



URBS URBIS CRP SYSTEM

FOURTH DRAFT



INDEX

PRESENTATION	5
My intentions.....	5
Thanks.....	5
NEW PARAMETERS FOR THE MODELS (AXES)	7
Inputs & Outputs.	7
Tourists Attraction Capacity, Tourists Accommodation Capacity.	7
Employment Details	8
Desiderability.....	8
RESOURCES & GOODS.....	9
Resources.....	9
Resource cost & Resource price	9
Unit of measure	9
Goods.....	10
Goods Price.....	10
Effects of transport on costs.....	10
Goods and traffic network (Freight Cost by Network)	10
Inputs/Output Ratio	10
IMPORT/EXPORT	13
Harbors	13
Railroads	13
Canals.....	13
Air	13
THE DEMAND	14
RCP(FORMER RCI) ZONING	15
Density	15
Raw material extraction or gathering, cultivation or breeding.....	16
Refining Industries.....	18
Manufacturing Industries	19
Retails	20
Advanced Commercial.....	21
Tourism Commercial.....	22
Standard Residential.....	23
Communitarian Civic Buildings	24

HOW THE COMPUTER TAKES THE ECONOMICS DECISIONS	25
About Productive buildings placement: Production I, II, III.....	25
About retail buildings placement: Commercial I.....	26
About residential buildings placement: Residential I.....	26
About other buildings placement: Residential II, Commercial II, III ,Mixed.....	26
About building development and building abandonment.	26
The OE.....	26
The DE.....	26
APPENDIX	29
RESOURCES IN DETAIL	31
A CHART SHOWING THE OVERALL PRODUCTION CHAIN.....	36
UNIT CORRESPONDENCE TABLE.....	37
SUGGESTED FREIGHT COST BY NETWORK TABLE.....	38
Q&A	39

PRESENTATION

This is the third draft of my economic system proposal for Urbs Urbis. In this draft I have tried to correct many mistakes I made in previous releases.

To achieve full realistic economy is out of scope of a game, nevertheless a better model is necessary than the one of SC.

The city size (and the near surrounding area) of our simulation helps us to simplify many macro-economical problems; No Inflation or monetary matters, Infinite demand from outside, Infinite goods from outside, help us to focus on the production chain and the residential demand.

While the model has grown many other questions have arisen and some of them are still “in the air”: demand is still unexplored and untraveled, I simply assume that citizens have the money to fulfill their needs and that needs are the same for all the citizens without differences of EQ or wealth.

Many other chunks are well developed: I describe a minimum number of RCI (renamed RCP) zones to make the system work. I know that every categorization is somehow arbitrary but I hope this is a logic one, easy understandable by players. I’m fully open to enhancements and suggestion about zoning.

All the parameters to have a production chain are shown; the two economic engines DE and OE, upon that computer rely for economic decisions, are also fully described.

My intentions

- 1) To avoid micro-management or complexity for the player the management of resources, and linking between buildings are computer managed.
- 2) To improve the realism of the economy: I propose to introduce resources. I propose to have TWO economic engines: the OE (Offer Engine) and the DE (Demand Engine) I will describe their work.
- 3) To keep it simple for the players: we have three levels for each zone type now (based on density), we’ll have three (two for residential) levels for each zone type with the new system (based on functions).
- 4) To aid for better traffic model that can trace not only the workers routes but also the goods routes the tourists flux and the shopping traffic.... if we decide to have such features.

Thanks

I have to thank many Urbs Urbis developers that help me so much with their support and criticism: Doctor Soul for his charts and clear explanations (better than mine own) in support of my proposal, lacavin for the severe and constructive critics, Star Torturer for his suggestions on zoning, Yogiya for suggestions about prices, Yamaneko and Harbinger for many good observations and the interesting materials they often share with us, Croxis, Urbas, Xelebes, Daryn07, JFman00 and all whom will reply to my proposal.

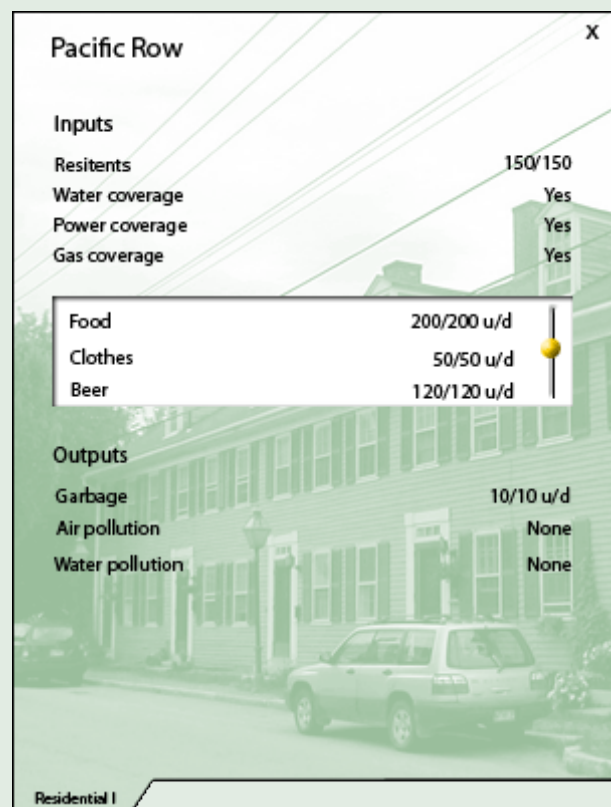
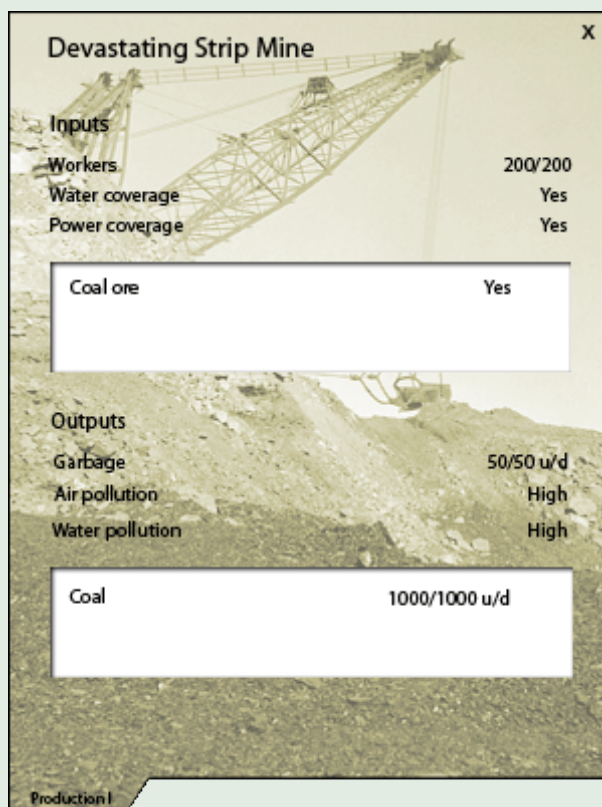
PARAMETERS FOR THE MODELS (AXEs)

New parameters for models are a necessity. First, we need to demaxificate our game; second, we want a better level of realism.

Inputs & Outputs.

The introduction of input and output is a consequence of having resource in the game. To rationalize things I think we should transfer water need and power need in to inputs and garbage in to outputs.

Example of a possible AXE query:



Few remarks on these pictures:

Quantity is measured in u/d, see page 8 and 9 for explanations. White box are little scroll windows where specific inputs and outputs are listed.

The xxx/xxx format show the current occupancy or production on the left: how far the input and workers value is met determines the maximum amount of output. The overall maximum output or input is shown on the right.

The High, Low, None values are here only as example, a numeric value could work far better.

An interesting feature could be the possibility of double clicking on an input or an output to open a map showing the route or the routes of the goods and the buildings down and up the chain.

Tourists Attraction Capacity, Tourists Accommodation Capacity.

Tourism is a major feature that SC never simulate. Someone suggested adding a new category to RCI demand, a new RCIT. I think we have no need of a new category.

Why tourist come in our city?

Virtually every building could have Tourist Attraction Capacity; an historical building, a wonderful high skyscraper, the City Hall, the house of a famous writer, a famous restaurant, a luxury hotel, a statue. If you want think at them as “landmarks”.

Natural reserves, parks, beaches and ski runs will have a Tourist Attraction Capacity too. This is a new category of zones foresee by many developers for getting advantages by certain landscape’s features.

Tourist Accommodation Capacity will be a feature of Tourism-Commercial only; hotels, villages, inns. This will be a characteristic of Tourism Commercial (Commercial III) zones.

Example of touristic city

Employment Details

Desiderability

Desiderability is a indirect index of public services demand. Better is cover of the zone from civic services and better is the index.

Each building have it, even if residential have many more issues than industrial and different issues from commercials. Desiderability is a factor in the choice for building’s placement. For a description of the various desiderabilities see the zoning section.

RESOURCES & GOODS

Resources and goods are the core of this system. They add to the game a new profoundness.

Resources

Mother earth gave us resources to survive. So iron, coal, fertile-land, game are resources because you can find it in nature. Cattle needs breeding to develop, so it is not a resource is a good; copper from copper ore is a good too.

Distinction between *resources* and *goods* is essential. I try to be clear: Crude-oil resource is that you have in the underground. You need an Oil-field to get it (or a platform rig over the sea). But the output of the Oil-field is a good (Oil) because the man gather it from the underground. You can transport Oil good, but you can't transport Crude-oil resource (you must extract it before).

Resources should be in fixed numbers, because we need to show them graphically in some way and allow the player to lay them in landscape editor.

So we must be sure to put in the game every essential resource known (maybe making some little generalization: coal and not turf, lignite, anthracite, lithanthrax... natural gas and not methane or butane... lumber and not oak, acajou, beech, pine).

This is a possible list of resources we need to have:

Fish	Stone	Sulfate ore	Copper ore
Fertile-land	Sand	Natural gas	Tin ore
Rich-waters	Salt	Crude oil	Lead ore
Game	Water	Coal ore	Bauxite ore
Lumber	Clay	Iron ore	Uranium ore
Poly-metallic ore	Gemstone		

There are special resources that don't need to be shown graphically: Solar energy, Wind, Geothermic energy, Tides.

For a wide description of all these resources see the appendix.

Resource cost & Resource price

Resource cost would be related to the distance or the depth of the resources from the building. Mining a coal layer 300 feet under the soil level is more expansive than mine a coal layer 30 feet from the surface.

Resource price would be fixed for all resources; this is quite realistic, one mining company can't decide for the price of a resource, not even for a rare one.

If we are going to have some kind of real historic periods, we can have an historical table of the resources' prices. Randomize prices is another way to add variety. I strongly support these features, because they add a great realism with few troubles.

If the game will have fixed prices for resources, probably a coal layer 1.000 feet under the surface is so expensive to mine that a mine will never develop over it.

Unit of measure

In real life there are many unit of measure: tons, liters, sq yards, gallons. This is too complex for the modelers to deal with.

A generic Unit for all the resources and good is quite acceptable, so all the industries will have an output of x/x u/d. or quantity produced/maximum production capacity Unit per Day.

If programmers will find that calculate a daily production is an heavy task for the CPU we can shift to weekly or even monthly production.

If we want, but it's not strictly necessary, we can have a table to show the relation between the Unit and the real measure of many key goods.

Goods

All the stuff coming from resources that has been modified by man are called goods.

Goods can be dynamically inputted by modelers simply filling the input and output fields, just like they filled up a database field; two parameters they must add to each good: Freight Cost by Network and Price.

Goods Price

Goods price is a choice of the single company, in the game this means that each building has his own price for his goods.

The price of goods is chosen by the modeler, I rely on them about the realism of such price.

Effects of transport on costs

Goods need other goods or resources to be produced. The price of the transportation of the required goods or the cost of extraction of a resource, is added to the price of the final good and it is paid for by the purchaser.

As the purchaser paid for the transport only Input goods need of a FCN.

Goods and traffic network (Freight Cost by Network)

Usually different goods have different shipping methods: coal travels by ship or by train, rarely on trucks. Crude Oil travel only by ships and oil pipelines, refined fuel travel also by train or trucks.

This is because each good is different (different mass, different state: liquid, solid or gaseous, different sizes, and different wealth).

So each input good will have five different freight prices, one for each network we have in the game for the freight use: road, railroad, canal/sea, air, pipelines.

If we want, but it's not strictly necessary, we can have a table to show the freight cost of many key goods.

Few special goods need a special kind of network. Water need aqueduct, Power need Power grid, Gas for heating need pipelines.

Oil usually travel by ship. If an Oil field is in middle of nowhere probably it use a pipeline to move oil toward the nearest harbour.

In Saudi Arabia many Oil fields are near the coast between Kuwait and Bahrain or in the desert; pipelines cross the desert toward Aquaba or Ad Amman, Najmah or Al Jubayl.

If no other mean is available truck could be used (as during the Iraqi Embargo), but such situation is far to be efficient and it was profitable only for the high price of the good.

Water is different because it has a low price, it is uneconomical transport it by truck and even by ship. So even if we could transport it by other means, pipelines are the only economical alternative.

Power is even worst, because you can transport it only by wires.

Inputs/Output Ratio

Different buildings of the same kind could have different Inputs/Output Ratio.

Imagine a lumber mill with an input of 100/100 u/d of lumber and an output of 200/200 u/d planks.
Now imagine that a modeler want design a modern lumber mill that with 100/100 u/d lumber can produce 300/300 u/d planks.
The first one have a 1:2 ratio, the second 1:3. If the two lumber mills sell the product at the same price, the second is more profitable.

I rely on modelers about the realism of such ratio: Is not possible that from 100 u/d of lumber we can produce 1.000.000 of planks.

How this parameters affect the simulation: Infinite Diversities in Infinite Combinations

Playing with the parameters shown above could affect the game in so many ways that diversity is assured even with few buildings.

Imagine too lumber mill, both are 20 miles away from the lumberjack camp, both are connected with a country road with a 35 mph speed limit (so they have the same cost of production) Both sell their product to the same furniture factory that have a maximum need of 400 u/d planks.
The first one produce 300 u/d planks with 100 u/d lumber, the second produce 200 u/d with 100 u/d.
The first one sell his product at 2 urbits per unit, the second one at 3 urbits per unit.
For the game economic engine, they have the same profitability, but the first one has the great advantage to have better price.
So the furniture factory prefer to link the first one. But it still need 100 u/d planks so it buys half output of the second lumber mill.
The rest of the planks produced by the second lumber mill could be exported.

IMPORT/EXPORT

Likely a region does not have every resource in the game, this is obvious, the opposite is unrealistic even in Wonderland.

To avoid shortage of any type we must import goods from the outside. All the goods that aren't in the map or industrial materials will be available through harbors or map borders by canals, roads and rails.

Resources are not importable. A mine must extract local coal ore, I never heard of a mine importing minerals!

The surplus of raw goods, refined goods and manufactured goods that can't be sold to city consumers will be exported in the same way.

Avoid shortages do not mean deny them: harbors, rails and roads have a capacity and this will put a limit to the quantity of goods imported or exported.

Harbors

In this scheme harbors will become strategic for our cities: it has to export and import goods, to move local goods, to manage passengers from regional towns and handle tourists from the outside.

As in real life we can have specialized harbors, that manage only one good. So we could have fishers harbors, passengers harbors, touristic harbors.

We can also have generic harbors that can manage many different goods.

I prefer to have modular harbors (I know that is not a mayor task), so we can have many specialized docks: for import only, for export only, for local freight only, for tourist and passengers, for agricultural goods, for industrial goods or even for coal export only or for cattle importation only.

Some industry models could even have a private harbor or dock.

Harbor never pays for freight, someone outside the map pays for it.

Railroads

SC Heavy railroads need many enhancements. A better cover of the city (usually a big city has a great central station, and maybe a minor one).

As for harbor we can have specialized stations and even private station for the biggest factory.

Freight Station never pays for freight, someone outside the map pays for it.

Canals

Canals are a new network. Is a good way to have an access to the sea. Canals need harbors or docks to work with freight barges.

Canal harbor never pays for freight, someone outside the map pays for it.

Air

Airport could be used for freight too, but only for few goods. The main task of an airport is to move passenger inside and outside the "region". Another airport main task is to handle tourists from outside the region.

However freight terminals could handle high wealth light goods such precious stones, precious metals, weapons and so on.

Airport never pays for freight, someone outside the map pays for it.

THE DEMAND

RCP(FORMER RCI) ZONING

This system could work with different zoning systems, I developed mine but the “grey zone system” foresee by Star Torturer is good too (even better because perfectly works with Doctor Soul/Hjanfield UI). Kasdem developed another system for mixed zones.... Whatever system we are going to use, we must have, AT LEAST, the zones described here:

SC4 have already three kinds of industries: low, medium and high density. My system have three kinds of industries too, I like to call them Productive Zones.

Raw material extraction, gathering, cultivation or breeding	(Production I)
Refining Industry	(Production II)
Manufacturing Industry	(Production III)

SC4 have already three kinds of residential: low, medium and high density. My system have only two kinds of residential.

Residential	(Residential I)
Communitarian Civic Buildings	(Residential II)

SC4 have already three kinds of commercials: low, medium and high density. My system have three kinds of commercials too.

Retails	(Commercial I)
Advanced Commercial	(Commercial II)
Tourism Commercial	(Commercial III)

Example of mixed zones:

Workshops	(Production III/Commercial I)
Farm shops	(Residential I/Production I/Commercial I)
A big city tower	(Residential I/Commercial I/Commercial II)
A little apartments house with a dentist	(Residential I/Residential II)

We should have special zones also: garbage, urban parks, natural reserves and so on.

Density

Density a feature of each zone, a debate is going on about density: replace it with rules by neighborhood, replace it with rules by zone, keep it similar to SC.

Whatever decision we'll get, that don't change my overall proposal.

Raw material extraction or gathering, cultivation or breeding

These are grain farm, cattle farm, fishery, coal mine, lumberjacks' encampment...

Resources' Industries must be placed directly over the natural resource to work properly.

Fishing docks or harbors, should be an exception, they need only to be built on the water (as near as possible to Rich-waters to contain the costs.)

Usually they send their raw goods to the Refining Industries.

We need to separate farm-fields or corrals from the farm building that must be a residential. The better way to do it is by mixed zone (Residential I/Production I)

A farm-field will need a farm-house near to work. A single farm-house can handle more farm-fields depends on the size of fields, commute time, how many workers fields need and how many people live in the farm house, this add even more realism; we can have fields only (Production I) built over Fertile-land, with workers coming from nearby country village.

Farm shops should be mixed zones (Residential I/Production I/Commercial I). To keep things easy the production output and the retail input should be the same (the farm sell all his production to residential).

Example of possible query for a ranch:

Brown Cow Ranch X

Inputs

Residents	15/15
Water coverage	Yes
Power coverage	Yes
Gas coverage	Yes

Food 18/18 u/d

Clothes 5/5 u/d

Beer 10/10 u/d

Outputs

Garbage	10/10 u/d
Air pollution	None
Water pollution	None

Residential I / Production I

Brown Cow Ranch X

Inputs

Workers	15/15
Water coverage	Yes
Power coverage	Yes

Fertile land Yes

Outputs

Garbage	40/40 u/d
Air pollution	None
Water pollution	None

Meat 50/50 u/d

Milk 175/175 u/d

Leather 45/45 u/d

Residential I / Production I

A list of desiderability factors for these buildings:

Positive Relation

Police cover

Firemen cover

Hospital cover

Negative Relation

Traffic

Water pollution

Fertile-land in XXI century

In the last centuries technologies allow us to cultivate even the poorest lands. So restrain fields to fertile land is somehow silly.

This is a possible emendation: If you zone for a Production I on fertile land you surely get a field or a pen for breeding. If you have a field you don't need any fertilizer; if you have a pen you don't need any feedstuff for your animals.

If you zone for a Production I on ordinary land you get your field or pen but you need both fertilizer or feedstuff.

Remember that you have to zone for Production I, so if you build over a resource for example rocks you will get a quarry, so you must build a Production I on a land with no resources at all to get a field. Obviously a Fertile-land field is more profitable (it has no costs) so easier to grow.

Refining Industries

Refining Industry works the raw goods and makes industrial goods. All the productive buildings will grow likely as near as possible to the input good, on the shorter/quicker way between the input and the output sources. Usually they send their refined goods to the manufacturing Industries.

Example, a steelworks and a lumber mill query:

Very Dirty Steelworks		X
Inputs		
Workers	1800/1800	
Water coverage	Yes	
Power coverage	Yes	
Inputs		
Iron	150/150 u/d	
Coal	200/200 u/d	
Outputs		
Garbage	50/50 u/d	
Air pollution	High	
Water pollution	Low	
Outputs		
Steel	165/165 u/d	
Production II		

Old Cletus Lumber Mill		X
Inputs		
Workers	45/45	
Water coverage	Yes	
Power coverage	Yes	
Inputs		
Trunks	150/150 u/d	
Outputs		
Garbage	50/50 u/d	
Air pollution	None	
Water pollution	Low	
Outputs		
Planks	200/200 u/d	
Production II		

Refining Industry has very low standards of desirability; it don't cares about pollution, traffic, beautification, A firemen, hospital and police cover is required for a minimum security need.

A list of desirability factors for productive buildings:

A list of desirability factors for refining industries:

Positive Relation

Police cover

Firemen cover

Hospital cover

Public transports

Parking receptivity

Negative Relation

Traffic

Manufacturing Industries

Manufacturing is the use of tools and labor to make things for use or sale. Manufacturing takes place under all types of economic system.

In Urbs Urbis Manufacturing Industry works Industrial goods and make finished goods for commercials. As in reality it will be possible to skip the refining process, and to link raw goods with Manufacturing Industries: a gold mine send his gold to jewels factory .

All the productive buildings will grow likely as near as possible to the input good, on the shorter/quicker way between the input and the output sources.

Usually they send their materials to Retails.

Workshops, little mfg. industry that sell their goods for direct consumption by the purchaser, it is a way to sell goods without freight them to shops and so with a lower price. They will be mixed zones (Production III/Commercial I).

A list of desiderability factors for refining industries:

Positive Relation

Police cover

Firemen cover

Hospital cover

Public transports

Parking receptivity

Negative Relation

Traffic

Retails

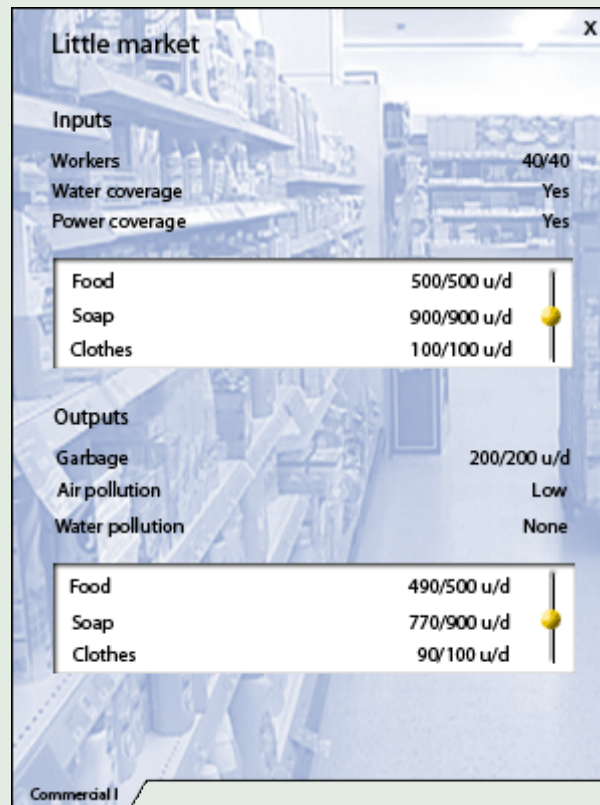
Retailing consists of the sale of goods, from a fixed location such as a department store or kiosk, in small or individual lots for direct consumption by the purchaser.

Retails are linked to Manufacturing Industries, each retail sells goods. If that good is not produced by industrial system can be imported from harbors or map borders (canals, roads and rails).

Retails are linked to demand too. The retail's outputs will meet the residential inputs to fulfill them.

Retails will grow likely near demand, on well traveled ways.

Example, a local supermarket query:



Usually a shop sell the same goods purchased from the industries. Few shops, usually traditional ones, as bakeshop, cake shop and similar, transform their inputs in different output (flour and salt in food for bakers), just like the productive do. To avoid confusion is better say that they are only Commercial I and not mixed. Only Workshops are mixed.

Retail prices could be calculate in such way: good cost + freight cost + x% of recharge (between 3 and 5% could work).

A retail will buy goods to fulfill maximum capacity, so if the purchases are too low the shop profitability will suffer.

A list of desiderability factors for retail buildings:

Positive Relation

Police cover

Beautification

Firemen cover

Entertainment

Hospital cover

Traffic

Public transports

Parking receptivity

Negative Relation

Air pollution

Water pollution

Sound pollution

Advanced Commercial

That is a complex question. All the non retail commercial will go here; we can have advanced commercial that use input goods to sell services (Taxi company), we can have advanced commercial that don't have inputs at all and only sell services.

These are the greatest part, linked only to the growth of the city; more people, retails, industries need more advanced services. They are disengaged from any other link with industries. That kind of commercial can grow everywhere the minimum conditions of desirability are matched. This includes banks, insurances, companies HQs, lawyers firms, TV and radio companies, cinemas and theatres.

All them don't have an output to sell, they sell services that help the grow of the city.

A list of desirability factors for advanced commercial buildings:

Positive Relation

Police cover

Firemen cover

Hospital cover

Public transports

Beautification

Entertainment

Traffic

Parking receptivity

Negative Relation

Air pollution

Water pollution

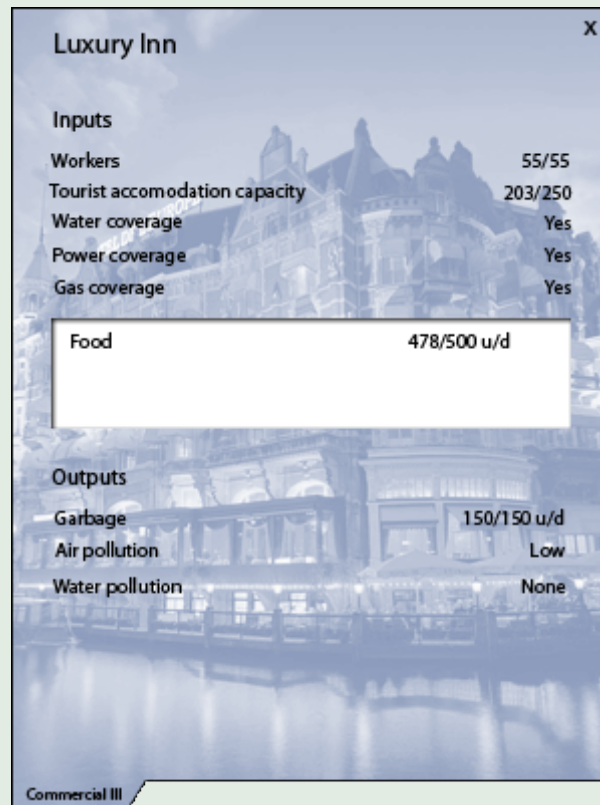
Sound pollution

Tourism Commercial

Tourism Commercial is linked to tourists: Hotels, Villages, Inns.

Tourists are attracted in the city by landmarks, parks (both natural and urban), historical buildings and every buildings that has a "Tourist Attraction Capacity". They will come from harbors, airports or map borders. They must be settled in Hotels (buildings that have a "Tourist Accommodation Capacity"). The Tourism related commercial will grow likely near landmarks or natural attractions, on the ways traveled by tourists.

Example, an hotel query:



A list of desiderability factors for tourism commercial related buildings:

Positive Relation

Police cover	Firemen cover	Hospital cover	Public transports
B eautification	Entertainment		

Negative Relation

Traffic	Air pollution	Water pollution	Sound pollution
---------	---------------	-----------------	-----------------

Landmark hotels and villages

As in reality the presence of a famous hotel or the presence of a village on a beach is a mean for attract tourism. So we may often have an hotel with both Tourist Attraction Capacity and Tourist Accomodation Capacity.

Standard Residential

Standard residential includes all housing in the game. Residential will supply workers to all the commercial/industry zones and demand to retails.

Example, an apartments building query:



A list of desiderability factors for residential buildings:

Positive Relation

Police cover	Firemen cover	Hospital cover	Education cover
Civic cover	Parking receptivity	Public transports	Beautification
Culture	Spirituality	Entertainment	

Negative Relation

Traffic	Air pollution	Water pollution	Sound pollution
---------	---------------	-----------------	-----------------

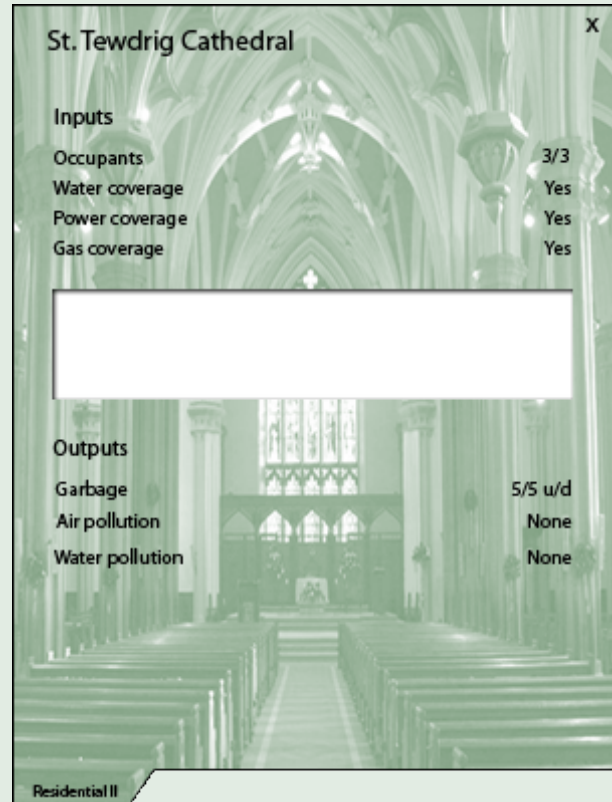
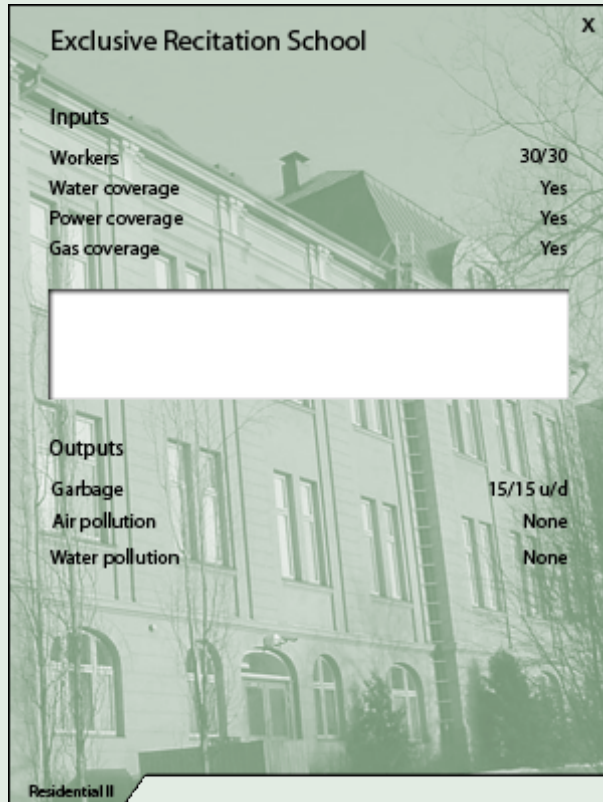
Communitarian Civic Buildings

This is something I see often around the forum: private initiative or NGO initiative.

Communitarian Civic Buildings are Religious buildings, private schools, private security, private clinics, parties HQs.

Some Communitarian Civic Buildings will have a “Tourist Attraction Capacity”.

Example, a religious building and a private school query:



A list of desiderability factors for communitarian buildings:

Positive Relation

Police cover

Beautification

Firemen cover

Hospital cover

Public transports

Negative Relation

Traffic

Air pollution

Water pollution

Sound pollution

HOW THE COMPUTER TAKES THE ECONOMICS DECISIONS

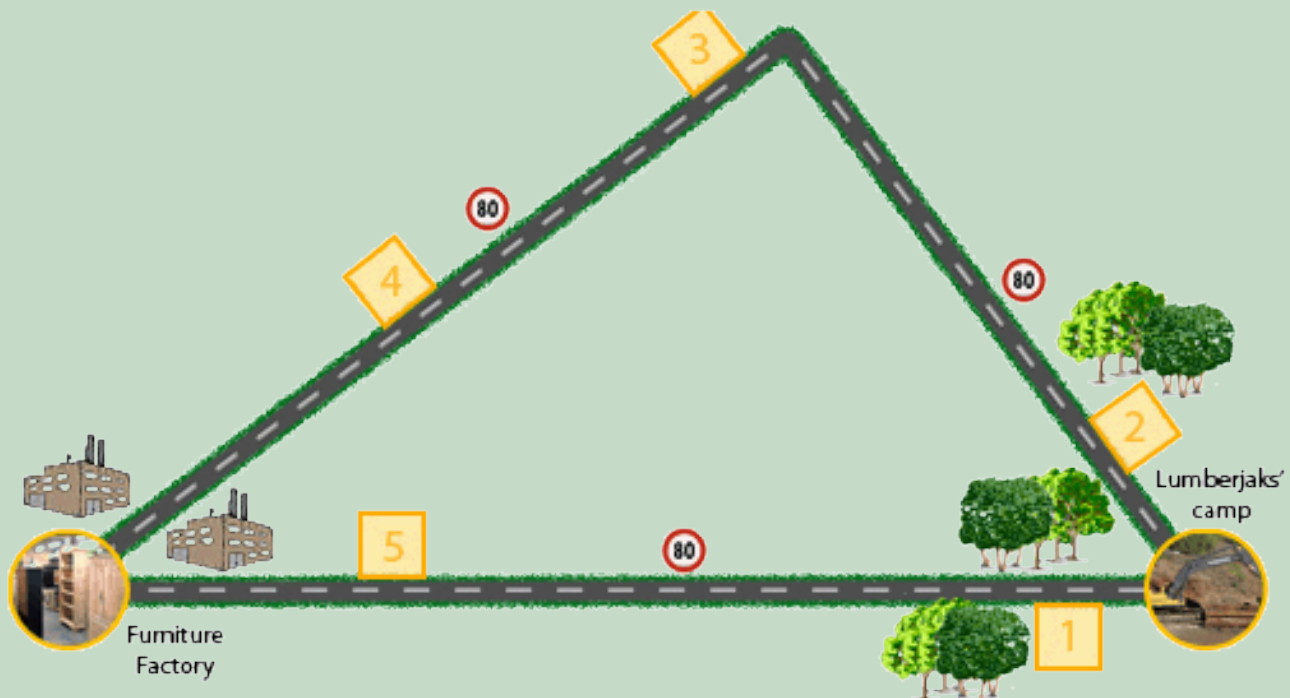
I must still answer to a question: If all the goods and resources are potentially available (from local or imports) how the computer decides what industry build next? And where to build it?

We need two different economic engines namely: the OE (Offer Engine) and the DE (Demand Engine)

About Productive buildings placement: Production I, II, III

The best placement of an industrial building is where the transport costs of both inputs and outputs are lowest. So the computer (Offer Engine) will place the building on the shorter/quicker or cheaper way between the input source (or sources) and the output destination (or destinations), where a Production II or III zone is available. An abandoned building is the similar to an empty zone, but less attractive because the demolition costs. For imported and exported goods destination is the harbor or the railway station.

This is a very simple situation: we have a lumberjack camp (Production I) and a Furniture Factory (Production III). The player had zoned for the Lumberjack camp, the Furniture factory is born from demand of furniture and imported planks (from a harbor 2 km away). Conditions are ready to build a local lumber mill. We have only two possible ways where to zone for Production II, the player build some of this zones and computer will check for the cheapest, Fastest or shortest route from the Production II zones available. The speed limit is the same for all the roads so, as Pitagora said long time ago, the shorter/faster route is the direct one. Where we can find zone 1 and 5. Zone 1 is the nearest to the forest and so has the lowest freight cost for the lumber mill, lumber has a greater freight cost than planks and the distance between zone 1 and the furniture factory is shorter than the distance of the factory from the harbor; so the lumber mill will grow on zone 1.



Now imagine that the direct route between the lumberjacks' camp and the furniture factory has a speed limit of 40 km/h. The placement of lumber mill change, because the fastest route is now the longest one. The mill will grow on zone 2. The freight cost for the mill is the same, but the freight cost for the factory is higher. Anyway the freight cost of the factory is still lower than the freight cost from the harbor.

Imagine now that you build a new highway between the factory and the harbor with a 150 km/h speed limit. Now the freight cost from the harbor is lower and so the factory will purchase planks from outside.

Obviously desirability is a factor in the placement of buildings, secondary to the principle shown above. It may help when the choice is between two or more identical places.

Desirability for productive buildings is different from desirability for commercial and residential. Productive need a good fire protection, police protection, health protection; but they don't care about air pollution, water pollution, sound pollution, entertainment or heavy traffic.

About retail buildings placement: Commercial I

Retails will grow where the demand is. Retails have no needs to minimize the freight cost, they will discharge it to the consumers. Demand Engine will place them as near as possible to the highest demand for his goods.

Desirability is a factor in the placement of buildings, Commercial will love heavy traffic and good parking, that brings costumers.

About residential buildings placement: Residential I

Residential follow higher desirability, appropriate wealth and education offer.

About other buildings placement: Residential II, Commercial II, III ,Mixed

Residential II will grow where the demand is, like retails do. So their placement is assigned to DE (Demand Engine) Commercial II (tourism related), will grow as near as possible to buildings or zones with attraction capacity and on the ways traveled by tourists.

Commercial III follow only the desirability.

All the mixed buildings that have a Production I,II or III follow the placement of productive.

All the mixed buildings that have a Commercial I follow the placement of retails unless they follow the rule above.

About building development and building abandonment.

Before placing a building the computer will calculate the profitability of an industry building in a specific place, if it is not profitable the build never grows. If it is profitable it grows.

Changes in demand, offer or in the traffic network could affect the profitability of a building.

If a building is no more profitable will be abandoned. Shortages of goods and workers will also force the building to be abandoned.

The OE

OE is a sub-program inside the simulation that have three tasks: Gathering, calculating and storing data about the industrial output and imports of industrial goods.

Send robots (something like Google does) looking in the mass of buildings data to find the ones with right inputs.

Find the best possible zone where to place it.

Description of the OE working:

The DE

DE is a sub-program inside the simulation that have three tasks: Gathering, calculating and storing data from residential demand.

Send robots looking in the mass of commercial buildings data to find the ones with right outputs.

Find the best possible zone where to place it.

Description of the DE working:

APPENDIX

RESOURCES IN DETAIL

Game

Game is any animal hunted for food or not normally domesticated. Game is a primitive good, marginal in the XXI century economy.

In-game importance

Game is the only resources that don't need any industry at all to work. It goes directly to the village butcher and could sustain few inhabitants. We can assume that men hunt for the food they need if they haven't any alternative.

Goods derived:
Food.

Water

Water is essential to life and it is a renewable resource. Fresh water can be defined as water with less than 0.5 parts per thousand dissolved salts. Sub-Surface water, or groundwater, is fresh water located in the pore space of soil and rocks. Water usually travel by pipelines.

In modern times, it is far more common for mineral waters to be bottled at source for distributed consumption.

Goods derived:
Water, Mineral water.

Coal ore

Coal is a readily combustible black or brownish-black rock. Coal is still indispensable for the production of steel.

Goods derived:
Coal, Graphite.

Iron Ore

Iron ores are rocks and minerals from which metallic iron can be economically extracted. Aluminium is generally present in iron ores as clay. This is usually removed by washing the iron ore, and by fluxing. However, again, iron oxide deposits must be relatively low in aluminium in order to be considered ore.

Iron is the world's most commonly used metal. It is used primarily in structural engineering applications and in maritime purposes, automobiles, and general industrial applications (machinery).

Goods derived:
Iron, Nickel.

Poly-metallic ore

A metallic ore is a volume of rock containing metals in a mode of occurrence that renders it valuable for mining. An ore must contain materials that are: valuable, in concentrations that can be profitably mined, transported, milled, and processed, able to be extracted from waste rock by mineral processing techniques.

In-game importance

Poly-metallic Ore is a little trick to have even the most rare metals for high-tech industry.

Goods derived:

Mercury, Zinc, Gold, Silver, Platinum, Iridium, Rhodium, Palladium, Tungsten, Cobalt, Chromium, Titanium, Molybdenum, Lithium, Potassium, Calcium....

Gemstone

A gemstone, gem or also called precious or semi-precious stone is a highly attractive and valuable piece of mineral, which — when cut and polished — is used in jewelry or other adornments.

Goods derived:

Crude ruby, Crude sapphire, Crude Emerald, Crude Diamond, Crude amethyst, Crude agate....

Lumber

Lumber or Timber is a term used to describe wood, either standing or that has been processed for use—from the time trees are felled, to its end product as a material suitable for industrial use—as structural material for construction or wood pulp for paper production.

Goods derived:

Logs, Cellulose.

Rich waters

Rich water generate fish: They are of tremendous importance as food for people around the world.

Goods derived:

Fish.

Tin ore

Cassiterite is the chief ore of tin today. Most sources of cassiterite are found in alluvial or placer deposits containing the resistant weathered grains. Tin is a silvery, malleable poor metal that is not easily oxidized in air and resists corrosion is found in many alloys and is used to coat other metals to prevent corrosion.

Tin bonds readily to iron, and has been used for coating lead or zinc and steel to prevent corrosion. Tin-plated steel containers are widely used for food preservation, and this forms a large part of the market for metallic tin.

Goods derived:

Tin.

Copper ore

Copper has played a significant part in the history of mankind, which has used the easily accessible uncombined metal, Copper is malleable and ductile, a good conductor of heat and, when very pure, a good conductor of electricity.

It is used for: Piping, including, but not limited to, domestic water supply. As a material in the manufacture of computers. Electromagnets. Wires. Roofing, guttering, and rainspouts on buildings. In cookware. To line parts of ships to protect against barnacles and mussels. As a component of coins, often as cupronickel alloy.

Goods derived:

Copper.

Lead ore

Lead has a dull luster and is a dense, ductile, very soft, highly malleable, bluish-white metal that has poor electrical conductivity. Native lead does occur in nature, but it is rare. Currently lead is usually found in ore with zinc, silver and (most abundantly) copper, and is extracted together with these metals. Most ores contain less than 10% lead, and ores containing as little as 3% lead can be economically exploited.

Lead is used in building construction, lead-acid batteries, bullets and shot, and is part of solder, pewter, and fusible alloys.

Goods derived:

Lead, Silver.

Uranium ore

Uraninite is a major ore of uranium. Uraninite is a uranium-rich mineral with a composition that is largely UO_2 (uranium dioxide), but which also contains and oxides of lead, thorium, and rare earths. Uranium is a silvery white, weakly radioactive metal, which is slightly softer than steel.

Uranium is used as a colorant in uranium glass, producing orange-red to lemon yellow hues. It was also used for tinting and shading in early photography.

Research by Enrico Fermi and others starting in 1934 led to its use as a fuel in the nuclear power industry.

Nuclear weapons used enriched uranium and uranium-derived plutonium.

The major application of uranium in the military sector is in high-density penetrators. This ammunition consists of depleted uranium. Depleted uranium is also used as a shielding material in some containers used to store and transport radioactive materials

Goods derived:

Uranium (238).

Bauxite ore

Bauxite is an aluminum ore. Aluminum is the most abundant of all metals and the third most abundant element in the Earth's crust, after oxygen and silicon. It is found combined in over 270 different minerals. The chief source of aluminum is bauxite ore.

Aluminum is remarkable for its ability to resist corrosion and its light weight. Structural components made from aluminum and its alloys are vital to the aerospace industry and very important in other areas of transportation and building.

Aluminium is the most widely used non-ferrous metal for: Transportation (automobiles, aircraft, trucks, railway cars, marine vessels, bicycles etc.), Packaging (cans, foil, etc.), Construction (windows, doors, siding, building wire, etc.), Cooking utensils, Heat sinks for electronic appliances such as transistors and CPUs. Powdered aluminum is used in paint, and in pyrotechnics such as solid rocket fuels and thermite.

Goods derived:

Aluminum.

Crude oil

Crude oil is a naturally occurring liquid found in formations in the Earth consisting of a complex mixture of hydrocarbons.

Oil is used mostly, by volume, for producing fuel oil and gasoline (petrol), both important "primary energy" sources. Oil is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics.

Goods derived:

Oil.

Natural gas

Natural gas is a gaseous fossil fuel consisting primarily of methane but including significant quantities of ethane, butane, propane, carbon dioxide, nitrogen, helium and hydrogen sulfide. It is found in oil fields and natural gas fields.

The major difficulty in the use of natural gas is transportation and storage because of its low density. Natural gas pipelines are economical, but are impractical across oceans.

Goods derived:
Natural gas.

Salt

Salt is a mineral essential for animal life, composed primarily of sodium chloride. The manufacture and use of salt is one of the oldest chemical industries. Salt is also obtained by evaporation of sea water, usually in shallow basins warmed by sunlight.

Today, most refined salt is prepared from rock salt: mineral deposits high in salt.

Goods derived:
Crude salt.

Sand

Sand is a granular material made up of fine mineral particles. It is a naturally occurring, finely divided rock. Sand is often a principal component of concrete. It is the principal component in glass manufacturing. Brick manufacturing plants use sand as an additive with a mixture of clay and other materials for manufacturing bricks.

Goods derived:
Sand.

Stone

A stone is a naturally occurring aggregate of minerals and/or mineraloids. Lithic technology marks some of the oldest and continuously used technologies

Goods derived:
Stone, Marble.

Clay

Clay exhibit plasticity when mixed with water. When dry, it becomes firm and when fired in a kiln, permanent physical and chemical reactions occur which, amongst other changes, causes the clay to be converted into a ceramic material. It is because of these properties that clay is used for making pottery items, both practical (Bricks) and decorative (Porcelain).

Goods derived:
Clay.

Sulfate

Sulfur, in its native form, is a yellow crystalline solid. In nature, it can be found as the pure element or as sulfide and sulfate minerals. Its commercial uses are primarily in fertilizers, but it is also widely used in matches, insecticides and fungicides. Sulfur has many modern industrial uses. Through its major derivative, sulfuric acid, sulfur ranks as one of the most important industrial raw materials. It is of prime importance to every sector of the world's economies.

Goods derived:
Sulphur.

A CHART SHOWING THE OVERALL PRODUCTION CHAIN

The chart attached to the this document shows the complexity of the production linking that can be build with only 20 resources. For the sake of the size I shown only productive and retails. The chart don't show ALL the possible linking but could be a good starting point for modelers.

Notes:

- 1) Metallic Ore or Poly-metallic Ore is a little trick to have even the most rare metals for high-tech industry.
- 2) At the start of the game when you have 100-400 residents and no other resource exploited still a village butcher can gather game from hunters and produce little food for the village needs.
- 3) Cotton plantation is just an example of an industrial use of a farm: we can have rubber or coffee.
- 4) Some buildings could have more than an output from a single input: in the chart we can see enriched uranium facility that could produce both enriched uranium (main product) and plutonium.
- 5) For the sake of clearness I doubled chemical plant.
- 6) As you can see for car factory many mfg industries are linked together.
- 7) I split Hyper Mart around the chart but it is the same.
- 8) Village carpenter is an example of workshop.

UNIT CORRESPONDENCE TABLE

This is only an example of a table to convert game unit to a real world measure.

	Game Unit	Metric	US/UK	Suggested price (Urbits)
Coal	1	1 t		
Iron	1	1 t		
Copper	1	1 t		
Tin	1	1 t		
Lead	1	1 t		
Aluminum	1	1 t		
Uranium	1	1 t		
Gold	1	1 kg		
Silver	1	1 kg		
Platinum	1	1 kg		
Precious stones	1	50 carat	50 carat	
Wool	1	1 m ²		
Cotton	1	1 t		
Water	1	1 m ³		
Lumber	1	1 trunk	1 trunk	
Plank	1	1 plank	1 plank	
Furniture	1	1 m ³		
Beer	1	1 bottle	1 bottle	
Car	1	1 car	1 car	
Oil	1	1 barrel	1 barrel	
Natural gas	1	1 m ³		
Food	1	1 kg		

SUGGESTED FREIGHT COST BY NETWORK TABLE

This is a table to shown suggested freight cost for some key goods. All the prices here are in Urbits per Minutes.

	Quantity (u)	Road	Railroad	Canal/Sea	Pipeline	Air
Coal		0,1	0,06	0,02	-	-
Iron		0,1	0,05	0,03	-	-
Copper						
Tin						
Lead						
Aluminum						
Uranium						
Gold						
Silver						
Platinum						
Precious stones						
Wool						
Cotton						
Water		-	-	-	0,001	-
Lumber						
Plank						
Furniture						
Beer						
Car						
Oil		0,2	0,07	0,01	0,001	-
Natural gas		0,25	0,08	0,02	0,001	-
Food						

Q&A

Just a little selection of old questions I gather from the forum.

Q: Can I force the construction of a coal mine laying a single Production I zone on a coal layer?

A: Yes you can. This is a change from SC model. You have the opportunity to force and orientate the development of your industry deciding what resource exploit at the start of the game.

This is quite realistic because the choose of exploiting resources is often political (concessions for mines....).

Q: Having to deal with resources is not a mayor task, Why I must do it?

A: If you discard the initial choose to lay a production zone over a specific resource, You never have to deal with resources, if not for curiosity or for a very fine tuning. Probably casual players rarely going to have serious troubles with resources.

A: How about productions problems of a single industry?

D: As in real life you (the mayor) will never decide upon such things: what building to build, where, profits and costs are private's troubles.... The computer will manage it and spare you from micromanagement.

Q. Usually cities have few or even no resources. Why I must have resources if I don't want them?

A: When you design your map you are free to lay the resources you like to have. If you like to have no resources you can build a map without resources.

You must remember that Fertile-land, Water and Lumber are quite abundant in mild climates, but you can even have a desert if you desire it (you will have only a lot of Sand and Stones).

If no or very few resources are in your region, You have to rely upon your transport network to have it imported from the outside.

Q: What happens if I have an earth-land city and I can't build harbors?

A: You have to rely only on canals, rails or roads... It's hard to have a metropolis far away from an harbor (Mexico City and San Paolo are the only exceptions), but you can still have a big city with a canal system and big railway stations.

Q: What models the amount of resources outside the region? Are they infinite?

A: Yes, for the game purpose, is quite realistic to suppose that resources from outside are infinite.

Q: What is the real advantage of adding that much complexity if nothing change for the player?

A: A better underlying economic model give us many advantages when, in the future, we want to add enhancements to traffic model.

We could have better charts and graphs, we will know the GP of our city both in quantity or in money. So we could have a wide array of taxes and ordinances.

Enhancements are possible for education and careers too.

Q: Don't you think there are too many goods in your model?

A: We can't restrain the number of goods. If a modeler want a pub that sell only Beer he will do it... moreover, if he want a pub that sell only Brown beer he'll do it... moreover if he want a pub that sell Mr. Smith Delicious Brown Beer[®] he'll do it and we can't stop him.

I must say that too many goods will slow the game on the slower computers; so we must have, from the release of the game, a variety of goods that allow to build many stuff without adding new goods. With time modellers will add many goods, but computers will be fast enough.

Q: What happens if I try to bulldoze a building in the middle of the production chain, if the building run out of workers or abandoned?

A: Before deciding to bulldoze a building you can open the query to see where the output go and look if you harbor can import it. A warning before bulldozing could be helpful.

If for any reason your harbor can't import it, probably computer will build the same building you bulldozed in another place. If another place is not available or not economical, a shortage will cause the abandonment of the buildings on the chain.

If these buildings produced a key good (like food) the harbor automatically switch imports to such good.

Q: How can I build companies?

A. We could have primitive companies with this system If, when modelers make buildings, they are free of fill the input field with every kind of goods they want, they can link specific buildings to specific together to have a company.

Exemple: I want to build the Cousin Jethro Tomato Shop that sell only tomatoes from the Cousin Jethro Farm I just batting the shop and fill the field input with the string Cousin Jethro Tomatoes and batting the Cousin Jethro Farm filling the output field with Cousin Jethro Tomatoes.

Now they are linked together.