SYSTEM DYNAMICS' SILVER ANNIVERSARY: A TIME FOR REFLECTION AND REFORMULATION

Willard Fey, School of Industrial and System Engineering, Georgia Institute of Technology, Atlanta, GEORGIA, USA.

(This paper is based on a letter circulated by Willard Fey prior to the 1981 System Dynamics Research Conference at Rensselaerville, New York, aimed at focusing attention on the need for S.D. practitioners to intro- respectively review the state of the subject.)

In the fall of 1956 Jay Forrester founded the Industrial Dynamics Group at the Sloan School, M.I.T. In the ensuing twenty five years many people have learned System Dynamics methods and used them to study a wide variety of systems. On the occasion of this silver anniversary it is appropriate to celebrate our many accomplishments as well as to reflect on our present condition and future aspirations as a professional field of knowledge and practice. Perhaps, as a result of that reflection some of our weaknesses may be recognized and our research, teaching and professional practice may be revitalized, coordinated and redirected in ways that will produce an even better future.

System Dynamics is the only science-based methodology that is sufficiently logical (causal based), comprehensive, flexible and quantitative that it can serve as the basis for realistic analyses and substantial improvements of complex, nonlinear, nonstationary, noisy human systems at the managerial levels of aggregation where the major long run behavior patterns are controlled. These are the systems (the world, countries, social agencies, industries, companies, cities, . . .) and problems (inflation, escallating antagonisms and debt, oscillating profits and exchange rates, increasing hunger and crime, . . .) upon which rest the survival of our civilization. Considering the vast number of critical dynamic problems now facing these systems and considering the enormous potential contribution SD could make to the solution of these problems, one would expect that after 25 years of development SD would be well-known, widely used and extensively taught. Most of the SD practitioners with whom I have talked are disappointed with our progress in these areas. The purpose of this discussion paper is to review our condition and to suggest procedures for identifying strategies that might improve the field and our contribution to the world community and its organizations at all levels.

Present Condition

The SD field is defined to include all worldwide accumulated SD knowledge, wisdom and information both written and mentally stored: the people who have been trained in SD methods whether or not they are now practicing SD and the SD work they have done or are doing; the client individuals and organizations who have used or are using the methods and/or are supporting their development, use or teaching; SD educational programs and students; and the combined images of the field in the mind's of potential clients, the academic community, potential students, publishing/media, and the general public. While some information about the time histories of these variables does exist, particularly at M.I.T., it is not extensive. Therefore, no definitive statement can be made about our past history or present condition. However, my perception of the time histories and present state of SD variables roughly matches the perceptions of several colleagues with whom I have talked.

This perception suggests that SD has not developed as clear and broad a base of theoretical knowledge as 25 years of work should produce or as is needed to create an image of professional competence and legitimacy and to support a teaching effort which must transform normal college graduate students into capable practitioners of a difficult science-aided art. The applications literature is somewhat broader than the theoretical; but it is inadequate in convincing, understandable, practical successes. The nature of the field makes such successes difficult to achieve and document, but that is an obstacle we must overcome.

The number of trained practitioners seems to be smaller than it "should" be after 25 years of teaching and much smaller than it must be to do the theoretical research to develop the field's knowledge base, the teaching to increase the quantity and quality of practitioners and the analyses to study the many systems that could greatly benefit from exposure to the method. Furthermore, the quality of the work is not uniformly high. This may be due to low capability of a few analysts or special circumstances of some studies. In any case practitioner quantity and average quality both appear to need improvement.

Past and present clients and supporting organizations such as universities at which SD programs are taught, research funding organizations, industry and government do not appear to be exceptionally enthusiastic about the field. Certainly, a few are enthusiastic, but there are only a few universities worldwide that I know about that offer SD as a field of specialization at the Ph.D. level in management, engineering, the physical or social sciences. The hundreds of universities that do not have such programs do not seem to be actively seeking skilled SD people to start advanced SD programs in their schools. The large government funding agencies in the United States such as NSF and DOD do not seem to be actively soliciting SD studies. There are a few, of course, but not a number even remotely commensurate with the age of the field and the potential benefits from the use of the method. There are some SD staff groups in industry and some industrial consulting, but it is not extensive. There is some academic and government support for SD programs and projects abroad, but it also seems not to be commensurate with the promise.

Finally, the perception suggests that the SD image is not clear,

widespread or very positive for people outside the field. Antagonism and/or lack of respect for the field is fairly extensive and well-known in the academic community. In particular, many economists seem to hold SD in low esteem, but some members of some other fields have similar feelings. SD does not seem to be well-known in industry, particularly in medium and small business, or in government, particularly at the operating levels. SD is not well-known in publishing and the news media and the general public knows virtually nothing about SD. Those who have heard of SD usually have not heard glowing reports of great successes. Our reviews typically are mixed at best.

In summary the apparent condition of SD as of mid 1981 is that it is not growing very rapidly, is not very large for its age, does not have extensive professional credentials, has not produced many clear successes, and is not widely known or highly regarded. But it has the theoretical potential to transform the prospects for mankind. While the details of this perception vary somewhat from person to person. I have never heard anyone suggest that SD is a large, healthy, rapidly growing, well-known, widely respected field that is producing substantial numbers of high quality practitioners and successful practical results (my goals for SD).

The above perceptions involve both an awareness of actual conditions and judgements about goals (what is desired). I hope that I am either misinformed about conditions or overly demanding in setting goals. If the perceptions are true and the goals are reasonable, it would seem that changes should be made in our activities to improve the field. But what changes?

Development of the System Dynamics Field

The SD methodology teaches that human systems are complex combinations of coupled feedback loops which function through time to create the patterns of variation (trends and cycles) observed in the important variables. Improved patterns are achieved by altering feedback structures in appropriate (effective and possible) ways. In any particular system the identification of effective and possible changes requires a clear understanding of the existing feedback loop structure, a thorough understanding of the human characteristics of the system's participants who will influence the changes, and a creative synthesis that discovers effective modifications within the realities of structure and human capabilities and attitudes.

I suggest that the field of System Dynamics is a human feedback system as described above which exhibits unacceptably low growth rates for its important variables. It would seem that if we are to increase the growth rates substantially, we should redesign the feedback structure. In order to redesign the structure we must understand the existing SD structure; understand our practitioners, clients and students; and develop a creative synthesis. Then we should follow our own advice.

To my knowledge no one has attempted to identify the feedback structure of the field and the attitudes of the practitioners and leaders. It seems to me that until we do this, discussions of structure changes such as establishing a SD society or expanding publications are premature. Therefore, we should try to identify some of the important loops with the aim of providing a target to shoot at to begin the process of using our own methods to help our development. (An old French proverb says "shoemakers are always the worst shod." Perhaps, we can disprove it.) It is my hope that all who read this will attempt to draw their own influence diagrams or at least think about the loops. Only then we can have a substantive discussion of the process that is restraining our growth.

As a general rule an organization fails to achieve reasonable growth either because there are no high gain positive feedback loops in the system or because the existing positive loops are restrained by stronger negative loops or limits of some type. Once the loops and limits are known, structure changes designed to create positive loops or to decouple existing ones from restraints are indicated. Considering the severity of restraint in this case, I suspect that superficial changes such as the creation of a society or expanding publications, while helpful, will not be sufficient to alleviate the restraints. Therefore, I request that everyone be prepared to consider more fundamental changes in areas such as the type of research we do, the nature of our consulting, greater coordination of work within the field, ways to produce clear demonstrations of success, collaboration with analysts from other fields, greater emphasis on education at the primary and secondary levels, and wider outside publicity for our successes.

1) What are your perceptions of the SD field in terms of the desired and actual condition of our knowledge base and applications literature; the number and quality of SD educators and practitioners; the number and enthusiasm of present and former clients and supporters; the money provided for continued support; the number and quality of SD students at all levels; and the image of the field and how widely it is known among industry, government, academic, publishing/media people and the general public? How confident are you of your perceptions? Are your perceptions from personal experiences or opinions expressed by others?

2) What feedback loops are operating to create the real dynamics that underlie your perceptions? Are there important variables that have not been mentioned above?

3) What kind of changes in activities and procedures in the field might "improve" the performance patterns?

4) How interested in and committed to the field are you? What would you be prepared to do to help the development of the field?

I suspect that it will be difficult to raise SD to its potential and essential performance. Almost certainly it will require greater levels of commitment, direction, understanding, communication, collaboration, and cooperation among SD practitioners than have existed in the past. But it can and must be done. The world needs our skills!