SIMULATION: METHODOLOGY FOR THE SYSTEM SCIENCES

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Sessions:

α. Systemic Analysis and Model Synthesis
β. Simulation: Ensuring its credibility
γ. System Scientists: Executives in disguise

0. LEXICON

A. Simulation (dynamic, stochastic): A generator of realisations from a time series, or stochastic process, of generally unknown characteristics.

B. Credibility: That quality of a literal model which is established as a result of:
(1) its concise, lucid, logical, and unambiguous expression; and,
(2) its precise reproduction of the simuland's observable behaviour.

C. System: A collection of interdependant and interactive elements which together behave in a collective effort to attain some (usually specifiable) goal.

D. System Science: The search for explanations for (i.e., credible models of) systemic behaviour.

E. Simular: Of, or having to do with, a simulation model. In contrast with:

F. Systemic: Of, or having to do with, the system (or simuland).

G. The Scientific Method: The operational procedure by which man augments his knowledge of the World:

I. Systems analysis - The isolation of the salient components, interactions, relationships, and behaviour mechanisms of a system;

II. System synthesis - The grammatical and logical organisation of the literal representation of a system's behaviour, in accordance with the findings of the preceding systems analysis stage;

III. Verification - the comparison of the model's responses with those anticipated if indeed the model's structure were programmed as intended;

IV. Validation - the comparison of recorded observations of the simuland with the simular responses emanating from independently seeded encounters of the verified model, thereby establishing the verisimilitude of the model and the modelled;

V. Inference - the fifth (and most rewarding) stage of a model's development, concerned with designed, simular experimentation, employing independently seeded encounters with the verified and validated model.

Ω. Null stage - At the outset of a scientific enquiry, a statement of modelling goals, acknowledging the system scientist's accumulated neural recording of his religious, societal, and cultural upbringing, plus that of his personal experience with nature and that of his exposure to precedent scientists via educational institutions and their libraries.

α. SYSTEMIC ANALYSIS AND MODEL SYNTHESIS

I. SYSTEMS ANALYSIS

A. Definition of systemic goal(s).
B. Delineation of primary systemic attribute(s).
C. Study of primary systemic event(s).
D. Specification of secondary systemic attributes.
E. Determination of secondary systemic events.
F. Et Cetera: The Uncertainty Principle of Modelling.
G. Circumscription of boundary for systemic feedback mechanisms.

A Note Aside: The Cornerstone of Successful Modelling is the set of instructions for the collection of data that shall be required by the programmed (written) model.

II. SYSTEM SYNTHESIS

A. The Simulation's Executive Algorithm. [Cf: Figure 2.].
B. Definition of state variables.
C. Formulation of operationally defined event algorithms (exogenous and endogenous):
   1. Test section;
   2. Action section;
   3. Report section.
D. Stochasticity - seed phyla:
   1. Histograms;
   2. PDF's;
   3. Series records;
   4. Stochastic process.
E. Specification of initial conditions.
F. Selection of an ad hoc simulation programming language.

A Note Aside: Model completion can be considerably expedited by means of contemporaneous programming and data collection efforts. [Cf: Figure 2.].

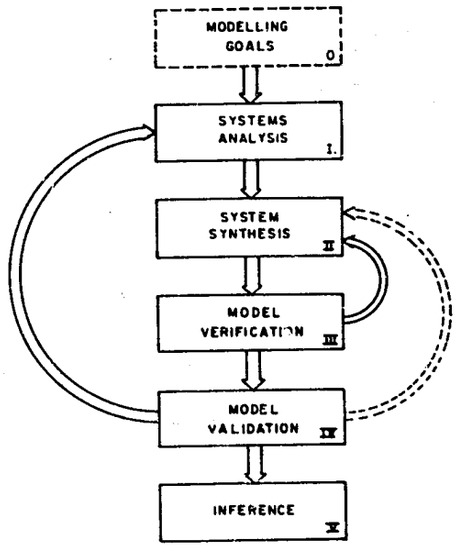

Figure 1. SCIENTIFIC METHOD
(or: CYBERNETICS OF EPISTEMOLOGY)

β. SIMULATION: ENSURING ITS CREDIBILITY

III. MODEL VERIFICATION

A. Grammatical rectification.
   1. Orthography: at the keypunch machine.
   2. Syntactic analysis.
B. Logical veracity.
   1. Ambiguity exclusion: the language faults corrected.
   2. Deterministic verification tests.
C. Fundamental Principium of Seeding
   1. Random samples.
   2. One-sample statistical tests.
D. The Cycling Between Modelling Stages. [Cf: Figure 1.].

IV. MODEL VALIDATION

A. The Simuland Sampled: The Uncertainty Principle of Modelling Revisited.
B. The General Principium of Seeding:
   1. Experimental error.
   2. Two-sample statistical tests.
C. The Cycling Among Modelling Stages. [Cf: Figure 1.].

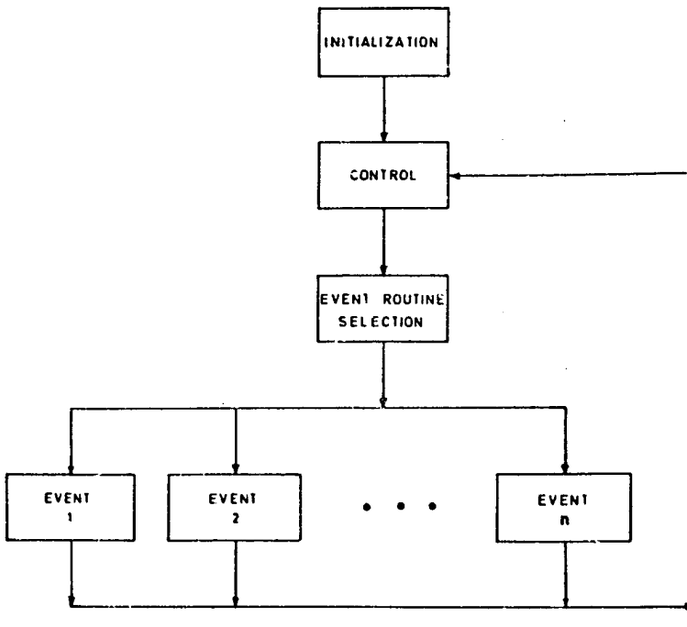

Figure 2. THE SIMULATION ALGORITHM
(or: CYBERNETICS OF EFFECTIVE EXECUTIVES)

Y. SYSTEM SCIENTISTS: EXECUTIVES IN DISGUISE

V. INFERENCE

A. Modelling Goals: The Null Stage Revisited.
B. Analysis of Static Effects
   1. Point and interval estimation of distributional properties.
   2. Forecasting the distribution of systemic yields.
   3. Prediction of the significance of differences in systemic operating conditions: Analysis of variance, regression, multivariate analyses.
   4. Foretelling preferabilities among operating conditions: Multiple ranking and comparison techniques.
   5. Prophesying optimal operating conditions: Response surface methodology.
C. Analysis of Dynamic Effects
   1. Trend predictions: their disclosure and removal.
   2. Systematic fluctuations: spectral analysis.
D. The Augmentation of Human Knowledge [Cf: Figure 1.].

MANAGEMENT IN SCIENTIFIC PERSPECTIVE

A. Planning: The Scientific Method [Cf: Figure 1.]
B. Programming: The Executive Algorithm [Cf: Figure 2.]
C. Budgeting: The Regrettable, but Necessary, Constraint.

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