THOUGHT CRITERIA FOR USE OF SYSTEM DYNAMICS

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ABSTRACT

The purpose of this paper is to explore the thought criteria of modelling in system dynamics.

Thought criteria of system dynamics has appeared as a dynamic theory in the field of economics. This field has three characteristics: nonlinear fluctuation, time delay and qualitative transformation. These characteristics constitute the basis of model building in system dynamics.

The concept of thought criteria is based on the process of cognition: Study of subject--Modelling--Understanding of object. It is closely associated in series with interactive elements of the system. The modelling has been inspected in practice as a transitional link between subject and object so that modelling has turned into a cognitive and analytical method and will be used, first, to carry out simulated tests of the prototype and thus deepen our comprehension of it; secondly, to compare the specific properties of theoretical and experimental systems with those of the real system, and by means of the result from these comparisons, to improve a causal relation loop; and thirdly, to show a tendency to pass from qualitative analysis to quantitative analysis, thus leading to the combined assessment of the system. The rules of the combined of the application of the system model are identification, interchangeability, controllability and availability.

1. INTRODUCTION

System dynamics as a total system mathodology has been received a great deal of attention in both the hard and social sciences. System dynamics studies the laws of dynamic behavior of information-feedback systems. It uses computer simulation to provide some understanding and improve the ways in which complex systems of human activity may be improved.

Modern natural science came into being only after the

emergence of experimental science. Now system dynamics has constructed a bridge between the natural and the social sciences.

The computer simulation method has played a relatively important role in both sciences, and pushes forward a strong knowledge flow between them. This has two results, one being the use of achievements in natural scientific research to overcome complex problems in national economy; the other is the use of natural sciences to fulfill socio-economic demands.

Thought criteria of system dynamics has appeared as a dynamic theory in the field of economics. In the past three decades the great successes achieved by system dynamics have transformed social system model building into a scientific means of understanding society clearly.

2. THE UNITY OF SYSTEM IN SYSTEM DYNAMICS MODEL

The degree of similarity between a model and its prototype is never complete. As model testing is carried on by the system dynamics method, modelling in form is a concentrated expression of the subjective, but in content, it is an objective law of activities of the objective, characteristics, unity and coherence as well as relative reflection of the true situation in the decision process.

Within our cognizance of the system elements, the unity of system in system dynamics may be expressed in four aspects:

1). The studied system is an amalgamation of multiple factors which condition each other. Its elements are in a controllable position.

2). The characteristics of the relation between the various elements gives rise to the characteristics of the system as a whole.

3). The factors which control the element's characteristic also effect the behavior of a system.

4). The relation of each element in a system structure is pluralistic, and causes the different kinds of system function.

In the case of system unity, system dynamics models mirror a dynamic trend in economic field. This field has three characteristics: nonlinear fluctuation, time delay and

qualitative transformation. These characteristics constitute the basics of model building in system dynamics as follows:

Field Characteristics	Expressible Principle
1). Nonlinear fluctuation	Behavior of a system
2). Time delay	Dynamic input/output flow diagram
3). Qualitative transformation	Cause-and-effect information-feedback loop

As an organic whole this model testing includes observition, analysis and synthesis, induction and deduction, and draws a correct conclusion from objective facts. Therefore, system dynamics as a total system methodology has two parts, program and analysis. The causal relation and interaction of elements in practice are systematized by program; the analysis is calculated in mathematical program by computer. Meanwhile they are judged by man's understanding.

System dynamics over many years has been applied to a wide variety of situations with modern scientific theories in practice such as:

For System	Means and Ways
Description of system structure	Quantification and Graphics
Feedback of information flow	Cybernetics and Information theory
Construction of modelling	Mathematical statistics and Analogy
Analysis of system behavior	View the situation as a whole with Competition theory and Decision science

3. STUDY OF SUBJECT__MODELLING__UNDERSTANDING OF OBJECT

Modelling is an abstract means of studying objects. For this step, knowledge and social practice are not a goal in themselves, but a means of reaching the stage of simplified cognition and shortening the information flow process obtained from social prototypes.

This type of modelling simulates the properties of real objects. The conception of thought criteria of system dynamics is based on the process of cognition: study of subject--modelling--understanding of object.

The control relation are present in the various natural objects, such as in the technical organization, biological system and social action. There are many factors, some of which can be controlled, but some of which can't, so we need to study specific types of relations. The object of study is not merely certain, concrete elements, but a whole system.

While we probe the unity of complex society, the reflection of a direct judgment through the senses is not the essence of an object, but the characteristics of what is observed or indirectly perceived from objects. It arises from the process of recognition: Image--Problem--Idea. This idea expresses the synthesis of the actions of society. This synthesis in turn dynamically affects the model.

Now we have the means to handle complex problems by synthetic methods. A given factor existing in one area of a model may affect other areas. The factors and actions may result in instability. System dynamics has been carefully thought out to handle unstable situations, and it has related the subject (such as social individual, social group, social levels) and the object (such as natural, social, and industrial systems) to each other in modelling, and reached the goal of regulation and control of their interaction.

Modelling has been inspected in practice as a transitional link between subject and object so that modelling has turned into a cognitive and analytical method and will be used, first, to carry out simulated tests of the prototype and thus deep our comprehension of it; secondly, to compare the specific properties of theoretical and experimental systems with real systems, and by means of the result from these comparisons to improve a causal relation loop; and thirdly, to show a tendency to pass from qualitative analysis to quantitative analysis, thus leading to the combined assessment of the system.

The qualitative analysis of system dynamics is that it identifies the causal relations in a structure of system, the

positive roles among elements and the kinds of information flow in input/output relations; and describes their cyclical behavior, delay interaction and model validity; and delimits the boundaries of the system, the frontiers of the closed loop and causal-loops diagram; and recommends the changes of control policies.

The quantitative analysis of system dynamics is that it examines the selected structure of system, the results of the decision process and the benefits of optimum control; and provides policy choice for economic growth.

4. EVALUATION OF SYSTEM MODEL

Flow diagrams are essential to design the final quantified simulation model.

The rules of the combined assessment of the application of the system model are identification, interchangeability, controllability and availability.

It is considered that the evaluation of the system model is very important. System model draws a clear distinction between characteristics of each part in the system and makes also clear the interaction of parameter changes thus providing level control with material flow.

5. CONCLUSION

The Thought Criteria for use of system dynamics is very important, we can use it to acquire a better understanding for building model of system dynamics.

REFERENCES

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