The Systems Approach View from Professor Andrew P. Sage: An Interview

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Andrew P. Sage is the Founding Dean Emeritus University Professor, and First American Bank Professor in the Systems Engineering and Operations Research Department at George Mason University in USA. Professor Sage is recognized as one of the shapers of the Systems Engineering discipline by his important academic, scientific and consulting contributions for advancing the scientific knowledge and the practice of Systems Engineering from 1960s in the topics of: Systems Integration and Architecting, Complex Adaptive Systems and Knowledge Management, Economic Systems Analysis, and Systems Management. Professor Sage is author or co-author from several books on Systems Engineering and of more than 100 papers in top journals and conferences. Professor Sage has been Editor in Chief of the IEEE Transactions on Systems, Man, and Cybernetics (January 1972 - December 1998), Editor of Automatica (July 1981 - June 1996) and Co-Editor in Chief (with W. B. Rouse) of Information, Knowledge, and Systems Management, IOS Press, from April 1999 at present. Currently, Professor Sage is the Editor In Chief of the International Council on Systems Engineering Journal Systems Engineering from, January 1998. He has received several international awards for his academic and professional activities such as: the International Council on Systems Engineering (INCOSE) Pioneer Award (2002), the Eta Kappa Nu Eminent Member Award (2002) and the Third Millennium Medal IEEE (2000) among others. His formal education is a B.S.E.E. (The Citadel, 1955), a S.M.E.E. (Massachusetts Institute of Technology, 1956), a Ph.D. (Purdue University, 1960), a D.Engr. (University of Waterloo, 1987, Honoris Causa) and a D.Engr. (Dalhousie University, 1997, Honoris Causa). His wisdom has been gained during more than 40 years doing teaching, research and consulting. In IJITSA journal, we are honored to present the system’s view and thoughts from Professor Sage with the goal to contribute in the systemic integration of the Information Systems, Systems Engineering and Software Engineering disciplines. IJITSA’s questions and Professor Sage’s views are presented in next paragraphs.

IJITSA: First of all, we would appreciate your explanation on what is the discipline of Systems Engineering from a classic (the 1960-1980s period) and modern (the 1990-at present) viewpoints.
Professor Sage: In many ways, systems engineering is unique in contrast with traditional engineering disciplines. In particular, systems engineers do not build tangible products. Civil engineers design highways, and electrical engineers design adaptive array antennas. Systems engineers play an external design role in all of this and rely on other engineering disciplines to accomplish the internal design and deliver tangible products that are the realization of the systems they engineer. Systems engineering efforts span the entire system lifecycle. Systems engineering focuses on defining customer needs and associated functionality in terms of specifications for a system to be engineered. It proceeds with development of the system in terms of conceptual and real architecture and then proceeds with efforts to deploy the system in an operational environment and accomplishes operational test and evaluation to insure a trustworthy and reliable system that satisfies customer needs in a cost effective manner.

This view of systems engineering is, I believe, as valid today as it was three of four decades ago. Of course, there are new challenges today that were not seen to exist several decades ago. Not only do we have new systems management strategies, new systems engineering processes, and systems engineering methods and tools, but we also deal with the notion of a system of systems, federation of systems or systems family concerns that were not considered in the early days.

IJITSA: Could you define for us the concepts of systems approach, systems thinking or systems paradigm in the context of the discipline of systems engineering?

Professor Sage: Systems engineers need to consider human, organizational and technical needs of all stakeholders with the goal of providing a quality product to satisfy user needs. Taking this approach to the engineering of systems is inherently complex, since behaviors of and interaction among the human, organizational and technological system components are not always well defined or understood. As a result of this, a systems architect often serve as an interface between the various interests in developing a conceptual systems that can be evaluated to determining effectiveness before the expense of detailed implementation is accomplished.

An appropriate conceptual model for systems engineering results from the realization that:

1. The competitive environment of the organization practicing systems engineering and management, coupled with organizational leadership and strategy, leads to the competitive strategy of the organization and the resulting systems management policies.
2. Systems management drives the choice of process that is to be used for the particular systems engineering effort under consideration.
3. The use of a systems engineering process, or systems engineering lifecycle, leads to, drives, or results in the system (product or service system) being engineered.
4. There are a great variety of tools and methods, and associated metrics, that support systems management, systems engineering processes, and systems engineering products and services.

These tools and methods comprise the tools and methods of the systems approach and associated systems thinking.

IJITSA: Based on your extensive research career and as a seminal shaper of the discipline of systems engineering, could you explain what are the core value and contributions of the system approach to the systems engineering discipline?

Professor Sage: In many ways, this question was also addressed in response to question 2. The methods and tools of systems engineering are the methods and tools that comprise the systems approach, or systems thinking. They are as valid and useful for the internal design of systems as for the external design of systems that comprises the transdisciplinary profession of systems engineering.

IJITSA: Based on your long career as consultant for business and governmental organizations could you explain why the systems approach is important for the development and deployment
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