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Forrester, Jay W.: Conference on Dynamics
of Social Systems, 1970

July 20, 1970

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

Jay W. Forrester-

Short notice, beginning at Bern. Concern with growing problems, and the need for methodology of approach.

Approaches of social system modeling may apply to the Club Project. Review of schedule for meeting.

Sunday afternoon picnic announcement.

Aurelio Peccei -

What is Club of Rome: a small group of generally eminent people, with a broad spectrum of interests and an ecumenical concern with world problems. Fundamentally non-political, trans-national, trans-cultural. Membership, now about 50, will grow further; stress on varied cultures in representation.

- Some believe the time available for avoiding monumental crises is measured in years, not decades.
- Action orientation requires contact with public policy and opinion. Change is mandatory.
- Why are we here: Club was formed in Rome, tested ideas around the world. Scepticism about the ability to change, but enthusiasm for the effort.
- Austrian meeting 10 months ago decided explicit statements needed. Hasan Ozbekhan became project director, produced "Predicament of Mankind" draft. Need found for definition of approach.

Systemic nature of interacting problems
System definition - planetary scope
Time scale - long term

We have come to learn about work on structure and behaviour of large-scale systems. Trade-offs must be made in subsystems...where?

Where do we go: Hope to achieve. To prepare a project worthy of support and capable of finding solutions. Combine methodology, information base, (wide support here at United Nations), and value base. Values in control of action now may have been overtaken by events.

Jay W. Forrester-

Systems work here has 40-year background at M.I.T.

Gordon S. Brown-

At M.I.T. since 1929, when arrived from Australia. Wrote Bachelors thesis for Vannevar Bush, about a machine whose concept dated from 1923. Integraph. Mechanical model of a mathematical statement of a real system...the "differentials analyzer". First machine used a watt-hour meter as an integrator, with water-cooled slide-wire potentiometer. Norbert Wiener influence on Bush. Work of Hazen, Caldwell. Navy's request for training support accepted. Further development gave 200-ton analyzer. Formation of Servo-mechanisms Laboratory, including Forrester. Height-finding radar on the carrier Lexington. About 1943, Forrester was asked to build a real-time simulator for 4-engined aircraft...given 36 simultaneous equations. Concluded easier to study real airplane than to build this analog device. Built up digital capabilities, resulting in Whirlwind computer, using telephone company approaches to vacuum tube technology.

Lecture Notes: Basic Concepts

D.L. Meadows

I Objectives of the Club of Rome

paradigm= achievement sufficiently new and important that it attracts a lasting group of adherents from competing modes of scientific activity.

it identifies a new class of problems for solution

it provides the methodologies, the criterion of success and the language for these problems.

without a paradigm scientific activity is primarily the collection of data

II Characteristics of an Industrial Dynamicist

- conviction that complex system behavior can be understood and controlled through the analysis of feedbackloop relationships
- ability to define a problem in dynamic terms and then perceive the feedbackloop relationships relevant to it
- skills in representing the feedbackloop relationships:
 - in equations
 - in figures
 - verbally
- ability to analyze the dynamic implications of a feedbackloop structure:
 - intuitively
 - through computer simulations
- experience in redesigning the feedbackloop system critical points
- capability to implement changes in the real system

III I.D.'s Hierarchy of Structure

Feedbackloop = sequence in which information about some parameter leads to action that eventually changes the parameter and thereby leads to new information and new action.

Closed Boundary = a limitation of the model elements to those just necessary and sufficient to understand and study the behavior of interest

the boundary will necessarily differ from one problem to the next

Two components of a loop are necessary and sufficient

Levels - describe the system state
have meaning even if you suspend the system in time
accumulation (integration) of past rates
depends not on other levels but only on its own past
value and the magnitude of the interim rates

Rates - describe the system policies, decisions
meaningful only for a time interval, not instantaneously
rate of change in the levels
depend only on levels not on other rates
auxiliaries are part of a policy separated algebraically
for reasons of its individual interest
rate composed of goal, observed condition, difference, action

July 20, 1970
1:30 PM

FORMULATION OF SIMPLE MALTHUS MODEL

- Gerald Barney - Intent of dynamic examples used here is to show the general method of approach, not to produce skills themselves. Own basic outline of the thought process:
1. Observe whole system and define problem
 2. Establish boundary
 3. Talk and read about subsystem inter-relations (Most material not in literature. See those who know. Break the discipline barrier.)
 4. Develop mental picture
 5. Model it on the computer
 6. Study its implications
 7. Experiment with the model. Pass laws. (What happens if...?)
 8. Note sensitive points in model. Recheck their logic. (Validate through logic and behavioural analysis.)
 9. Use the model. Find possible and impossible solutions. See what realistic goals might be.
 10. Suggest changes and implement.
 11. Try to implement
- Gordon S. Brown - Natural frequencies of systems are crucial. Learning is changing from "vertical" communication within discipline to "horizontal" channels, across specialty lines.
- Gerald Barney - Reference to paper: memorandum titled "Population Dynamics: Understanding, Modeling and Extending the Ideas of Thomas R. Malthus". Geometric population growth when unconstrained. Malthus took a 25-year doubling time for population; and saw the living environment as critical damping factor. Involuntary preventive checks (i.e. stillbirths); voluntary checks (i.e. birth control); and positive checks (i.e. warfare).
- Jay W. Forrester - In Memorandum Part II, discussion of model, page 3. Dimensions: a "rate" is measured in units of something, per unit of time. Social science frequently omits dimensions, and therefore concepts.
- Gerald Barney - Difference between Birth Rate as a rate (people/yr.), on the one hand, and the coefficient "Births per Thousand", which is in units 1/yr. BPT is similar to the interest rate on your savings account, while BR is like the number of dollars per year flowing into the account.

Modeling. DYNAMO uses three points in time: J,K, and L. A fixed interval of time called "DT" separates these times. Its magnitude may be arbitrarily set-but must be short enough so that the interval itself has no effect on the system's behaviour.

Discussion of equations and structure of "INVOL" model of Malthus' involuntary constraints to population growth. Table functions indicate that the environment exerts little constraint when population is small in relation to its available space and resources.

Jay W. Forrester - Approach starts with a "normal" situation, as a matter of personal style. It could as well work completely from a table of numbers, rather than as modifiers of a "normal". But flow diagram and equations must be consistent and directly related.

Dennis L. Meadows - "Environmental Limit" is not a limit. But seeing the way it appears in and acts on the system makes its definition clear.

Trip through Asia/India, lecture notes will suffice. Kuhn departs from traditional linear extensions of existing change modes. Knowing dynamics \neq knowing DYNAMO. DYNAMO is just notation vocabulary.

Through the analysis step, ID modeling is totally apolitical.

Committees can reach agreement because each member thinks he is winning. ID makes things clear, however, and no one can fool himself.

Values will not come from ID analysis. Values come from political and cultural systems.

July 21, 1970
9:00 AM

SOURCES OF MODELS, INFORMATION, DATA,
RELATION TO MENTAL MODELS, SOURCES OF STRUCTURE

Jay W. Forrester - There is widespread misunderstanding of modeling. Reality must be simplified in modeling; choices of important issues are crucial - and so are omissions of irrelevance.

Point of view is the key. Choices of phenomena to be studied are pertinent only to the interest which causes the model to be built. Another interest, coming later, cannot expect a prior model to deal with its concerns.

Everyone uses models all the time. In our heads we hold concepts of relationships, and we continually use these concepts to represent reality. We are going to have models; question is not whether to use them, but how good they will be. Formal vs implicit. Mental models have historically been better than mathematic approach in social sciences.

Perfection is not the criteria for judgement of a model. Rather, it should be compared with the alternative models available. Mental models are unique to individuals, cannot be standardized. Mental models shift with time, concentrating on few variables at a time. They do not integrate whole system.

Formal models force explicit statement of the system. Severest critic of a model is its builder; he is committing himself in the writing.

Scope of issues and problems defies mental connection of inter-relationships. Attention limited to few issues at a time. True of nations as well as individuals.

Social science modeling tends to concentrate on the parts, and presume that knowledge of subsystems will give understanding of the whole. Our group at MIT differs here; knowledge of all factors acting on a situation does not yield understanding of whole-system behaviour.

Corporation problems well recognized at subsystem level. Managers feel they are solving their own part of the problem, but their actions interact to CAUSE the problem. Knowledge of components is not sufficient.

We start with mental models. We do not know how to tell a student how to extract relevant structure of a problem. Art and judgement are applied at the frontier of all fields-including the sciences. Intuition and judgement required, always, at the frontier.

July 21, 1970
9:30 AM

EXTENSION OF THE MALTHUS MODEL

Gerald O. Barney-

Discussion of Malthus paper, Part III. A sudden change in a complex system has tendency to make the system itself relax, to counter the effect of the change. Examples from Figures 4, 5 and 6 show that sudden increase of decrease in average life expectancy will not persist over time. "Births per thousand" more sensitive than ALT.

Discussion of voluntary population control, Malthus paper Part IV (D-1352).

1. POP = population
2. BR = birth rate
- 2.1. BPT = births per thousand
3. BPTM= births per thousand multiplier
4. EVP = environmental pressure
- 4.1. EVL = environmental limit
5. PPM = population policy multiplier
7. EVPP= environmental pressure perceived
8. EVLP= environmental limit perceived
9. PEPR= population's environmental perception rate
10. DR = death rate
11. ALTM= average life time multiplier
13. ALTE= average life time effective

Think of EVL (the environmental limit) as the point where environmental stress begins to exert forces on birth and death of population. Perhaps a better name would be "critical population level."

In the advanced countries there is a real pressure toward increasing population; through corporate advertising which promotes big families.

Problem with population modeling and social sciences: people describe systems verbally, without rigor and without concept of behavior.

Social sciences emulating a factor of physical sciences which does not exist. Social Science taking open-loop examples with statistical approach, and using the approach for closed-loop feedback situations.

Gordon S. Brown- Recognition coming now that limits do exist. Fundamental problem in education process; we change it without measuring impact of the last changes, or the current ones.

Dick Douglas- Symptom of problem is change in mental models governing expectations from society.

Jay W. Forrester- When one demand stands out from others, it gains attention and action...limited scope of view.

July 21, 1970
11:00 AM

A MODEL OF GENERATION OF SOLID WASTE

Jorgen Randers

- Excited about dynamic modeling. Limitation of human intuition for visualizing behaviour of multi-level systems. Piece-wise approach no longer suffices; all aspects of a system must be considered simultaneously.

Tool: Industrial Dynamics applied to complex social systems, with plots of behaviour over time. Computer simply draws the logical conclusions of the model put into it. So the problem is to design the model...this is everything.

Studying production of waste, not its disposition. With population of 2×10^8 people, the US produces 3.5×10^9 tons of waste. About 10% is traditional "urban waste", of which 82% is hauled somewhere, covering 2×10^4 acres per year.

Recycling already provides 52% of US lead consumption, and 45% of its copper and brass. Some disagreement in the group on timber consumption for paper production.

Proposals would tax waste or require consumer to return it to the merchants.

- Discussion of 3-level model. "Products in Use" includes both capital and consumer goods, and does have direct influence on production rate (cars require gasoline, houses require oil, etc.) Without recycling, world burns out.

More elaborate model designed to show influence on production and consumption of advertising, and perception of needs. Time delays in the beer advertising sector are much longer than the lifetime of beer in the consumer's refrigerator, so the latter delay is insignificant in this example. In other products it might be important.

Four-level model adds pollution and energy conversion. (Solid waste is defined as re-claimable; pollution is so finely distributed that it can never be recycled.) Manufacturing and recycling both produce pollution and consume energy.

July 21, 1970

1:30 PM

JAY W. FORRESTER: DEVELOP THE WORLD MODEL
(POPULATION, POLLUTION, FOOD, NATURAL RESOURCES)

Discussion of World system model efforts. Suggestion that work groups discuss structure of the pilot model prepared for this session.

Page 5 of memorandum number D-1348 represents initial effort to capture discussions at Bern meeting. First step: to define meaningful levels. Then rates. Equations written on Saturday, July 4. Unique experience: first run on the model worked without substantial error. Disquieting result of 1970-1980 results.

Will not here try to defend the detail of this model. Where you feel changes are indicated, try them. Then we shall discuss.

Great books in economics are limited to those few which describe theories of how forces interrelate. Adam Smith, Marx, Mill, Keynes.

A theory exists until disproved. There is no theoretical proof possible in basic theories. Proof consists only in failure to find contrary examples of behaviour.

As you model, you find many, many things to include. But complexity of including everything forces you to combine and define variables whose action is similar. For instance, wood in the world model acts like a food, because it is replenished by re-forestation. Natural resources, by definition, are not replaceable.

Discussion of "clip" functions as a mechanism for inserting a change in any value, when any other variable reaches a specified value.

This model avoids need for quantifying such variables as capital investment in 1900, by using instead the ratio of 1970 values to 1900 values. Assumed here that value in 1900 was $\frac{1}{4}$ of today's.

Large amount of interesting substance in just the 5-level model. Additional classes of people and geography could be included, along with the links between them. World-wide averages used here.

Analysis of table function relating material standard of living to birth rate. Disagreement: some research is necessary here, if we determine that the shape of the curve is important in the light of other structures. Table BRMMT gives Jay W. Forrester's impression only. Must separate effect of capital investment from that of crowding, pollution, etc.

Pestel: experiments in Mexico showed birth rate declines when

television introduced. Men watched; women went to sleep.

Why is agriculture treated separately? Food comes first in the society that hasn't enough, and resources are not easily converted from railroads and office buildings into tractors. Agriculture here represents industrial food processing (and distribution?) as well as farm activity.

Equation 4 dimensions appear inconsistent.

Capital investment and natural resources discussed.

Education impact? shown, perhaps, only in capital investment. Would that suffice?

Pollution - could be a function of the average use of natural resources?

Does flow of materials always move from source-cloud to sink-cloud? Frequently series of levels where units are consistent, between clouds. Cloud implies sources and destinations outside the system being considered.

Material standard of living at zero would imply total lack of capital investment except in agriculture...i.e., a nomadic population.

EQ. 12

Death rate dependence on pollution: may not really have as much impact as DRPMT indicates. Pollution here is spread evenly over the entire earth. Curve such as this focuses attention and requires some form of representation. How much impact does pollution have? Table function gives modeler a chance to test sensitivity - determine how accurate the assumption has to be. Model lacks any mechanism for conscious restraint of pollution, as population recognizes its danger.

Auto industry lacks information on human tolerance to carbon monoxide.

EQ. 20

Shape of non-linear curves matters a good deal in modeling. Precise values not so critical. (more later)

Future development of model should look to reallocation of resources in the face of crises - decision processes not adequately shown here.

EQ. 21

Table FPCIT indicates 50% of agriculture would remain even if capital investment dropped to zero. Current world-wide figure: 1 acre of agricultural land per person (3.6 billion of each.).

EQ. 26.1

Table CIPCT. If there is no capital, or no standard of living, then it is very difficult to accumulate capital. Enough is enough at the upper end of the table.

Tables are uni-directional. Vertical axis is dependent function, and cannot be used to derive the horizontal function-because another DT will intervene between evaluations of the system variables. Direction of causality.

If oceans are already covered by oil a couple of molecules deep, then it may not take much more to cause very substantial changes in evaporation.

EQ. 34

Pollution itself can damage or destroy the earth's natural pollution-absorption mechanisms. If we reached the point where pollution (rising) meets capability of absorption (falling), then we must cut drastically the generation of new pollutants. Simply levelling off would not solve problem; absorption would continue to fall.

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

July 21, 1970

Dinner

Raymond Bauer: Comments on the White House
National Goals Research Program

Expectations were development of "Goals for America."

In Germany 1951-1952, found that historical explanations outweighed logical ones.

Last June, was asked to help devise "futures-oriented" group for social forecasting in light of relevant data for goal setting to report annually on July 4. Into operation in January.

"What do I do now?"

Small staff--10 generalists--no logistics--report due date. How select from spectrum of forecasts? Emulate Johnson report on social trends? No. Not enough change, plus weakness of data. Focus on current social problems? No. Time too short; material too big.

Prior memo to Leonard Darmouth had said popular ideas not necessarily good. State of Union message dealt with quality of life and growth, gave rise to fundamental questions. Identified six areas:

1. Population growth
2. Environmental constraints
3. Education and growth problems (moot)
4. Basic science (growth versus research resources)
5. Technology assessment (Daddario, Brooks, et. al.)
6. Consumer movement

Not attempting full coverage of any area. Many subsystems in total society, sub-optimizing in efforts and succeeding in meeting own criteria for accomplishment.

Enormous success of economy (in polluting environment as well as meeting own criteria).

Education: historic trend of filling landscape successfully met.

Should shift now from reactive to anticipatory mode of operation.

1. Urgency greater and systemic reactions faster.
2. Sufficient resource base to do it.

3. Tools available in past decade give us a chance. (though tools are more applicable to nuts and bolts than to policy-making.)

Temperizing the tools: popular disillusion with "experts," demand for participation. Centralization can be bad. Rational debate needed.

Environment: We could absorb 100 million more; we may be at zero population growth now. Covered unusual stuff. Have resources, but can we dump the waste? Do we have to stop economic growth?...inequitable to minorities. Suggest exploring recycling and all that jazz.

Education: schools are historical transmitters of information, but now outweighed by T.V. Need integration of information flow. Plurality of values face young. Schools should give bases for judging values.

Basic Science issues: funding: short versus long-term investment.
relevance: impact and intervention with ecology.
attack on social support: pollution, war research, etc.

Technology Assessment: need for evaluating second order consequences and deciding what we will do. Prejudicial to economic growth... how avoid that? How assess anyhow? Weaseling on obvious cases--but what about the legion of un-obvious cases? Congress, OST, Environmental Council--all getting reports of some kind. But tens of thousands of project reports say nothing. How cope? (Rely on industrial R & I process.)

Consumerism: students and activists could say "up your cornucopia." Industry proud of services rendered and of rate of change. But consumer organizations complain of surfeit of new products. Need balance protection versus progress.

Summary of report: beware goal-setting. Takes more work than we have done. We selected areas where we could say something. Performance criteria for specific areas have been too narrowly set. Need for people to decide what they want.

Thiemann/Cannes meeting of Rand President and Guishiani reversed roles regarding centralization. Rand said needed, Guishiani said cumbersome.

Organization theory prevelant now is reactive. Spontaneous mechanisms in organization stop central-run philosophy (McGregor). But no one has a perfect Theory - Y organization either.

At present system state, it is time to re-evaluate critieria which brought us to where we are. Can human beings assess impact of technology? [Would Daddario comment have been appropriate several decades ago?...probably not.] How in 1910 could men have seen future impact of automobiles?

Know complexity of social systems. Can say what might happen. Cannot give affirmative effect, you can at least cry wolf on what appears critical. Can tell something is wrong, even if not what.

Where would anticipatory policy be manifested? Two new agencies: Domestic Affairs Council absorbed with fire-fighting. President is serious; may begin policies of 30-year payoff period...government concerned with population growth policy...may show up many places in system. Targets of opportunity occur in crazy ways. Urban Affairs staff head wanted counter to Romney "new cities policy"...got briefing from Goals staff. What then?.."run for daylight."

University being overlooked as a resource? Could it be restructured to contribute outside of government? Could look forward, rather than backward. Students now can act later. Their intellectual input is critical factor, not available in government. Debate on freedom of the university, within.

July 22, 1970
9:00 AM

JAY W. FORRESTER: CONTINUATION OF JULY 21 REMARKS ON STRUCTURE

Structure of a model is a theory of behaviour. The great books of economics describe structure. From The Process of Education, by Jerome S. Bruner, Harvard:

Grasping structure is the crux of learning. Education teaches skills and principles; the latter is structure. Detail must fit into structure to be retained.

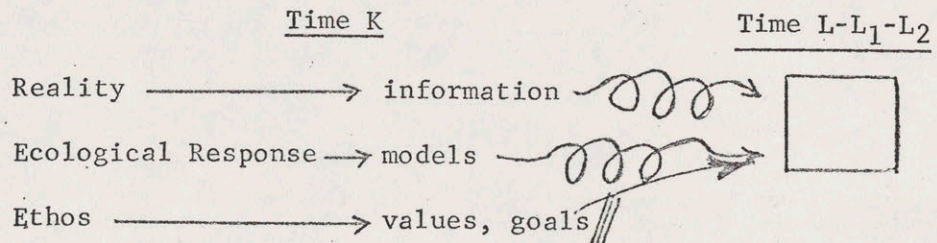
Beginner in a field should concentrate first on the generalities common to the field, rather than on the specific parameters which make his own sector of the field, or his own organization, "special".

Process of field-building is acquiring a library of basic structure understanding. A library of some 20 systems in corporate operations (which does not yet exist), would serve to examine 90% of corporate problems. Practitioner would need the library, and a full knowledge of the symptoms which accompany each system.

Corporate growth and market share work. (see "Industrial Management Review", Winter 1968, page 83.)

Railroad engines and hula hoops both have long lead times to prepare for manufacture, and short lead times in learning application. Transistors, as the opposite class, have short manufacturing set-up time and very long time requirement for customers to learn uses. (Factors influencing domination of markets.)

Aurelio Peccei



Reality; The world around us.

Ecological Response to Reality; including all the animal kingdom. A tiger knows how to be a tiger.

Ethos; does man know how to be a man? Great potential for disorder and disaster.

We risk arriving at descriptive models of the future, based on frozen concepts of today's values and goals. Need great swerve in values, and ability to project.

Jay W. Forrester

- Modeling approach can handle this kind of concept. Changes in table functions, for example, can represent changes in the way people respond to their environment.

Gordon S. Brown

- Need for consideration of values led to invitation to MIT's Humanities Department Chairman. Pioneering should be done in our educational institutions, and it now is not.

Hasan Ozbekhan

Jay W. Forrester

- Can you insert value changes into models?
(Yes, by inserting change processes themselves.)
How express the values? (Express alternatives ahead, and let the people form their values with understanding of where present values lead.)

Can we introduce specific values, to demonstrate what is needed? Reaction time to change values is dangerously long. (This is what we are about; we need the structure in order to demonstrate the impact of alternatives. We are here now because existing structure is degrading continually. System is not currently optimizing anything, so the level of performance is quite low. Not a "zero-sum game". Can improve some sectors without penalizing others.)

Dennis L. Meadows

- "Values" is really a reference to desired levels in the system. Validity of values is not at issue; only the consequences are.

Jay W. Forrester

- Knowing what can be changed, and how, the modeler can simulate system action. Short-run vs. long-range ethics. Asking the population today to suffer, for the benefit of the long-range future, is a ticklish business. Banfield on time-horizons of population classes, in The Unheavenly City.

Hugo Thiemann

- Adding table functions to show all new values may make it very complex. Human being is the engine. Assyrians had a predictive model for the moon's movement, but its basis was wrong; it didn't rotate around the earth.

Aurelio Peccei

Jay W. Forrester

- Values are integral to what we are doing. We operate on what we believe to be the facts - on our perception of the state of affairs. Even the simplest systems, such as the filling of a water glass, have implicit goals. Policies represent the action, to reach those goals.

Altering system by changing mass values may be a losing game. But most systems do contain sensitive points, which will radiate new perceptions of the state of affairs. The actors, or policies, of the system can still use their old values, but will change their actions because of the new information they see.

So it should not be necessary to ask people to change their basic motivation. Problem is to find the sensitive points.

Eduard Pestel

-

Table function consistency. Need care in how sensitive factors might be changed.

John F. Collins

-

Before modeling, city politicians promised more and more to everybody. Pie not big enough to cut that way.

Eduard Pestel

-

Perception times in World model? May make instabilities in system.

Jay W. Forrester

-

Perception times will not affect equilibrium, but have great effect on the path traced in reaching it. Needed in world model.

July 22, 1970
10:30 AM

JOHN F. COLLINS: CRISIS OF THE CITIES

Reminiscences. Inaugural address of 1960 gave views of city problems at that time.

At some point in deliberations here, you will give thought to problems of implementation. But first: lawyer at 21, service in Massachusetts House of Representatives. During recovery from polio, opportunity to consider model of city, leading to election in 1959 as Mayor of Boston. Election slogan "Stop Power Politics". Little guy's candidate. Entire power structure backed Power, and Collins turned the arrow. J.F. Kennedy story. Attitude toward responsibility, and toward City Council. "Not speaking of participatory democracy".

In 25 years preceding, Boston had lost 25% of its tax base. In 10 years preceding, Boston had lost 100,000 population. Taxes rising. No building boom after World War II. Blight rampant. Population and power structure had lost faith in government.

Mental Model: 1) Stop all new programs; hire no new people; reorganize. Austerity.
2) Begin a different kind of Urban Renewal; starting with 10 simultaneous programs involving citizenry in decision-making, and businessmen in planning.
3) Intergovernmental function and responsibility. Most States in U.S. are still reviving the stagecoach. State tax law. Collins set up meeting of candidates for governor, procured State tax program. Made some enemies, perhaps, doing it.

So came to MIT after seven years as Mayor. Luck, or Howard Johnson's acumen, placed his office across the corridor from Jay Forrester. Jay asked whether Collins could recruit a group of people "alleged to know something about cities." "How about next Tuesday?" And so began Urban Dynamics.

Implementation. How do you go about repairing a "Washington Park" slum area? Over 200 meetings in the neighborhood, asking how residents saw the area's future. Dialogue on goals and values. (Admission: leaders of meeting shape initial points of departure, and influence end decisions.) Residents said "we want to be residential."

Now see that pure housing not sufficient. If we had known it in those 200 meetings, could have done something about it. Could have talked about decay, tax law, building abandonment. Could have used opportunity to bring in jobs for indigenous people, training, economic self-determination.

It is true that short-term abrasion must be suffered for long-term gains. Vast educational effort needed to show this to involved people. But we can make interim tolerable. Once desired programs are reduced to desired laws, the short-run problem can be coped with. Palliatives can handle it.

Jay communicates Club of Rome's sense of urgency.

Private sector involvement. Trash collection by private contractors in Boston costs half.

Public has no comprehension of real problems. Critical need is for translators between public and technology. That's the reason for Urban Dynamics, and perhaps for World2 as well.

July 23, 1970
9:00 AM

JAY W. FORRESTER: URBAN DYNAMICS

(Editor's note: we will try here to capture only the lecture content which is not reported in the material you have received.)

Background: many different kinds of dynamic problems. Frequent encounters with groups knowledgeable in own fields, but Collins was different: he did assemble the needed expert group for system discussion.

Feeling, even before the group began work, that urban problems were dynamically related--that the job could be done.

Model should never "start now and move forward." It must, to have value, replicate the processes which brought us to "now." Only in this way can we examine the processes which caused present problems.

Boundary of system: must include everything necessary to the central issue, and nothing else. Here is most difficult part of the work--the greatest demand on skill of the modeller. (Copper and aluminum systems quite different.) Beginner becomes immersed in detail, ignoring structure.

Basic nine-level concept of urban model came just before one Sunday lunch, after several weeks of group's meetings.

"Industry" in the model means "industrial buildings." Aging processes--on average--mean different types of employment. "Underemployed" includes those working part time, those in marginal jobs and those who are not even looking for jobs.

Attractiveness concepts and multipliers affecting rates in the model. A good model always makes evident ideas previously unconsidered. Attractiveness is one such idea. It is obvious, but came clearly only because of need for rigorous, explicit explanation of the system.

A good model will do for the system what real life does for itself.

The urban area modeled is considered in relation to the world around it--eliminating need for including factors common to both the world and the city (rising standards of living, technology, etc.). It is this approach which permits a model run of 250 years.

Impact of housing supply on arrival of underemployed is picked as a point of difference. Slope of curve not seen in city measurements now, because our present stagnation operates in the flat range of Table UHMT.

Dennis L. Meadows-

Data-bases, and the use of them to infer structure (as opposed to dynamic modeling) should be examined by the Club of Rome in ongoing program.

Jay W. Forrester-

We are essentially saying that social science data-oriented techniques are invalid for structure analysis. Not proven theoretically, but we should be prepared for the possibility we are right.

Model is a piece of geography--not a political city which can expand its boundaries. So land can fill.

Ratios of housing and jobs for underemployed are virtually constant during the growth phase of the area, and shift drastically when land-filling suppresses further growth. If you wanted to create slums, you could find no better way to do it than by setting up legal structure as it exists. And our legal environment (tax law, building codes, constitutions, local ordinances) was created as attempts to solve the problems.

There is no possibility whatever of a city holding a position more attractive than all other cities. If it were more attractive, people would come to it--and keep coming until the city's attractiveness returned to equality with the outside area.

But the city can have a different mix of features influencing its attractiveness. That mix would define the city's "style." (San Francisco and transportation; Berlin and the Wall.) Delays in the system--for perception times, construction delays, etc.--prevent "instant migration" and contribute to overshoots.

One gets captured by the folklore of a system. It took two weeks after seeing effects of low-cost housing, before the idea of decreasing slum housing occurred.

Impact of slum demolition frequently misinterpreted. Real effect is increase in economic activity gives mobility to underemployed through creation of jobs and opportunity to escape the slum "trap."

Modeller here is omniscient; he knows everything about the model. But he must not presume such knowledge about the real life system. Design of policy must be related to real knowledge. Factors must be found in the model which can be measured in real life. Sensitivity analysis can indicate what policy changes may have an impact. Must relate model coefficients to things present in real life--so real people can tell when they have enough, too much, or too little.

If the force which stops exponential growth is only a tenuous one, drift may follow. Force needs to be a strong one, countering a strong one. "Snubbing force." Politically attractive equilibrium appears stable, unfortunately.

Aurelio Peccei- Generality of model? State housing in Sweden, cultural differences elsewhere. (Coefficients and tables would have to change, but structure itself would probably still be applicable.)

Jay W. Forrester- City problems largely stem from managers' view that "their city is different." Similarities often ignored.

Raymond Gastil- Applicability to special situations...gold camp?
(Might need additional level for Natural Resources.)

Eduard Pestel- Major changes in outside environment--ie. changes in demand for exported products? (Cannot be answered by this model--needs its own model, starting with fundamental questions and issues. System definition and boundary problem.)

Raymond Gastil- Job training program in the model arbitrarily takes
Jay W. Forrester underemployed people and makes them completely equivalent to labor people, at zero cost. It is a perfect program. Result: relaxation of the system's own mechanisms for upgrading people; increase in down migration; increase in outflow of labor; increase in in-migration of underemployed. Verified by those involved in manpower programs.

Transportation improvement gains more congestion.

Common city Statements of Goals attempt to make all things better for all people. Doomed to failure.

Gordon S. Brown-
John F. Collins

Communications advances. Collins on Commission on Cable Communication--envisioning changes in society as selective communications grow.

Eduard Pestel-
Jay W. Forrester

Ghetto area has no product to export. Impact of putting industry in ghetto versus outside? Not a zero-sum game. Need the economic power for ghetto people's purchasing power.

Alexander Christakis-

Spatial distribution? (Age distribution more important where people go is less relevant than the fact they have gone. If people are prevented from leaving, they will build their area to their own liking.

England, or the Northeast Quadrant of the U.S., might be seen as the area in question in the model.

July 24, 1970

9:00 AM

JAY W. FORRESTER: POSITIVE FEEDBACK, TRANSITION
BETWEEN POSITIVE AND NEGATIVE LOOPS, GROWTH, EQUILIBRIUM, DECAY.

Exponential processes must eventually revert to other modes. What happens at end of growth phase? (See paper on corporate growth and marketing.)

Salesmen bring in orders, adding to backlog, producing shipments, bringing revenues, allowing hiring of more salesmen. Positive feedback loop, showing behaviour of a good new product. Limit imposed, eventually, is applied by capacity-and most companies don't recognize it.

Delivery delay negative aspects discourage customers to the point where orders entered cannot exceed capacity.

Great stresses are created by forcing change from positive to negative loop control. Oscillatory behaviour likely. Rising and falling delays, salesman morale. Transitions are the stress points. We may be seeing in world systems now, the signs of internal pressures signalling stop of exponential growth. Strong growth forces go with strong counter-processes.

How to manage the transition to equilibrium? From Urban Dynamics, we have found that forces to limit growth could be chosen, deliberately, during the growth phase. City could select its own negative limiting factors-and then must cherish them...if the chosen set of negative values is damaged, the system itself will substitute a new set.

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

July 24, 1970
9:30 AM

GILBERT LEVIN and EDWARD B. ROBERTS: MODEL OF DRUG ADDICTION
AND THE COMMUNITY

Dr. Gilbert Levin--Albert Einstein College of Medicine.
Dr. Mel Roman--colleague at the college.
Gary Hirsch--student at Sloan School.
Professor Edward Roberts--Sloan School of Management

Levin: teaches and researches in social dynamics, and manages community mental health center in a portion of the Bronx. Tried to interest graduate students; no luck. Solved most start-up problems without planning. Finally funded for projects in applying Industrial Dynamics to improve performance of the Center, and assist in development of others.

Center has circa 250 employees, has hospital beds, serves 180,000 population. Operated by University, paid for by City. One quarter of land is vacant. Working class area. Public housing popular. Minority groups coming in now.

Strategy: pointless to devise policy independently of people who would use it. Had to work with all involved.

Patient Dropout model seemed to work. Began to look for others; narcotics was prime problem of the area. Complex: mental health, police activities, social change -- values.

Data-gathering: literature review, interviews with experts, addicts, police, etc. Laymen grossly overestimate the problem. Data conflicts. People talk about disquiet and call it "drug problem." People concerned with local social change and with generation gap.

Isadore Chein, The Road to H (Basic Books?), gave good system description. Pressure on police to act, with results: they arrest known addicts, so as to get convictions.

There were fewer heroin addicts in 1968 than in 1900 in U.S. Rate of increase was alarming people in 1890 and in 1920. When problem becomes visible, people are shocked.

OPIUM -- MORPHINE, HEROIN, METHADONE
PSYCHEDELICS -- HASHISH, MARIJUANA, LSD & OTHERS
COCAINE
HIGHS -- AMPHETAMINES
LOWS -- BARBITUATES

Heroin was first introduced as a non-addictive substitute for morphine. Taken orally, snorted or injected. Intravenous is most addictive. "Pusher" is a salesman supporting his own need.

Publicity about drugs is political and cyclical. Action is not. Original study concept felt public interest at a peak. But still increasing.

Public official: "I don't set priorities--I have no funds."

Expert: "To avoid effects of dirty-needle-use, teach sanitation."

Crime: Heroin-related crime is committed under need for drug, not under its influence (unlike alcohol).

Treatment programs: methadone maintenance, self-help community groups.

Using Industrial Dynamics as conceptual tool, encouraging dialogue instead of rhetoric. Model is a flexible device for thinking through a problem.

Discussion of model: street addicts, community response, rehabilitation, attitude toward community. Some 250 variables. Talking about people in the model. And about crime-related drugs. Only slight ties between soft and hard drug use. Definitely no causal relationship. Given no drug availability at all, the addict population probably would have become alcoholics.

Discussion here is not advocacy of theories, but only consideration of the community-wide systems problem.

Potential Soft-Drug Population includes everybody from 10 to 30 years old. Users of Soft Drugs includes occasional users (sniffers) of hard drugs.

In addition to methadone substitution, there are therapeutic programs. Community itself resists efforts to set up a therapeutic center which gives visibility to, or attraction to, addicts.

Potential users flow into user pool, and back again. Addicts flow in and out of pools of methadone, therapy and prisons. (See charts to be reproduced.)

Factors affecting community attitude toward the problem, on police versus medical-social problem: number of addicts; level of resources allocated to police; frustration with police ineffectiveness; relationship to arrests publicized; education.

Attitude positive toward medical-social treatment facilitates establishment of treatment programs, and gives credibility to education efforts.

Factors influencing addiction, restraining casual users from turning to hard drugs: education; apparent effectiveness of rehabilitation (which makes heroin less frightening); appeal and availability of drugs; number of addicts in contact with potential users; availability of soft drugs; poverty and psychopathology.

Effects of reducing heroin supply: increase in crime above "accustomed level." Migration factors: alarm at crime; community structure and cohesiveness; community change.

Model runs: exponential growth standard. Eventual (25 year) downturn in number of addicts as result of vast police action; no effect from education alone; no effect from education alone; no effect from methadone alone (but relatively low cost); success with police PLUS education (peak at about 15 years, with recovery to present situation at 25 years); less success with police PLUS methadone.

Implementation: effective programs hinge on community attitude which comes only with frustration at failure of alternatives.

How difficult must life get before people change their attitudes?

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

July 27, 1970
9:00 AM

Jay W. Forrester: THE NATURE OF COMPLEX SYSTEMS

Characteristics of social systems:

-Resistance to policy changes. Systems themselves contain mechanisms which counter attempted changes. We change a policy and expect the flow through it to change accordingly. But the other system components change too, and the new information they generate alters the effect of the new policy. New information, acted upon by new policies tends to produce the old results.

-Influence points exist. When these policies change, the new information generated radiates through the system, altering the effects of other, unchanged policies. Problem is finding the influence points which can, in real life, be controlled. Second problem: determining in which direction to make a change...here is the "counter-intuitive" nature of system behavior.

-Complexity of a model is independent of the complexity of the system itself. Aggregation of minor influences is key. Need penetration into the system only far enough to bring understanding. Sixty levels in corporate model are possibly too many. Single biological cell would require as many levels in model as would world system.

-Number of levels ("order"); number of loops interacting; nonlinearities--all characterize "complex" systems.

Hugo Thiemann-

Danger of oversimplification. Club treating world as a whole; some say it must be treated separately, as character of developed and underdeveloped areas differ so widely.

Jay W. Forrester-

Many very important issues can be handled by aggregated model: impact of industrialization comes through clearly. This model cannot cope with issues of disparity between areas; a disaggregated model would have to be built for that purpose. But simplicity must come first, to bring enough understanding to do the work at a more complex level.

Dennis Meadows-

First approach should be determining what question should be answered. John F. Collins: "make things better."
Eduard Pestel: "quality of life."

If we had two separate worlds, without interaction, then entirely separate models would serve.

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

July 27, 1970
10:00 AM

DENNIS MEADOWS: DYNAMICS OF COMMODITY STABILIZATION,
BASIC MODEL

Economist in 1876 concluded that pig price advance and decline was most certain factor in past 20 years. Still true now - for 120 years, and for 33 basic commodities. Cycles are vital to underdeveloped nations, 90% of whose exports are composed of these commodities.

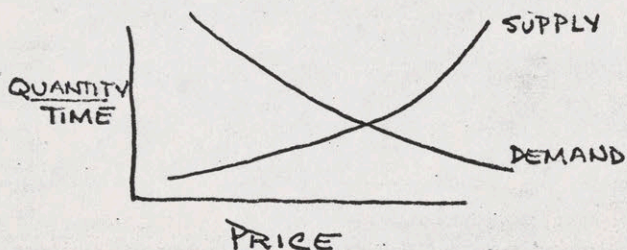
In decade of the '50's, commodity prices declined relative to manufactured goods. Attempts made to stabilize, but they failed.

Plots of prices and deviation from the mean yield 5 to 25 percent variations, depending on which commodity. Bolivian tin dependence related to political strife. Risk in agriculture can't be borne by peasants, so land remains concentrated in a few hands.

Approaches to stabilization:

- (1) Buffer Stocks, where third party holds an inventory and enters market to stabilize price. Cannot work.
- (2) Buffer fund, where producer sets a firm internal price and sells at open market price. (Ghana and cocoa)
- (3) Long-term purchase agreements. Wheat sold by Canada and U.S. is relatively stable in price...but requires political power to work.
- (4) Quota systems, where producer countries hold product off the market.

Characteristic behaviour of described two-level system is oscillatory. fluctuation of commodity prices gave rise to economists' "cobweb model", a general theory of behaviour.



Assumption of supply and demand curves, and tracing response to sudden change, is exactly analogous to modeling on the computer. But time scope very limited, and assumptions unreal.

Problems in attacking a new area with dynamics modeling: people say phenomena cannot be understood; people say that data is not available.

Literature relates price to production rate. But in reality, commodity prices are related to inventory.

Confidence in model depends on its behaviour relative to the real world. Price cycle model works. Not applicable to such problems as Ghana's internal response to cocoa price changes.

Structure of system can be defined before the basic question of values is approached.

System structure itself precludes making some changes. Noise input causes regular cyclical oscillation - even with no regularity to the exogenous input. Without noise, system would damp out.

Buffering agency, set up with equivalent of 2 months' product and money, succeeds in stabilizing price so long as its desired price is precisely equal to actual market levels. Buffer agency cannot change average price. If it attempts to stabilize with a target price rapidly adapting to recent market history, it can succeed in stabilization.

PROCEEDINGS OF THE CONFERENCE ON DYNAMICS OF SOCIAL SYSTEMS

July 28, 1970
9:00 AM

JAY W. FORRESTER: SKILLS AND TRAINING NEEDED
FOR SOCIAL SYSTEMS DYNAMICS

Social Systems Dynamic analysis proficiency requires the same degree of training as any major profession. As in medicine, some education is valuable to anyone. But a few days of concentrated study does not give proficiency. Like watching a surgical operation from the amphitheater.

We are on the threshold of a whole new era. Human history characterized by frontiers -- in art, government organization, literature, music -- and most recently in science and technology. Next frontier must be understanding of social systems -- human prejudices, psychology, folklore, traditions, modes of living.

Individual who does well in social dynamic systems does not fit the popular image. In general, mathematics, statistics, physics -- do not fit a candidate well. Theories of dynamic interaction are not widely taught...appear in portions of electrical engineering, mechanical and chemical and aeronautical engineering. Gradually, approaches to non-linear systems are spreading.

Hagen's book on social change is outstanding. Deals with emergence of primitive societies -- and often used as a model of the corporation. Sets authoritarian personality (gov't. corporation and primitive tribal leader) as one who fits into the system and runs it, making the best of what he does not understand. Innovative type, in contrast, believes understanding is possible, and that -- with it -- it is possible to influence the environment.

Hagen believes the personality type is established by age of six. Forrester feels some innovative traits may remain through college, before it is stamped out.

Social system analysis appears to require the innovative type of personality -- not typical of the highly trained mathematician. Requires a man who will act on imperfect information -- who recognizes need for decision based on best model available. Pure science trains people as critics, not movers.

M.I.T. Industrial Dynamics curriculum begins with a laboratory, develops with courses on theory, and proceeds to applications-oriented activities. Reasonably full course through master's degree. Still developing educational programs; after 15 years, we have only 30% of what would be needed for a full professional school.

Hugo Thiemann

- How do economists and political sciences serve as preparation? (Best candidate is feedback-trained, but has moved on to management or politics, where reality is king. Unrealities of economics traditional education are a positive detriment.)

Eduard Pestel

- Student difficulty with block diagrams shows problems in conceptualizing flows. Dynamics approach can make it clear.

Theoretical approaches can produce equation-orientation divorced from reality. Mathematical approach. Control system practice is needed, more than theory.

Gordon S. Brown

- Deploring "over-intellectualization" (Killian). Real hardware emphasis is declining. Students are right in concern over relevance.

Every available approach to systems visualization is needed. Theory up through LaPlace transforms is useful. Tendency for young faculty is to find security in theory, because of availability of proof. Right mix is critical.

July 28, 1970
9:45 a.m.

JAY W. FORRESTER: CORPORATE GROWTH MODEL

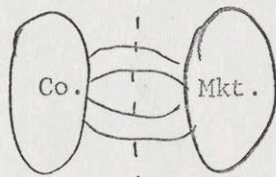
Experience with corporate organization since 1940 made Industrial Dynamics seem applicable to problems of business growth. Literature is abysmal: only one pertinent book known: Edith Penrose, Theory of Corporate Growth. Speaks of managerial decision processes and does deal with whole scope of problem.

Modelling begins with a question: why are there differing patterns of growth? (Smooth exponential growth stabilizing; growth interrupted by crises; growth followed by fluttering; growth followed by crash.)

No correlation with product quality, or with type of industry. "Good" vs. "bad" management is true, but not sufficient for understanding.

Approach requires generality; modelling a single company would be a mistake. Focus on technically based corporation. Approach requires a viewpoint apart from the specialized functions; presidential eye too is biased, and too close to activity; stockholder viewpoint too ignorant of detail. Taken here--the viewpoint of qualified investment banker--concentrating on management and men more than on business detail.

Form of model structure took two years' work, resulting in



Identifying what passed across the boundary between the company and its market: product, quality, "newness", difficulty of getting product (delivery delay), price, etc., flow from company to market. Orders, money, and market attitudes toward company aspects flow into the company.

Six weeks' work, with a school class, developed the actual 60th order system. . . 260 variables, the most complicated model Professor Forrester has done.

Model describes intangible information flows and decision-making processes--mostly information outside the accounting system. Top management power structure.

Model deals explicitly with how goals and traditions of the company are generated.

Model deals with the pressure system operating on the the organization. Quality, marketing, financial strains, etc. These pressures influence other decisions made in resource allocation--hiring, spending, etc.

Model deals with quality of information. No information is absolute representation of true state of system. Deficiencies here cause most major problems of real companies.

A. PECCEI/
G. S. BROWN:

Corporate model deals with a substructure of the world ecological system--one whose aims may be counter to the benefit of the whole system.

J. FORRESTER:

A policy requires information, a goal, a measurement of the discrepancy between perceived state and desired state, and action to change a rate of flow. A desired inventory of six weeks' product supply is a goal which is itself a child of the company's history. An operating goal for quality may originally be set by founders--but representing it requires a scale. Arbitrary scale of zero-to-ten may be based on examples known to the company.

On reading a quality goal, other pressures begin to operate. Reasons for claiming company resources are based on out of control situations. Quality will be sacrificed for aiding other, more troubled areas, until its degree of trouble equals theirs.

Tradition influences operating goals. So does an "absolute goal"--to which the founder or leader clings in spite of failure to attain it. A "weighting factor" determines whether tradition or absolute goal dominates. Tradition, over time, moves toward perceived quality level. Absent the absolute goal, the system will run down, because pressure mitigates toward actual quality being less than tradition, and tradition follows actual quality downward.

Ability of the manager to preserve his goals (his values) in the face of adversity. Few men can project their goals over an entire organization . . . Watson at IBM, Haggarty at Texas Instruments. Distortion of goals at different levels is more typical. What is happening at lower level may be just opposite of top-level concept.

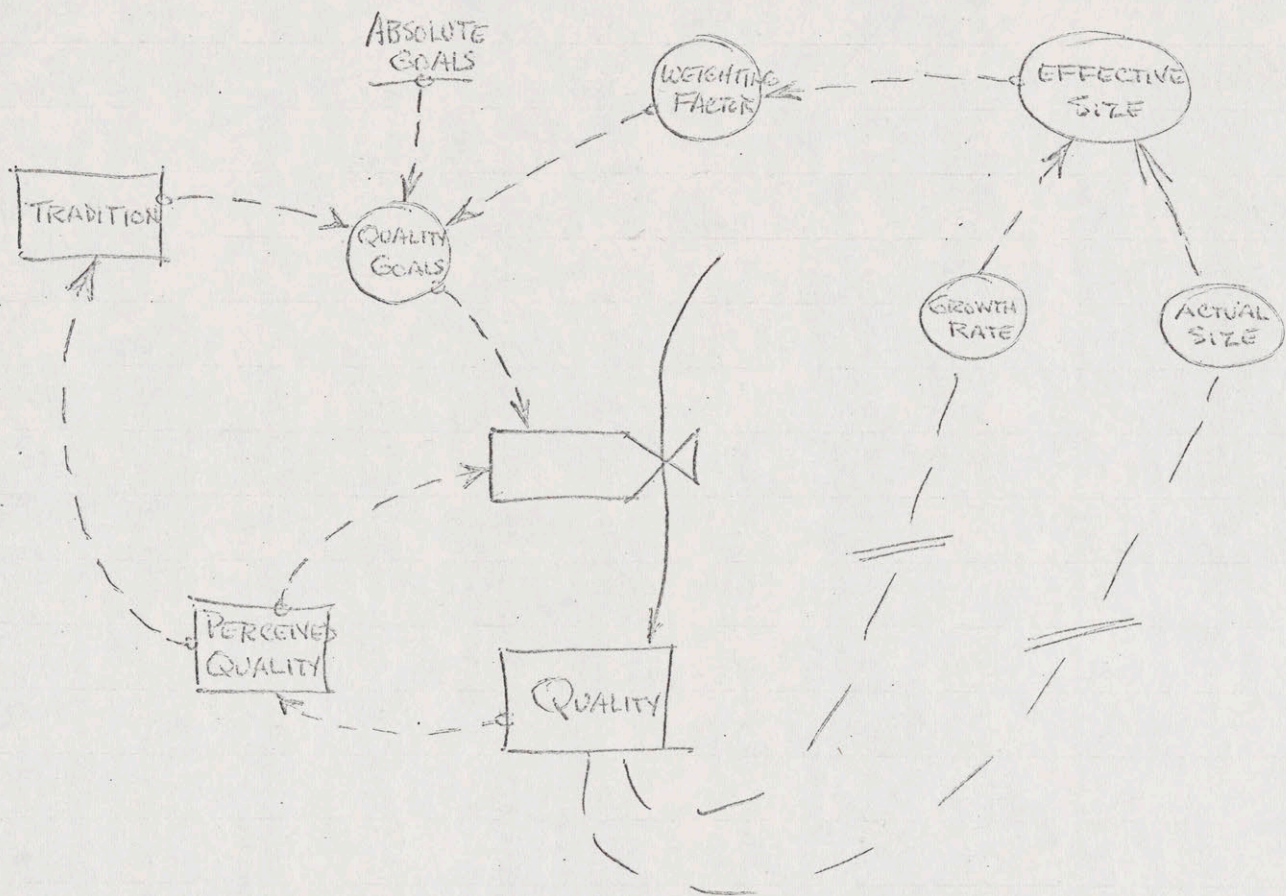
Tom Watson, Sr., visiting a plant would ask questions about some process, and keep pursuing it through departments, trying to find answer. Turmoil would result, without scolding, while the plant scurried for answers. Impact lasts for years. Top man of other company follows set, planned, pretty route on tours.

Effective size of organization, actual and growth rate, affect the ability to sustain high standards. New people coming in, with own average value structures, will attenuate higher standards in the organization.

People grow accustomed to what has been. Content with large order backlogs.

Information defects:

- 1) Persuasiveness. "Hard" information, particularly financial, is more persuasive than "soft". Can't measure much about customer attitudes; easy to ignore it.
- 2) Delay. What we see is what was, not what is. Sometimes delays very beneficial.
- 3) Distortion. An averaging process distorts by suppressing high frequency changes in favor of long-term trends.
- 4) Bias. Viewing a complaint letter as "unusual".
- 5) Cross-talk. Hearing what was not said. Or saying what is not meant--complaining "the price is too high" in place of design or construction flaws. Transposition. Cutting price deprives company of resources needed to fix real problems.
- 6) Error. Random mistakes. Trivial impact on the system, but the target of most efforts to avoid trouble.



July 29, 1970
9:30 AM

EDWARD B. ROBERTS: DESIGNING A SYSTEM FOR COMPREHENSIVE
COMMUNITY HEALTH CARE.

Harvard Medical School approaching problem of delivery of health care. One of the most noted medical schools in the world - characterized by aloofness, self-interest, and insularity. New Dean demanding more involvement in community medical problems. New Associate Dean is attempting to design an insured medical program for working people, to create and sponsor a "group medical practice", as a pilot project for others to follow. Had model of an effective program in California.

Tried modeling of the system as an aid to planning, and as documentation of the development, and as a research tool for future action; and as a teaching tool.

First problem: lack of understanding by doctors, and lack of ability of doctors to communicate with laymen. Doctors are taught to react instantly, and correctly, at the point of crisis. They have not been taught deliberate, causal analysis. Their professionalism is different than others'.

Dynamics model: Medical care requirements treats patient's processes of getting sick and presenting needs to the system; if we know more about health, we ask for care more often. "Known and unknown morbidity". Same dimensioning and measurement problems as in "quality of life". Higher insurance costs give higher morbidity subscribers, and higher costs. If plan can be low-cost enough to attract healthy people, then risk can be spread. Harvard also interested in educating their clients - but that means higher demand for service, leading to swamping the system.

The Doctor Sector treats allocation of medical staff time - clinic, hospital, patient screening, teaching, research, and own education. At Harvard, all areas must be touched: too much time on patient care would raise negative response by the faculty to the program. Key problems here arise from character of Harvard - but would show in other medical schools as well.

The Hospital Sector shows domination of few institutions in teaching hospitals, taxed to the fullest. Health program would face shortage of beds. Many patients are hospitalized for convenience and economic reasons, for both the patient and the doctor. Rate of discharge of patients itself depends on number of patients waiting to enter. Even the decision to hospitalize depends on number waiting - alternative is to send the patient home. More beds would mean longer stays in the hospital, more hospitalizations. And studies find no conclusive benefits from hospitalization.

Harvard insisted on assuming full enrollment of 30,000 at the beginning of the program. So model concentrated there. Mistake: their

big problems are start-up problems, and full enrollment is slow in coming.

Work with professionals in other fields requires contact. Sociologists, for example, have different methodological philosophy as well as concepts and jargon. Book on regional development required close work with widely varied economists, sociologists, demographers, etc. Collaboration and compromise. Advocacy of structure, and use of talents of data-gatherers.

Dynamics of the World Cocoa Market, by Helmut Weymar, combines techniques of dynamic analysis and econometrics.

Acceptance by broad community requires active participation and understanding by the representatives of that community.

July 29, 1970
11:00 am.

SUMMARY - CLUB of ROME PROJECT -

The extent of MIT Industrial Dynamics training program? Beginning course one of the most popular in the management curriculum--students elect it as a portion of their own educational programs. In industry, the best work is not published. Dynamo compiler widely used. International work, but we do not know well the calibre of the work.

EDUARD PESTEL

Psychologist name 'fear' as the driving force behind student unrest, crime, warfare. How can it be represented in the world system?

AURELIO PECCEI

Need to drive people to think in systematic channels. Problem is to bring people to see. This would bear on fears, and put them to beneficial use.

RAYMOND GASTIL

Unless fears essential to the way the system acts, they would not need specific inclusion in the model.

EDUARD PESTEL

Need explanation for phenomena: human reactions of fear and hope (German saving repeated after financial collapse.) arms race.

JOHN F. COLLINS

Fear could be a reaction to other forces, rather than a force in itself.

JAY W. FORRESTER

In approaching such discussion topics, two courses are open: theoretical, vs. pragmatic. Might be useful to try adding fear to the model.

GORDON S. BROWN

Changing tack: need for education and appreciation at level of United Nations working staff. In India, fear of isolated old-age drives population up. Ford Foundation work on birth control still lags behind.

AURELIO PECCEI

Lacking in model: "social pollution" - fear, frustration, insecurity, tension, etc. Not level of richness, but level of rationality.

GORDON S. BROWN

In one year, develop 100 convinced individuals at the level of Presidential speech-writers.

JAY W. FORRESTER

Issue is decision of what impacts (psychological) factors have on a structure. Takes very concentrated effort, but results in much clearer idea of what they are and what they mean.

A level for Fear would be increased and decreased by rates. Comparison of present states with historical states would show discrepancies; extrapolations could affect fear creation.

DICK DOUGLAS

In Cleveland fear has had profound impact on city migration, housing, crime, decay.

JAY W. FORRESTER

Process can be modeled if it can be stated. Need is for clear description--with model, test of importance is possible...fear might be important.

Model purpose is to show impact of present value system on the future--to create fear, in hope of changing value set itself.

EDUARD PESTEL

We know that fear can be capitalized upon by a few individuals. They can be driven into a frenzy to change the world.

People react by moving away from changing ethnic neighborhoods, while alternative is available. Lack of alternative would force people to live together.

AURELIO PECCEI

Thanks of Club of Rome. Plan for future action, now seen, is not so far as we would like to go. Hope that next step will be larger. Look for gain in our relationship with "our clients." The meaning of our step is in its direction, not in its length.