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Variety Dynamics: A new body of systems methods and a new mathematical field for management of dynamically complex multi-actor systems

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Abstract

This paper provides an overview of development of Variety Dynamics. This is a suite of systems methods developed by the author to address complex systems. Its development also comprises a new mathematical field; and the basis of a new approach to managing complex systems; over 30 axioms guiding systems management decision making for particular systems contexts; a new and improved definition of complex systems; a new and improved approach to management decision making relating to complex systems; a new definition of hypercomplex systems; a complete replacement for the theory of wicked problems and the approaches used to address them; a formal explanation of the limitations of existing traditional systems methods and an explanation of why they fail; and in short, a new foundation for the international systems sciences field. The paper will first explain limitations of existing systems methods, and the centrality of and dependence on different forms of prediction in all systems management and control activities. It will then describe the above elements of the Variety Dynamics field with examples from real world complex systems.

Introduction

To date, systems theories and methods have primarily focused on expanding the use of a mechanical modelling approach to more complicated situations. This almost universal approach models the causal consequences of one entity on another. It takes into account circular causal relationships by time stepping causes and consequences – or by subjective opinion/guesswork.

That perspective is at the heart of almost all Systems and Operational Research theories, methods and practices such as:

- Soft Systems Methodology
- System Dynamics
- Critical System Heuristics

- Systems Thinking
- Complex Systems Analysis
- Agent Based Modeling
- DEA modelling
- Participative and collaborative methods
- Systems Diagramming

In all cases, the essential purpose of each and every method, theory, perspective or practice in Systems, Systems Science or Operational Research is to facilitate improved management and control of situations regardless of their complexity.

This paper will introduce and provide an overview of a completely different approach to the above.

First, however, the paper will draw attention to three key, but often overlooked, aspects of Systems Science that reveal limitations and failures of all those Systems and Operational Research theories, methods and practices that rely on either the above kind of mechanical causal modelling, or participative or collaborative approaches such as Soft Systems Methodology. These three factors are:

- Characteristics of systems for which the mechanical causal approaches do not apply. This provides a definition of a new systems category of Hyper-Complex Systems.
- The central role of prediction. This provides an improved definition of Systems Science
- The biological cognitive limits to mental prediction of system behaviour and outcomes relating to system complexity. This provides an improved definition of Complex Systems

The paper then describes the Variety Dynamics approach, outlines the scale of Variety Dynamics as a new body of systems methods, outlines the main elements of the new mathematic field derived to support it and provides some practical examples of using Variety Dynamics theories and methods.

Characteristics of real systems that are problematic for Systems Sciences methods

Current Systems and Operational Research theories methods are inadequate to address and manage a wide variety of typical real world complex multi-actor dynamically changing systems.

Some characteristics of such systems that current Systems and OR methods have problems with and are int=effective in supporting management and control include:

- Systems with multiple changing system and subsystem ownerships
- Systems in which systems and subsystem purposes, perspectives and motivations change dynamically and relatively unpredictably.
- Systems with a variety of continually changing power and control subsystems and subsystem approaches.
- Systems in which the above dynamic subsystem and system arrangements reflexively influence the system environment (and hence the system and subsystems)
- Systems in which system structure, subsystems and their purposes and boundaries are changing dynamically.
- Systems with parts of the system and subsystems existing at times outside the system boundary.
- Systems with multiple dynamically changing feedback loop relationships between subsystems, environment, system and control actors
- Systems in which the external environment is changing and influencing a wide variety of factors, actors, purposes, system resources, system and subsystem behaviours and abilities within the system.
- Systems in which a substantial proportion of subsystems and system characteristics are unknown and dynamically changing in ways that, with other dynamic factors, influence system behaviours.

Systems with the above characteristics, I have named ‘hyper-complex systems’. These are systems for which the conventional mechanical approaches are insufficient for prediction of behaviors and outcomes resulting from management and control changes. In this I differentiate them from ‘complex systems’. The latter I have defined in terms of the ‘2 Feedback Loop Limitation Axiom’ or for brevity ‘2 Feedback Loop Law’.

Many common real-world systems align with this ‘hyper-complex system’ definition because they contain the above characteristics sufficient to render their behavior and outcomes incapable of prediction by mechanistic systems methods (including participatory or consultative systems approaches). There are many examples of such hyper-complex systems in e.g., management of epidemics, energy infrastructure, environmental issues, economic competition, IT development, politics, war, etc.

Hyper-complex systems with the above characteristics do not fulfil the core assumptions required by current systems theories and methods:

- That the system structure remains constant for the period of analysis and prediction
- That the sundry ownerships, purposes, roles, motivations, relationships of different elements of the system and its controlling subsystems remain constant.
- That the system and subsystems and systems elements remain within the system boundaries
- That the effects of the environment on the system and subsystem structure, ownerships, purposes, roles, motivations and relationships are predictable.
- That knowledge of the causal relationships is sufficient for mechanistic prediction of behaviours and there are not missing realms of information that make modelling, analysis and prediction of behaviors and outcomes impossible.

Existing systems methods are not only ineffective at managing hyper-complex systems involving such dynamics and complexity, worse, they provide little or no guidance to managers or those attempting control of such systems.

Systems theories and methods, along with OR approaches attempt to compensate for their lack of competent ability to address such systems by sundry methods that result in faulty outcomes, e.g.:

- Reducing complex systems into merely complicated systems
- Applying mathematical mechanical modelling of causes and effects in spite of its limitations
- Attempting guess system functioning by using social methods, or graphic methods such as those of Bob Horne.
- Attempting to guess the outcomes resulting from management decisions by using participatory or collaborative methods.

The above approaches exist as delusional or wishful thinking by systems academics and practitioners. None of them are effective at predicting behaviours and outcomes in relation to either hyper-complex systems, or systems whose behaviour or outcomes are shaped by 2 or more feedback loops.

The central role of prediction in Systems Science

One way of understanding Systems Science is to ask which activity is essential for systems science to exist and essential for its methods and theories to be epistemologically and practically valid.

The activity of prediction is the core essential for Systems Science as a discipline and for systems theories and methods The above approaches exist as delusional or wishful thinking by systems academics and practitioners to be valid and fulfil their purpose.

The primary function of ANY theory or analytical method intended to help understand or manage a system is to provide a means of predicting what outcomes will result from management or control decisions or interventions in the system.

This central and essential role of prediction in systems science is also found in the functioning of all systems and in the core foundations of human thought, feeling, decision making and action.

All systems for their functioning depend on prediction in its various mechanisms as the basis of the activity of all systems elements.

For humans, prediction is the foundation of all human-related activity: internal and external. For example, recent research debunks the traditional idea that thinking consists of sensing and then processing what is sensed. Instead, the recent evidence has required a shift of understanding to the idea that the primary purpose of the brain is prediction and that what we see, hear and think are in fact predictions of the brain based on its current best evidence and modified continuously moment by moment in light of new evidence.

In short, the validity of all theories, methods and practices of systems science depends on the validity, accuracy and effectiveness of their ability to predict the behavior of systems and the outcomes consequent on that behaviour.

This immediately elevates into view a variety of questions, often overlooked – presumptively or by ignorance, whose answers are essential to understanding the limits of validity of systems theories, methods and practices. Such questions include:

- What are the limits to individual humans' abilities to predict the behaviour of systems and the consequent outcomes?
- What are the limits of specific individual systems theories in terms of their prediction of the behaviours of systems and the subsequent outcomes for different kinds of systems?
- What are the limits of specific individual systems methods in terms of their prediction of the behaviours of systems and the subsequent outcomes for different kinds of systems?
- Prediction of consequences of interventions
- Step change sin systems

Variety Dynamics is a new systems approach and suite of methods, and a new field of mathematics specifically tailored to managing the dynamics of power and control in these kinds of systems. It also offers a new suite of tools for managers to understand and predict the behaviors of such highly complex systems whilst avoiding the 2-feedback loop cognitive limitations of causal thinking. Variety Dynamics to date now contains over 30 axioms. The presentation provides practical examples of Variety Dynamics in systems contexts.

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