A Study of Multi-Agent Simulation in the Urban Transformation of Tamsui, Taiwan

Chun-Jung Ko, Tamkang University, Taiwan

The IAFOR International Conference on the City 2017
Official Conference Proceedings

Abstract
Cities embed the parameters driven components, which have intention behind those physical embodiments. Based on the research of Cedric Price's urban planning operated by the concept of the dynamic system showed the interactions to reflect such intentions of the immediate neighbors, participants, and the other informational feedback loop. The bottom-up intelligence phenomenon becomes easy to be observed and highly accessible today, the up-date tendency or changing pattern can be easy to recognize by the planner or the other participants. The research uses multi-agent simulation to show the modeling process could become a useful tool to reduce the gap between different thought from politicians' anticipations or the decision-making person, planners, citizen, who never made a strong connection with each other and often ignored of the actual situations. The research gives the example of how the infrastructure projects constrains by the geological relationship and reflect at the redistribution of land use in Tamsui, the seaside district in northern New Taipei City. As new infrastructures projects planned, the new traffic network will regenerate and reshape the city by its strong impact. The MAS models of Tamsui will demonstrate this regeneration process and reveal the important insight of different effects by different agents. The model of data flow will show the stringiness of adaptable system in this area to suggest which some components play crucial role than the other and revealing important hidden factors.

Keywords: Data flow, bottom-up, parameters, Multi-Agent Simulation,

Introduction

This paper, firstly, reviews the development of Cedric Price's design and planning as he had developed for the integrated education system with transportation interaction where the focus is on the allocation of population and improving employment issues. The dynamic urban planning model would be built accordingly and focused on the interactive components, which can introduce the agents based modeling and data visualization technics. Data visualization and interactive interface will take a great part to help decision-making process in the future, especially in the urban complex. It's will help designer and developer to understand and analyze how their strategy and implementation in the micro interaction level effect to the global of the whole city level. The process of making an agents model can help us to figure out the aggregative urban developing phenomenon from the complex individual behaviors highlight the advantage and disadvantage points of a political investment and development planning consequences. The knowledge of using models building technic is to raise the possible debate areas of decision makers to evaluate the different options. In the approach, the paper will question the main propose of some future strategy, which the government solutions did not reduce in order the achieve their main goal insufficiencies such as the requirements of some data monitor.

This paper will be divided into three parts. We explore Cedric Price's dynamic concept from review to analysis his urban planning project into an agent based model. Then, the same modeling procedures approaches one of his representation projects "Potteries Thinkbelt" to discuss of pros, cons and some insufficient information of the system. By extending the method of modeling tools, finally, we can benefit from the methodology for new kinds of urban development simulation tool to analyze the main issue and important factors of any new planning project. The paper will take Tamsui as example model.

From review to analysis of Cedric Price's urban planning projects

The research study through over 157 projects of his built or unbuilt architecture projects. It can be present of how his works transforming over time. The works can be divided into at least five periods, each period has a different focuses. By Review and analysis his projects, different system frameworks can represent in different types of simulation models[1].

1. The important concepts during the period 1954-1964 were represented by giving the variety of parameters and diverse activities, by New Aviary and Fun Palace
2. During the 1964-1967 projects, the communication and networks function was promoted. Project example like O.C.H. Feasibility Study (OCH)
3. Between 1967-1976, wireless and mobility functions in the cities were used in the following of projects: Atom and Detroit Think Grid
4. The technology of processor and self-organization concept was found in the project of "Generator" from1977 to 1988.
5. Strengthening the attraction, connection, and adaptation functions of objects in the city between 1988-2003 in the projects, such as "Magnet".

[1] Chun-Jung Ko, 2014, A study on the open- ended system of architectural design method -The indeterminacy theory of Cedric Price. P76-90.

The above examples can be used to analyze into the system structure by the different scale (Table 1). Projects will be clarified and demonstrated as systems. Firstly, their physical behavior in the basic setting analyze, such as movable, fixed, responding, reacting elements and functions at each investigation project. Moving behaviors in the geometric dimension and the frequently applied assemblage methods of the system's organization will be put in focus. Secondly, the exchange target will be identified. Price's projects provide the connection to exchange information with other systems such as social, education, political, and economic ones in different projects. Clarifying the communicate target will indicate the project scales; whether they are buildings, local communities, institutions, or the infrastructure for the whole city.[2] The scale of the projects determines the functional purposes operated by their driving agents or potential agents (communication groups) in each system. Therefore, according to the result of system exchange indication, the opening properties of the system in his projects can be validated. That embedded concepts of indeterminacy, chance, or anticipation will be unfolded by the complex system structure. The result of his open-end system will demonstrate the properties of possible spaces based on the interactive relationships and the operational procedure.

Table 1: Basic system structure: Different level of local interactions in the complex system

system	Components or parts	set of behaviors, "function" or "purpose"	organize and interconnect of the pattern or structure
Architecture	floor, wall, ceiling, room, corridors, special functions ...etc.	Kitchen, office, play ground, park, residence area..etc.	architectural plan, space syntax, space sequence, space configuration
urban	buildings, urban furniture, housing units, green areas, streets, open spaces, zones etc.	Aggregation, density, land-use, develop, growth…	urban planning, traffic network, zoning, fabric, pattern, space syntax etc.

Here we can propose a framework in different types of simulation models. According to Joshua Noble's research, there are five levels of interactivity model, except for the final level (a real conversation between two people) is too complicated and beyond our handling model. When the design provides a user a way of controlling the tempo of information, when the function of user control is added in his program, the manipulation is more than just transmissions. Noble said, "When a user can accomplish a task or input data into the system that changes it in a substantial way and the project creates a means for that system to respond to what the user is doing, then the projects creating interaction." The case study Potteries Thinkbelt, for example, gives the clearest idea of the data flow in the regulative interaction[3].

[2] The scale divisions based on Assemblage theory. Manuel De Landa, A New Philosophy of Society: Assemblage Theory and Social Complexity, Continuum, 2006

[3] Joshua Noble, (2009). Programming Interactivity, A Designer's Guide to Processing, Arduino, and Open Frameworks, Introducing Interaction Design (pp.16-19). The United States of America, O'Reilly Media, Inc.

1. Reactive Interaction (London New Aviary, 1958-2001)
2. Data flow in the regulative interaction (Potteries Thinkbelt, 1963-1967)
3. Various geographic constraints of the regulative interaction – (Atom 1967-1968)
4. A learning mode of interaction –(Generator, 1976-1980)

System analysis process

The system analysis method was introduced to reconstruct the project model by following steps: firstly, analyse all physical behaviours, movements, fixed, responding, reacting elements and functions in different scale of the project. Then, identify the exchange target between two systems. In the case of Potteries Thinkbelt, if the entire system works properly, the PTB will become the best bearer system for driving human resources. The transportation system exchange with education system was the communicated target indicates the urban regeneration in the project. Finally, it is important to ensure the opening properties of the system in his projects can be validated. Price's attention is the possibility of various activities or various functions. He designed three levels of project components as following diagram: (fig.1 Potteries Thinkbelt three levels of the system hierarchy)

1. The first level is the PBT network using the original local railway.
2. The second level is the local transfer area includes three areas, Meir, Madeley and Pitts Hill.
3. The final level is local residents and student resident communities.

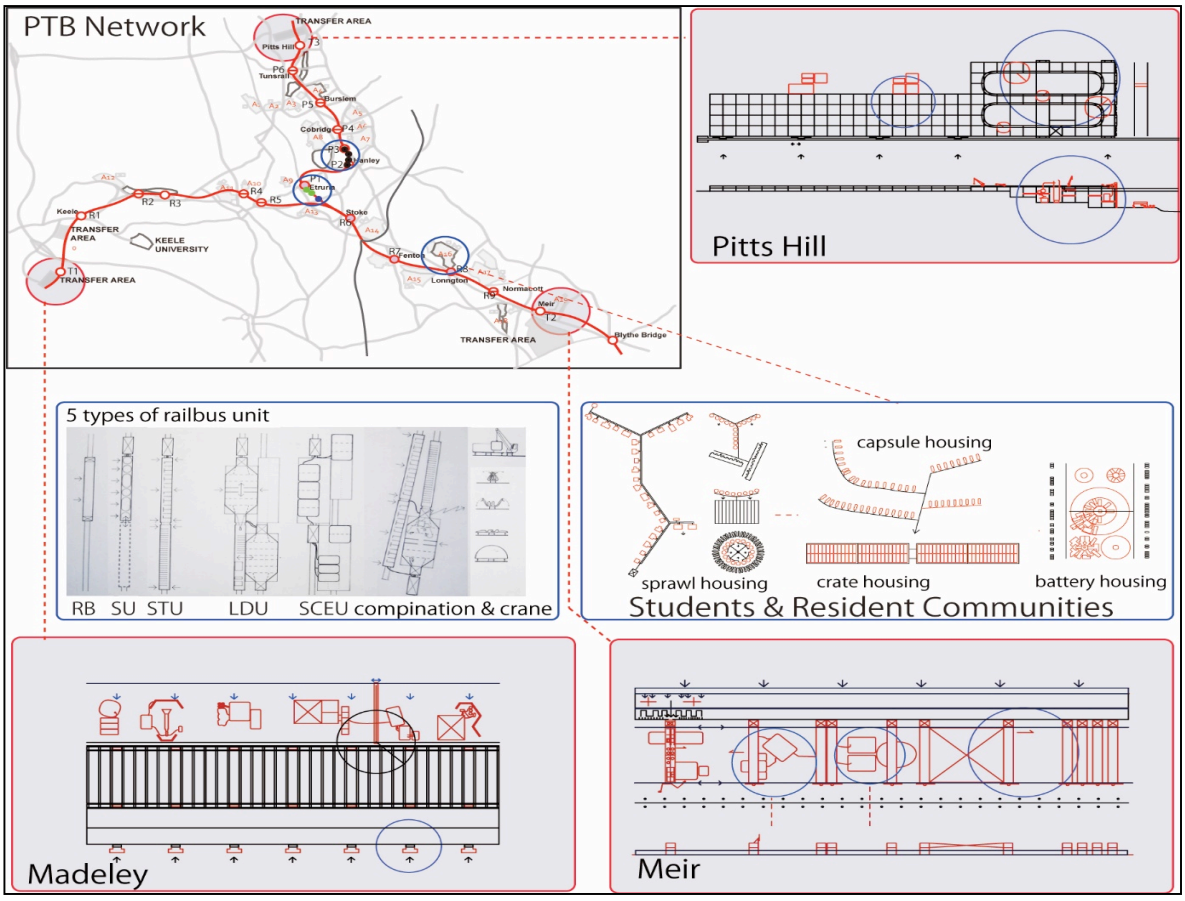

Fig.1 Potteries Thinkbelt three levels of the system hierarchy

The data flow of the system in the regulative interaction
-Potteries Thinkbelt (1963-1967)

The functions and proposes displayed by the interaction agents are synchronized and connect to the entire system use object orientation programming technic. It can be seen in the system's structure that each transfer area has its own physical components working as flexible program in the transfer area of the site. However, it is unknown how the class was arranged on the site, because the movable integration or flexibility of the project cannot show the mechanism of the class in the data flow and characteristics of the curriculum in the PTB system. Instead of making a flexible campus interaction program, we demonstrated the area developing the condition and the how the factories relate to local changes. Physical moving elements behave as a path following logically the railway; that is how we are going to show the fluidity of the system. The interaction has to make some basic rules for each moving object. It is important for the objects to have a clear relationship each other. These simple rules make all agents work at the same time in the complex system, which follows three key principles:

1. Simple units with a short-range relationship.
2. Simple units operate in parallel.
3. The system as a whole exhibits emergent phenomena.

The movable objects (trains include rail-bus, seminar units, student self-teach and carrel units, information and equipment's units, lecture and demonstration units, inflatable lecture units…) in the network should driven by the input data of reality. However, there is no sufficient information about local capacities of industrial or housing area and it is not practical to perform investigation about the geographic conditions of the 1960s in that area, which can be used for the database. There were, however, some precise numbers of housing capacities in Price's design for the students and local resident's communities. The method is a reverse engineering of those data from the housing number designed by Price to making the assumptions for the working opportunities provided by factories. This will complete the circle of housing needs, job providing, and student entry numbers. Of course, this is the basic assumption, also based on the fact that the project was designed for 20,000 students as an entry number.

The increasing student number is due to the increase of jobs provided by local factories. In the PTB proposal, the university closely works and cooperates with local factories, the school provides research results and techniques, and the factory provides new technology feedback and training classes for students. We can have the flowing data input to the system. In order to make the network start to function, we need to make the assumption of housing increase logic on the data flow of housing area, which means the order of housing preference from workers or citizen. The interface finally shows the increase of local factory to determine local development.

There is a feedback loop in the regulative interaction system, which shows environmental resource provided opportunities and the constraint at the same time. Land use, volume, and capacity are the recourses form the site, system is good at adopt the changes from the local data; it is possible in the future give more details to

determine land use policy by investigation of population structure. We can see the results of the whole system visualization in the Fig.2

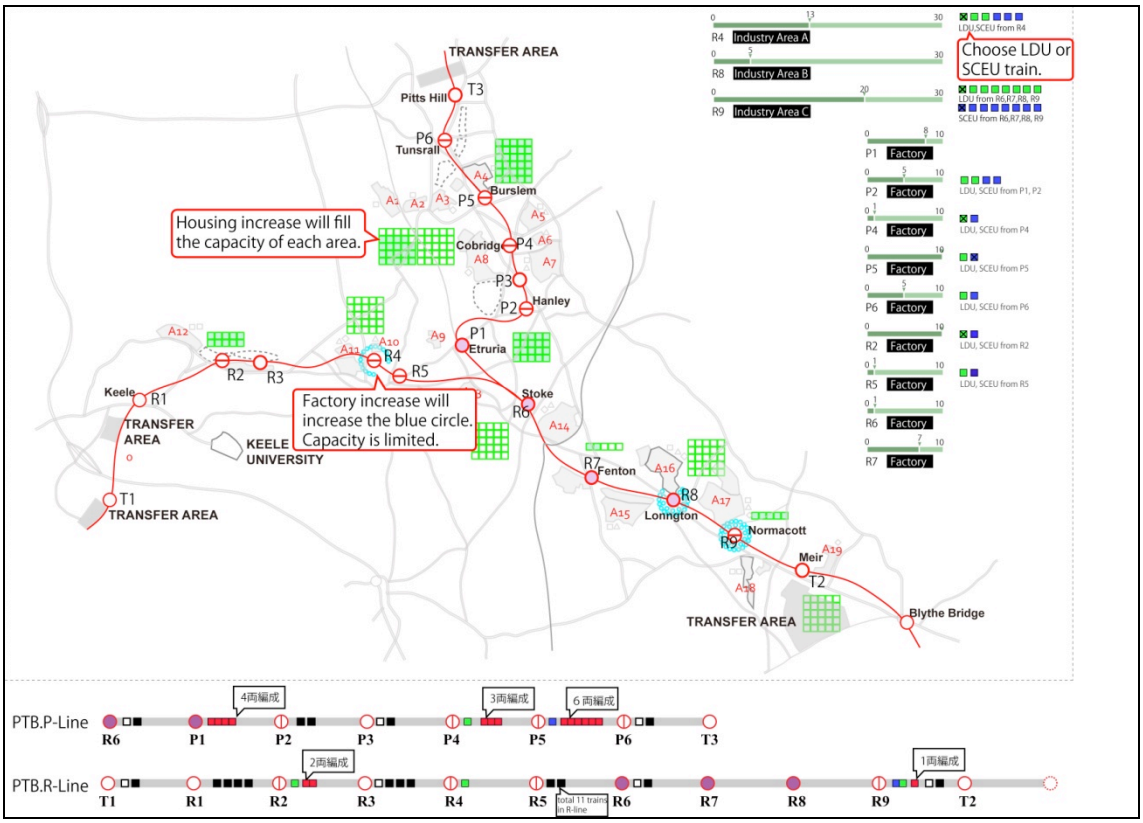

Fig. 2 Interface explaination

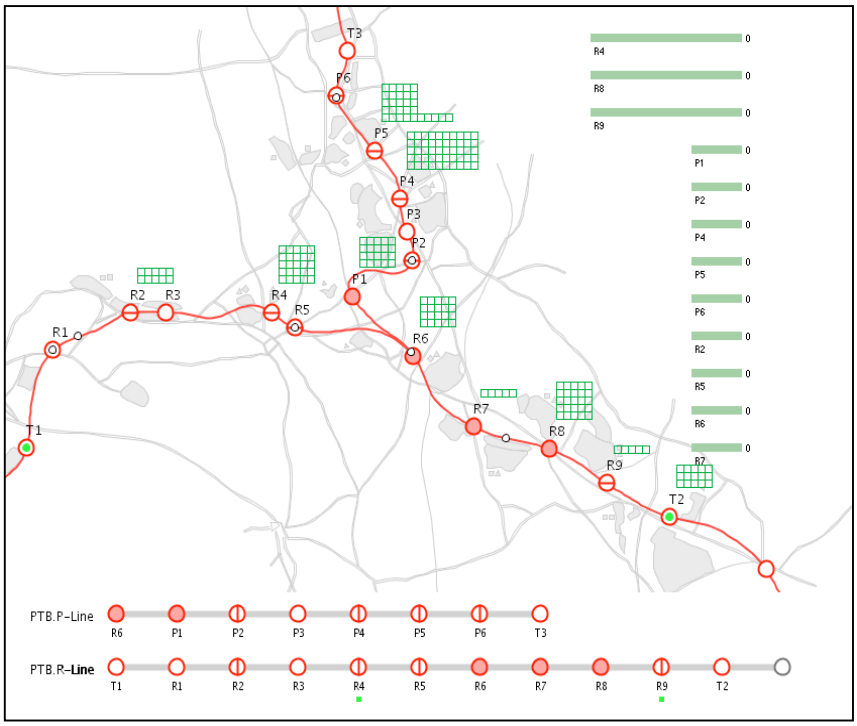

Fig.3 Original settings and environmental conditions, t=0.

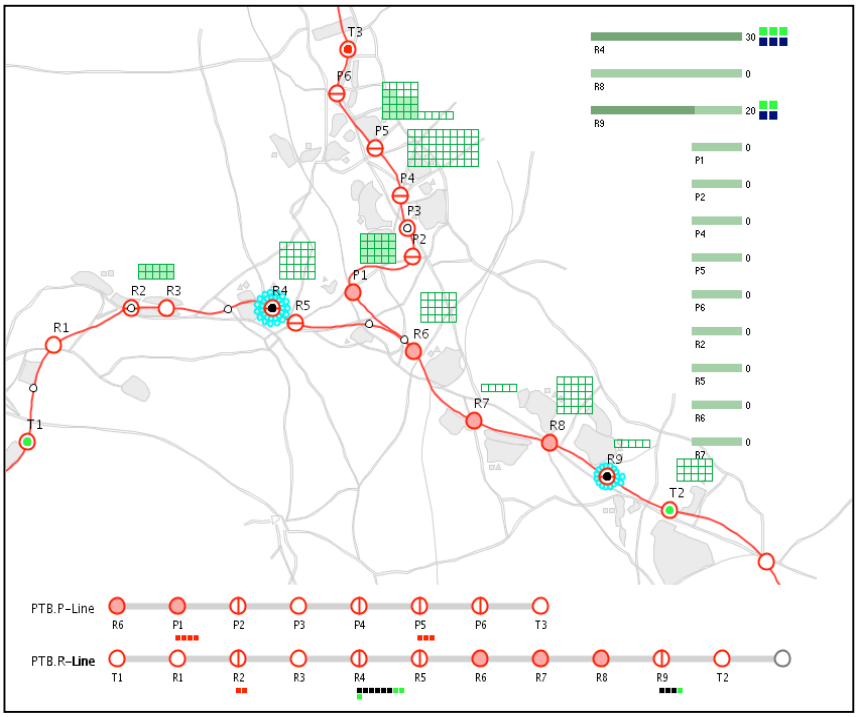

Fig.4 when the factories start to function in the industry area, the town attract people to move into the residential area. The train will start to move, t= f(x).

According to the result of system exchange indication, the opening properties of the system in his projects, therefore, can provide different spaces of possibility; the space of possible parameters, structure, and the space of possible spatial structures and metabolic pathways will be determined by the environments recourse where the systems are located. These possibilities and frameworks help us understand where the input value and output values are. The research can take the further stages of the real site for verified.

Applying modelling concept to Tamsui in New Taipei City

In the past 50 years, the development of the single core in the metropolitan area of Taipei led to the heavy traffic in the downtown area, resulting in traffic congestion and urban recession. Therefore, the municipal government of New Taipei city had come out an idea to provide a cheaper residential area for Taipei city. The function is expected to introduce 300,000 people move from Taipei. Without tracking the complex problem of local fabrication and unique geographic condition leads culture identity, their new urban planning like drawing on a blank page. There are four main issues urgent to be solved. The model in the study does not provide the direct addresses of these problems. However, through the modelling process, to propose and discuss which input and output factors or parameters will directly affect the success or failure of the planning.

The pathway from Tamsui to Taipei constraint by the geographical condition. The limitation of geographical conditions is mainly affecting the number of people who move from Taipei to Tamsui. The constraint here is only one path to Taipei. Including the traffic congestion, it normally takes more than one hour to Taipei by car, 47 mins

by MRT. Secondly, the alternative accessible path, the Danjiang Bridge (920 m), had some serious problems. The opening of tenders just fail by the process of tendering for the project was too complex in the technical difficulties where construction companies fear that they will not be able to complete the project under the current budget. Third, excessive investment had made high vacancy rate in this area, however, the high property price (of 9.2 times average annual income) stop young people from the purchase. Therefore, the function of providing a cheap residential area is fail, too. Finally, the municipal government lacks some knowledge and understanding of the conditions of the urban fabric, and texture sense of the area. They are actively trying to complete the so-called network system without co-operating with original content and "network".

System study in Tamsui project

The flow is changed over time. Predicted residential demand is an obvious stock, but it cannot show how people decide to move from Taipei to Tamsui. It is like a stock, where is the clearest statistical information from observation. Most of the time flow information is more important than stock. People's observation also tends to focus on stocks rather than flow. Our agent's model can help us to understand the flow behaviours in the project, like how many people go to work by train every from Tamsui to Taipei. How many young people who were raised in Tamsui has interest worked in Taipei…ect.

1. Define physical component and input parameters
2. Mechanism or Relationship between agents
3. Impose constraints, included: environmental conditions, the outer function between the objects, agent's capacities, and threshold.
4. Then start to organize the system hierarchies of inputs parameters: such as urban capacity and network structure based on the geometrical information.
5. The populations and agents preferences effected by environmental qualities.
6. Distance and speed in traffic conditions are the parameters and traffic jam phenomenon.

Above all of this data is how we make MAS model (Fig.5) of Tamsui. The model demonstrates the regenerate and transformation of those impact and reveals the important insight of the effects by one or more agents have on the global state of an urban development process. The model of data flow will show the stringiness of adaptable system in this area to suggest where it can be altered, transformed or change the plan to serve the need of the moment.

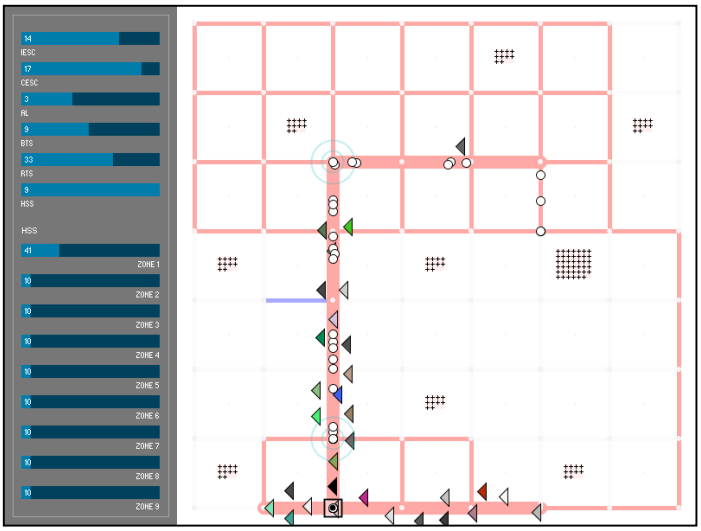

Fig.5 New city Grid with traffic system.

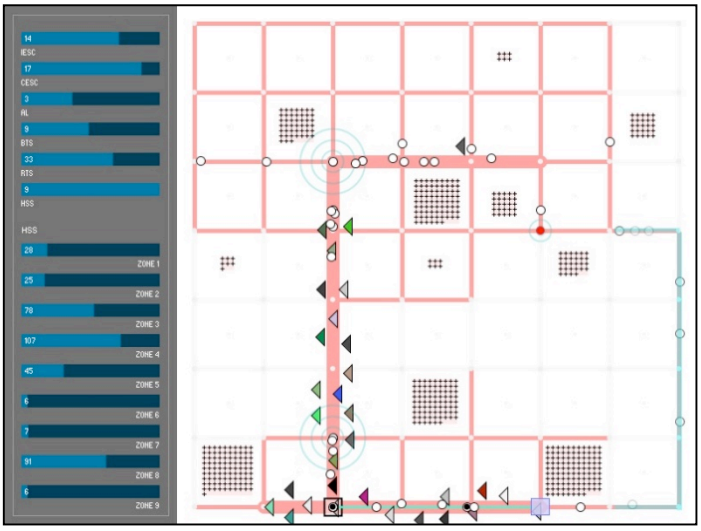

Fig.6 New city Grid with new traffic infrastructure

Conclusions

Geographical sources and capabilities are the most important effects for the model initial setting. Refine the research question about local interactive problems and environmental parameters can generate great network heterogeneity in the city models. Some people may have more information sources or abilities than others (such as purchasing capacity / workplace selection ...).There are a lot of data is not sufficient.

In this project the most important influencing factors/parameters related to the temporal scale of urban condition in the organizational –level (the location and development of residential are the path dependence agents. Although the Individual options (human level) are very important, political decisions play the most important role. The research uses multi-agent simulation to show the gap between politicians' anticipations and the political decision-making process which had been made without a strong connection with most of the local and geographical conditions.

References

Samantha Hardingham and Kester Rattenbury, (2007) eds., Cedric Price: Potteries Thinkbelt (SuperCrit), Routledge, London.

Donella H. Meadows, (2008) Thinking in Systems: A Primer ,White River Junction, VT: Chelsea Green Publishing.

Casey Reas and Ben Fry,(2007) Processing: A Programming Handbook for Visual Designers and Artists, MIT Press,

Joshua Noble, (2009). Programming Interactivity, A Designer's Guide to Processing, Arduino, and Open Frameworks, Introducing Interaction Design (pp.16-19). The United States of America, O'Reilly Media, Inc.

Manuel De Landa, (2006) A New Philosophy of Society: Assemblage Theory and Social Complexity, Continuum, New York.