

THE MODEL URBAX 21

GENERAL PRINCIPLES OF THE MODEL

The model is based on the idea that the urban system consists of six subsystems which can be identified as follows, from the most concrete to the most abstract :

- **Land use** : land as the basis of urban development and planning,
- **Public facilities** : infrastructures such as roads and sewers, superstructure such as schools, post offices, social and cultural centres etc. and their financing,
- **Urban fabric** : dwellings, factories, offices,
- **Demography** : the residents, their social distribution and their attitudes,
- **Economics** : jobs, enterprises,
- **Legal framework** : planning documents, land use authorisations.

At the outset, the system is activated by commercial, manufacturing and administrative activities. Urban growth is the result of the creation of non agricultural jobs.

Job creation attracts new inhabitants. Positive migratory balance adds to natural growth, (difference between births and deaths), to form demographic growth.

Demographic growth in turn generates demand for housing. On the same line new activities need premises. Housing and business premises require developed land. They use up space.

Population growth results in increased demand for facilities and services to be supplied either by the local government or by private bodies.

Inhabitants and enterprises are also tax payers who contribute to the local government revenues and allow it to pay for public facilities. Finally, the local government is led to implement local plans and building regulations in order to control the urban development.

Thus the causality series is the following :

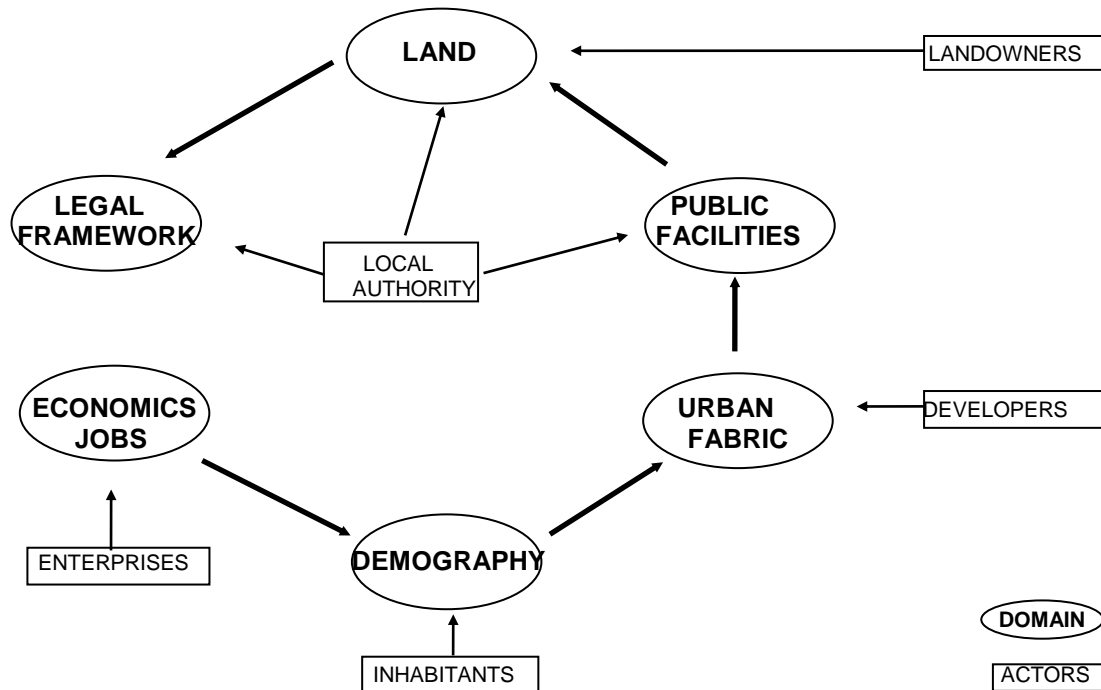
Enterprises -> Demography -> Urban fabric -> Land use -> Facilities -> Plan

In fact the system is neither so simple, nor so linear. There are a great deal of secondary interactions. For instance, existing housing has an impact on new enterprises : it is necessary to house the workers attracted by new enterprises at a reasonable cost. Another example : a planning document has an influence on land prices since it designates buildable plots. The urban system is a complex system.

In the decentralised institutional systems of Western countries, local authorities are the principal regulators. However, they cannot act directly either on economic activities (job creation) or demography (residents are free to move and to settle elsewhere) or the building sector (they cannot construct all dwellings and factories). In reality, the sectors in which local authorities have a certain amount of direct power are those that concern urban development : land supply, facilities, land rights and public finances. In the other sectors (enterprises, population, housing) local authorities cannot act as directly in a regulatory role. They must co-operate with other controlling or decision making bodies such as the State or companies. But, through the process of urban development and planning, the municipality acts indirectly on the other sectors because the physical development of the area (facilities and organisation) has an effect on the population, housing and activities. Thus urban

development and planning is a lever that allows local government to influence the urban system as a whole.

THE SYSTEM OF URBAN PLANNING AND DEVELOPMENT



DESCRIPTION OF THE MODEL

The model is made of six subsystems linked together to form the urban system. It must be remembered that a part of the simulation is done directly by the participants and not the computer programme. Urban development and planning is still a system of actors. Actors are free to act as they will and the results of the simulation are unpredictable. The system is random and not determinist.

Enterprises

The economic base theory is the pillar of the model. According to this theory, creation of jobs in enterprises that produce to satisfy a demand which is outside the considered area (exporting or direct jobs), is the key factor of urban growth. These jobs are the « economic base » which foster city development.

In turn, these exporting jobs generate induced jobs (or indirect jobs) to satisfy the needs (marketable and unmarketable) of the city's inhabitants. The number of induced jobs is a function of the number of exporting jobs.

For instance, a computer manufacturing plant creates exporting jobs. The latter induce indirect jobs in retail (bakers, butchers...), crafts (electricians, masons...), services (hairdressers, insurance agents...), local civil services (school teachers, town hall and social services employees...).

Homer Hoyt, the first to formulate the theory, estimated the ratio between direct and indirect jobs to be about one to one (every direct job induces one indirect job).

Conversely, the loss of exporting jobs following factory closures results in the disappearance of induced jobs.

In the simulation, the creation of exporting activities is done by the entrepreneur roles whereas the induced jobs are generated by the computer. Entrepreneur roles must make sure that the chosen activity, taking into account national and international economic situation and the existence of a demand, allows a big enough margin to pay for operating expenses and for the leasing or buying of premises. When creating new plants and office buildings, certain considerations must be taken into account by the enterprise:

- the social status of the city which depends on the average per capita income of inhabitants ; a high technology company will look for an urban image capable of attracting the engineers and the technicians it needs ; on the contrary, a transformation plant will find a working class city to be satisfactory;
- the block attractiveness, i.e. the level of equipment : the headquarters of a tertiary company will not settle in a polluted industrial zone but rather in a well serviced district with an acceptable level of environmental qualities ;
- the suitability of the land (plot large enough for outdoor storage, for truck manoeuvres etc.) and of the premises (indoor volume or floor space, construction quality related to the image of the activity).

In the simulation, entrepreneurs must manage the interfaces between economic activities and urban aspects, thus becoming active participants in urban development.

Demography

New jobs (direct and indirect) result in a positive migratory balance to which the natural balance of births to deaths is added. This demographic aspect is entirely controlled by the computer.

Socio-economic categories are defined by their revenues. These revenues determine the social status of the blocks and of the city. This notion of social status has a real impact on housing demand. Some districts are more in demand than the others.

The various socio-economic categories locate themselves in the urban districts according to the value of housing. This value is a function of spatial criteria : attractiveness (level of facilities, proximity to the centre, environment) and social status. The value is also a function of the quality of the building : intrinsic quality which is an initial given of the construction, maintenance and comfort level which can be modified by renovation. The Software programme reproduces this link between social structure and housing structure.

The Software programme generates political feed back by simulating the attitudes of the various socio-economic categories vis-à-vis the local government. Thus it furnishes continuous reading of the public opinion. Opinion of the various social classes are affected by creation of new facilities, local tax rate modification, coercive action of the local government such as expropriation, and by the continuous attrition of local government popularity as well. This is certainly the least « scientific » part of the model but its presence is

indispensable since political feed back is a fundamental part of the urban development system in democratic societies.

Housing

In the simulation the developers' and house builders' roles produce the supply of housing. Demand is simulated by the computer. Naturally demand is a function of demographic evolution which is itself the result of job evolution. To this demographic evolution we must add households decrease in size and replacement of old buildings which no longer meet housing standards and whose inhabitants must be lodged elsewhere.

The housing demand is distributed according to the amenities that they offer : location (block attractiveness and social status), building quality and building density.

Demand is also a function of the selling price not only of the product itself but of the selling prices in the neighbouring areas as well. Even if demographic evolution has generated new needs the demand will not be satisfied if prices are too high.

So housing demand is elastic in regards to prices, to location factors and to building quality. The Software programme simulates, with the help of a specific model, the confrontation between player produced supply and demand. It does determine that which is marketed effectively.

The Software programme also simulates the evolution of the urban fabric. Buildings deteriorate spontaneously. The lower the social class of the inhabitants the quicker the deterioration. Buildings tend to be spontaneously renovated if their value after renovation is higher than the sum of the former value and the renovation cost. This is the case in districts that are being gentrified.

So there is a strong interaction between housing the various socio-economic categories of the occupants and the evolution of the social fabric. When attractiveness and social status of a district are insufficient to provoke spontaneous renovation, the local authority must intervene with, on the one hand, subsidies and fiscal advantages to render renovation profitable and, on the other hand, with urban improvements to increase block attractiveness. But changes in block attractiveness produces changes in land values and, in the long run, changes in population, unless this tendency is compensated for by the creation of social housing.

There is also a connection between housing market and companies' earnings : if housing supply is insufficient or expensive, companies must pay higher salaries or invest directly in workers accommodation. So enterprises are concerned by housing policies as well.

Land use

Contrary to the housing market which is simulated by a model, the land market is the result of the action of the participants. Land prices are the result of auctions or transactions between participants.

The computer manages the evolution of reference prices according to the type of zones on the basis of recorded transactions. From this given data, it simulates the behaviour of tax valuers and expropriation judges when the comparison method is used.

Public facilities and their financing

In the game, local government has the responsibility of creating public facilities. Some of these facilities become necessary because of urban growth : streets and utilities, schools ... They may have a threshold, becoming obligatory when population reaches a certain level. Other public facilities are not strictly indispensable but they contribute to the general improvement of blocks and city's attractiveness : public open spaces, cultural facilities etc.

At first, extensions of urban development may take advantage of residual capacities of existing facilities. Some public facilities form a chain of elements which must be realised sequentially (for instance, a draining pipe for rain water needs another pipe further down the line). At the geographic level, every public facility is linked to a specific area, be it a town or simply one or more blocks, which they service and whose attractiveness they influence.

Besides direct urban effects (improvement of the blocks) and indirect effects (increasing attractiveness), public facilities also have an impact on voters' opinion. This impact varies according to type of facility and according to socio-economic classes. Some facilities interest the wealthy people and others the working classes.

Most of the local authority's budget is used to finance public facilities, first as investments and thereafter as operating expenses. Revenues to finance the local authority budget come from local tax payers, subsidies and grants from the State and region, and fees paid by those who profit from the facilities. These fees also concern both investment (planning obligations) and operating expenses.

The Software programme manages the various types of accounting, public or private, depending on the role being played by the participants. Public accounting concerns only financial cash flows but makes a distinction between investment and operating revenues and expenses. Private accounting indicates both flows (current account) and stocks (the balance sheet).

Local authorities can modify their income by varying local rates. But such rate changes entail changes in public opinion. Local authorities can also impose planning obligations which affect provisional budgets made by builders or developers and therefore land prices.

Planning documents and land use regulations

Land use regulations are implemented by local authorities. The Software programme registers them and does a quantitative check regarding the plot ratio when a planning permission is solicited. The effect of land use regulations on the global system is not calculated by the model but is the result of the players' actions who include them in their decision making process. This is especially the case when they establish a provisional budget before deciding to buy a piece of land. Land use regulations also have an effect on real estate markets since they determine the quantity of land available for urban development.

As a rule, legal aspects such as the respect of the great legal principles, are dealt with by the players (or the simulation leader) and not by the Software programme.

How open the system is regarding its wider environment can be fixed using the coefficients of the model. In a closed system, the consequential effects of an action, for instance job creation, will take place entirely inside the system. Relations between exporting jobs, induced jobs and migratory balance will be totally interdependent. Conversely, if the system is more open, there will be less interdependency. Induced jobs or population increase may have

effect outside the system as well as inside. A more open system will more broadly feel the effect of the variations of the environment.