is likely to do, standing alone.

Because of the demonstrated merit of these indexes, three of them have been assigned names corresponding to the researchers whose contributions they reflect: Miller Index, after George Miller; De Morgan Index, after Augustus De Morgan; and Aristotle Index. The Spreadthink Index reflects a discovery concerning why so much disagreement is always found in group work involving complexity. The Situational Complexity Index reflects the compounding effect of three of the other indexes.

CHALLENGE NUMBER 6: PHYSICAL INFRASTRUCTURE

To recognize and implement physical infrastructure requirements for working with complexity.

People are so accustomed to working in the same kind of limited physical space whether the subject of their activity is modest in scale or large in scale that it must be a surprise to learn that experimental evidence shows the necessity of using specially-designed infrastructure in order to work successfully with worldly problematic situations. This need was described many years ago by Harold Lasswell, but was apparently shrugged off by his colleagues, who ought to have known better. Two types of facility are required for overall effectiveness, although gains can be made if only the first type is used. The names given to these physical facilities are: "situation room" and "observatorium".

The first of these is used for group work in creating structures that describe and design whenever complexity is involved. The second is used for educational purposes to enable people who were not involved in the construction of carried out by a working group to learn the group's products, and the effort that went into developing them. The second also offers, because it displays the various products, the opportunity to assess their quality and to amend if amendment seems advisable.

CHALLENGE NUMBER 7:

SYNERGY

To learn the synergistic impact of accepting the previous six challenges as a whole and, accordingly, to implement them collectively.

Benefits in terms of better quality and better understanding have often been achieved when just a few of these challenges were accepted on a small scale by persons involved with particular problematic situations.

But the greatest benefit of accepting challenges posed here will be attained if they are seen as mutually serving. That is, each of the challenges, pursued as part of a total strategy, strengthens each of the others to the end that, beginning with little understanding of a worldly problematic situation, at the end a new design has been created and implemented specifically tailored to resolving the particular situation. A double benefit accrues to those who proceed in this way. On the one hand, they gain tremendous satisfaction from being part of a team effort that brought new and insightful understanding to a difficult situation which may have been troublesome for a long time. On the other hand, they gain still more satisfaction because they can be part of the beneficiary group, whose lives are enhanced, benefiting from the resolution of the problematic situation.

WHO WILL ACCEPT THESE CHALLENGES?

Those best positioned initially to take up these challenges are found in academia. They have access to the literature resources where the historical bases for the statement that all of these challenges are feasible can be found. Also included in these resources are the means to respond positively to these challenges.

For the most part, however, those who have taken up the challenges lie outside of academia in the communities that are negatively affected by complexity. Wonderful successes have been had when skilled practitioners have responded to the needs of such communities.

The need for such services is great. Academics can sometimes fill these needs directly, and a few have done so in remarkable ways. But, as in other areas of learning, they can be most effective indirectly by educating future practitioners who will respond to the needs, whether in government, in industry, in education, and in many sectors of human life.

The story of many of the existing practitioners remains to be told. Henry Alberts, Moses Ayiku, Benjamin Broome, Roxana Cardenas, G. S. Chandy, Alexander Christakis, Ross Janes, Carol Jeffrey, Roy Smith, Scott Staley, Reynaldo Trevino, and Robert Waller are pioneers who took up the challenge and made contributions that remain to be noted by the majority of the systems community.

ANNOTATED REFERENCES for the SEVEN CHALLENGES

Second-Order Thought. Warfield, John N. (2002), Understanding Complexity: Thought and Behavior, Palm

Harbor, FL: AJAR Publishing Company. Chapter 2, "The Infrastructure of Science" gives the history of evolution of second-order thought and numerous references to the subject.

Behavioral Pathologies. Warfield, John N. (2002), Understanding Complexity: Thought and Behavior, Palm Harbor, FL: AJAR Publishing Company. Chapter 3, "Behavioral Pathologies: Individual, Group, and Organization", describes the pathologies and gives numerous references to the subject.

Discursivity. Warfield, John N. (under review by *Systems Research and Behavioral Science*), the paper "*Linguistic Adjustments:Precursors to Understanding Complexity*" discusses discursivity requirements at length and gives numerous references relating to language requirements for systems science.

Quality-Control Principles. Warfield, John N. (2003) *"A Proposal for Systems Science"*, (accepted for publication in *Systems Research and Behavioral Science*), this paper describes the quality control principles in more depth, and gives key references to these principles.

Metrics of Complexity. Warfield, John N. (2002), Understanding Complexity: Thought and Behavior, Palm Harbor, FL: AJAR Publishing Company, gives definitions of the five indexes and a thorough discussion of the Aristotle Index, with key references to the other indexes, and values from a variety of applications.

Physical Infrastructure. Warfield, John N. (2002), Understanding Complexity: Thought and Behavior, Palm Harbor, FL: AJAR Publishing Company, discusses the infrastructural requirements, including the physical infrastructure, and gives references that offer more insights.

Synergy. Warfield, John N. (2003), *"A Proposal for Systems Science"*, (accepted for publication in *Systems Research and Behavioral Science*), shows how the other six challenges can be integrated into a vision of systems science. The paper gives more than a hundred supportive references.

EPILOGUE

This article is contributed as a tribute to my friend Charles François. I am grateful to Ernesto Grün for giving me the opportunity to contribute to this festschrift on the occasion of the 80th birthday of Charles.

END.

Seven Challenges

John n. Warfield, Palm Harbor, Florida, Nov. 18, 2002.

Written while looking at the Powerpoint presentation title MIDDLE HUMAN SCIENCE that he gave in Shanghai, China as a short talk IN AUGUST 2002., and this paper is basically a repeat of the China presentation with a little bit more stuff added.
The paper was written in response to an invitation from Ernesto Grun, of Buenos Aires, Argentina to participate in a Festschrift volume to be published in honor of Charles Francois. The volume is not published on this date, and if it is published by the Argentinians, then the paper will be a published status, but not yet.
Although most of John's papers are in WordPerfect, this one is in Microsoft Word, because the Argentine folks wanted it that way.