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SYSTEMS THINKING IN THE STUDY OF HOUSING DEVELOPMENT IN HONG KONG NEW TOWNS

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ABSTRACT

In this paper, we have applied system dynamics to analyse housing development in Hong Kong new towns. Because housing development is concerned with many factors such as population growth, employment, personal income, gross domestic product and government policies, it is a complex social-economic system that demands system thinking for its solution. We have constructed a system dynamics model that attempts to describe housing development in new towns. In this model, the interactions of various factors in urban housing development are taken into consideration. The model has been implemented in a computer simulation package named "I think". The simulation provides a trend of future housing development in Hong Kong new towns. These results can assist decision makers produce more appropriate plans for future housing development. We found that the application of system dynamics into housing development is a new and fruitful attempt.

INTRODUCTION

As in other places of the world, the Hong Kong government is also facing many challenges in urban housing development. The rapid population growth combined with the lifting of the previous tight controls over urbanization have been placing increasing pressure on the demand for housing units in urban areas.

Urban housing investment and development involves many issue of a complex system. The system has many features such as interrelated, non-linear, and multi-loop feedback. In dealing with this kind of system, we must have "Systems Thinking". "Systems Thinking" is widely used phrase in science field. "Systems Thinking is the art and science of linking structure to performance, and performance to structure-often for purpose of changing structure (relationships) so as to improve performance." (Richmond, 1993). We should also have a suitable research approach to study this problem. System dynamics is one of the useful methods in this field, because it supports the analyses of the structure and the cause-effects influence of the real system (Wang, 1988). By establishing the interactions of the major variables and using historical data for these variables, we can simulate and reality and observe the degree of influences among these variables.

Different fields of science have used different system approaches (Ossimitz, 1997). System Dynamics is a powerful method for studying the world around us, and it is also a suitable method for describing interrelated systems. System dynamics approach was founded by Jay W. Forrester at MIT at about 1960. It using causal loop diagrams, stock and flow, the simulation language for the numerical simulation of the system. It can accept the complexity, nonlinearly, and feedback loop structures that are inherent in social and physical systems. System Dynamics is a set of techniques for thinking and computer modelling that helps practitioners to understand complex systems. Unlike other scientists, who study the world by breaking it down into smaller and smaller pieces, system dynamics help us keep track of multiple interconnections; they help us see things as a whole. The essential concept to system dynamics is to understand how all the objects in a system interact with one another (MIT SDEP, 1996).

Urban housing problem has been embarrassing many governments., the reason is that it is a complex social system. The professional field known as urban housing investment to be many factors into consideration, such as urban population, birth rate and death rate; national economy and income; development of infrastructure; policy of

government; influence of finance environment, city plan and traffic between centre and new town, etc. In urban economy development, the most important factors are population, land and housing (Forrester, 1969), all of the factors were built in to our model.

This paper illustrates a descriptive and simulation model for Hong Kong new town housing development. The study based on the "system thinking". It uses system dynamics to enunciate the relations and influence each other of the corresponding factors for urban housing developing. The model established the quantity relationship between the several subsystems. The factors in these systems are all concerned with urban housing development. The computer simulation results can be the basis for investment and decision in urban housing development.

BACKGROUND OF STUDY

Hong Kong as a whole covers a land area of about 1,095 square kilometres (Census & Statistics Department of HK, 1997) and urban development in Hong Kong was first started in the mid 19th century. However, because of the rugged terrain surrounding the harbour, the early settlement was mainly established on terraced hillsides and on reclamation formed on both sides of the harbour. There was no proper town planning in those early years.

Facing the more and more crowded city that the Hong Kong government presents the plan of new towns development. The new towns program was initiated in 1973 to provide housing for 1.8 million people. Three new towns, Sha Tin, Tsuen Wan and Tuen Mun, became the earliest new towns in Hong Kong. Up to now, the new town program has expanded continuously to cope with the increase in population. The number of new towns has increased from 3 to 9 (The Housing Bureau of HK, 1997).

The new town housing development is considered as a complex problem. It is concerned with many fields of a society. It is a big system that constituted by several

subsystems. These include "hardware" and "software". Hardware refers adequate infrastructure, efficient transportation system, reliable utility services and a full range of community facilities etc. Software means the situation of moving population, selection of place to work, educational facilities and peoples' tastes and preferences etc.

How to develop a new area that is provided with gravitation for urban residents? This is an important topic during the planning and design process. The basic concept used in it is to provide a balanced community as far as possible. As above show, this includes good housing mix for both about the public and private developments, adequate infrastructure, efficient transportation system, reliable utility services, a full range of community facilities and a variety of supporting developments. All of these fields should be treated as a system.

THE SYSTEM DYNAMICS MODEL

MHKNT, a model about new town housing development is introduced. It is used to describe the Hong Kong new town housing development. Social systems are far more complex and difficult to understand than technological systems. Why then do we not use the same approach of making models of social systems and conducting laboratory experiments before adopting new laws and government programs (Forrester, 1971)? The System Dynamics model is a good policy laboratory to study of the social economic system (Chen and Jiang, 1995). We just built such laboratory for Hong Kong new town planning and development. We think that the research project has challenging and reality. The study of the new town housing development by using system dynamics approach that it is a new attempt in the professional field. The model can be successfully simulation the new town housing development. The investigation will be of significance to future researches in this field.

This project has explored the application of system dynamics to real problems. The objective of the project is explore how problems of great complexity can be dealt with.

The policy-makers will benefit from this study by running the models, analysis results of output, becoming familiar with how they work, and then experimenting with them.

The main aim of the study is investigate housing supply and demand in new towns. Figure 1 is a influence diagram that showed the corresponding main factors about urban housing development. The model is composed of the sub-system of population,

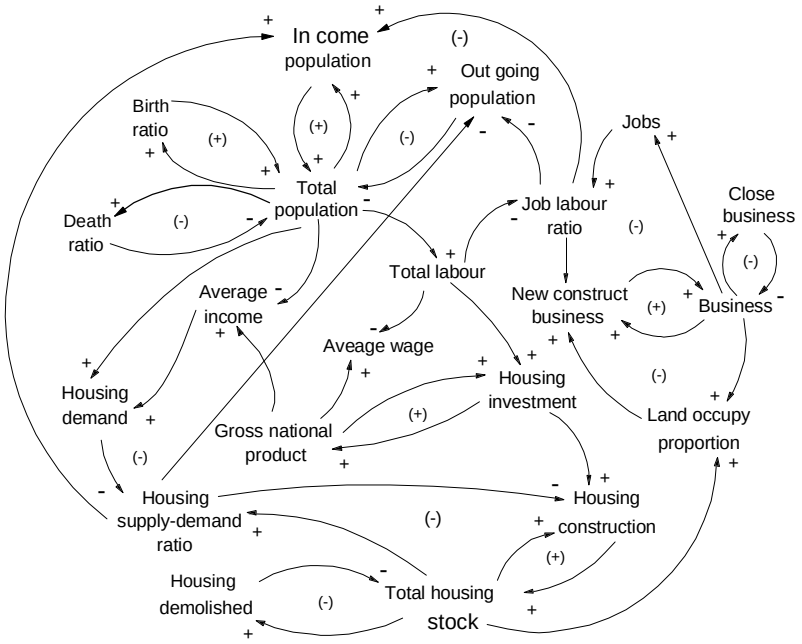

Figure 1 simplified influence diagram for the MHKNT

business activities, land use, housing development and economics. There are four major factors that determine the future status of the system at any time, they are total population, business, housing stocks and gross national product.

The total population is a key factor in this system (Su, 1988). It affects many other factors within the system. The population subsystem includes total population, natural growth ratio, change of emigrants and immigrants, etc. It not only influences the demand for housing, but also affects other things such as employment.

Housing supply-demand (S-D) is taken as an exogenous variable. It is both a beginning stage and end aim of the housing industry. There are many factors influenced housing S-D. Except the factor of population and change as above indicated, there are other factors such as income, housing price, family of structure, government policies etc. The most important influence on the housing market is total housing stock.

The housing market is an important part of the property industry in Hong Kong. It follows the economic circle, and plays an important role in the big economic circle that composed other industries. The production in the housing industry is also influenced by the whole social economic circle system. In the model presented, the relation between the housing investment supply-demand with gross national product is presented.

ANALYSIS OF SIMULATION RESULTS

Now we can simulate the housing development with computer. This study based on several factors that are important for Hong Kong new town housing development, i.e. population, land, and housing. Less important factors have been excluded in our model. It is a spatial analysis for the housing development in Hong Kong. This model is used to simulate the development of urban housing and other factors at the city for many years in future. We obtained the results that are intensely concerned with us. The result of computer simulation is shown in figure 2.

In figure 2, we can see the population in new towns will increase for many years in the future (curve 1). At present, the total population is over six million in Hong Kong. Thirty years later the population may reach nearly fourteen million if no changes are made on population and immigration polices. Another result is that the total number of enterprises in the area will decrease for many years to come (curve 2). This is because the economic structure in Hong Kong has transformed in these years. The proportions of land use for housing and for business have also changed. The accumulated housing

(including new constructed and rebuild) will increase step by step (curve 3). The amount of investment in housing will be a gradual changing process during this period, from fast increase is early days until steady development is later days (curve 4). The rising trend of housing demand will not change for a long time (curve 5). Because of the large number of people and limited land resources in Hong Kong, it is very difficult to keep the balance between the housing supply and demand.

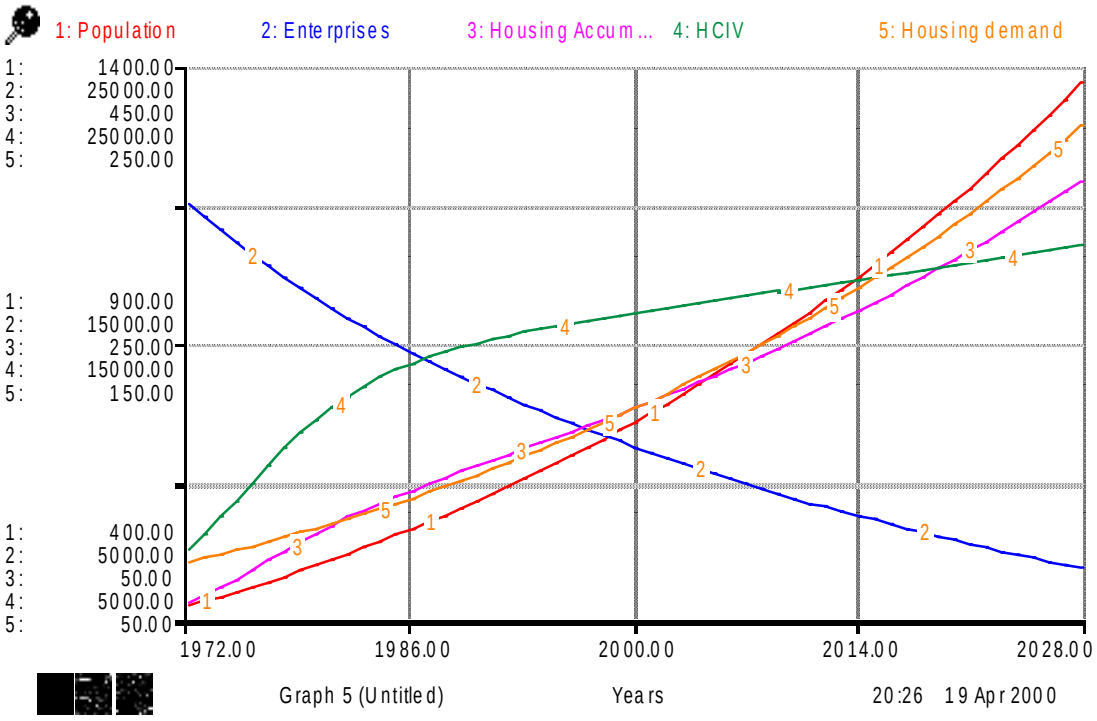

Figure 2. The results of computer simulation

CONCLUSION

The study of urban housing development is a very complex work. It needs an integration of large number of components as well as estimation of future condition influenced by them. Applying the system dynamics model to the study of the housing

development in Hong Kong new town, we can consider many factors influencing the development into the model and study the multi-feedback relations between these factors. As a powerful tool, it works well and the result will benefit policy-makers in their decision making process.

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