SIMCITY

Simulating a City, One Page at a Time

Stone Librande

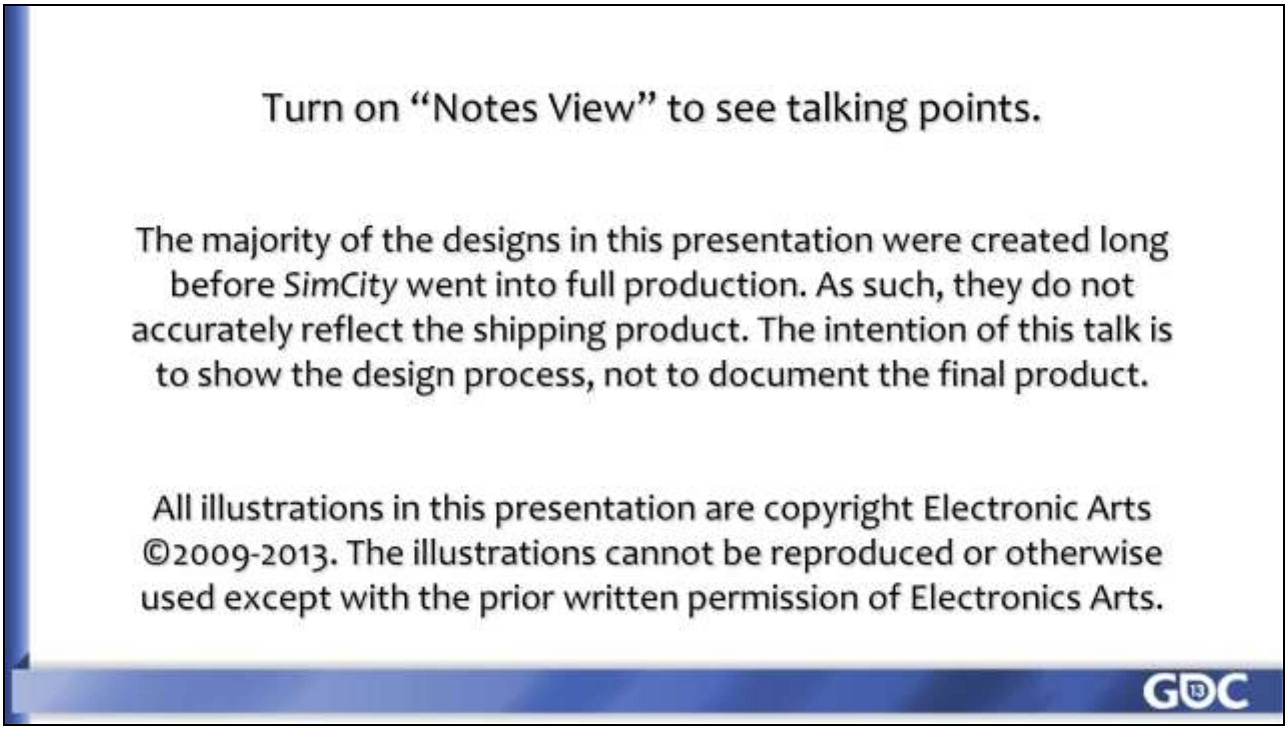
Lead Designer, *SimCity*

@StoneLibrande

GDC

Intro

Welcome!



Turn on "Notes View" to see talking points.

The majority of the designs in this presentation were created long before *SimCity* went into full production. As such, they do not accurately reflect the shipping product. The intention of this talk is to show the design process, not to document the final product.

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Legal Information

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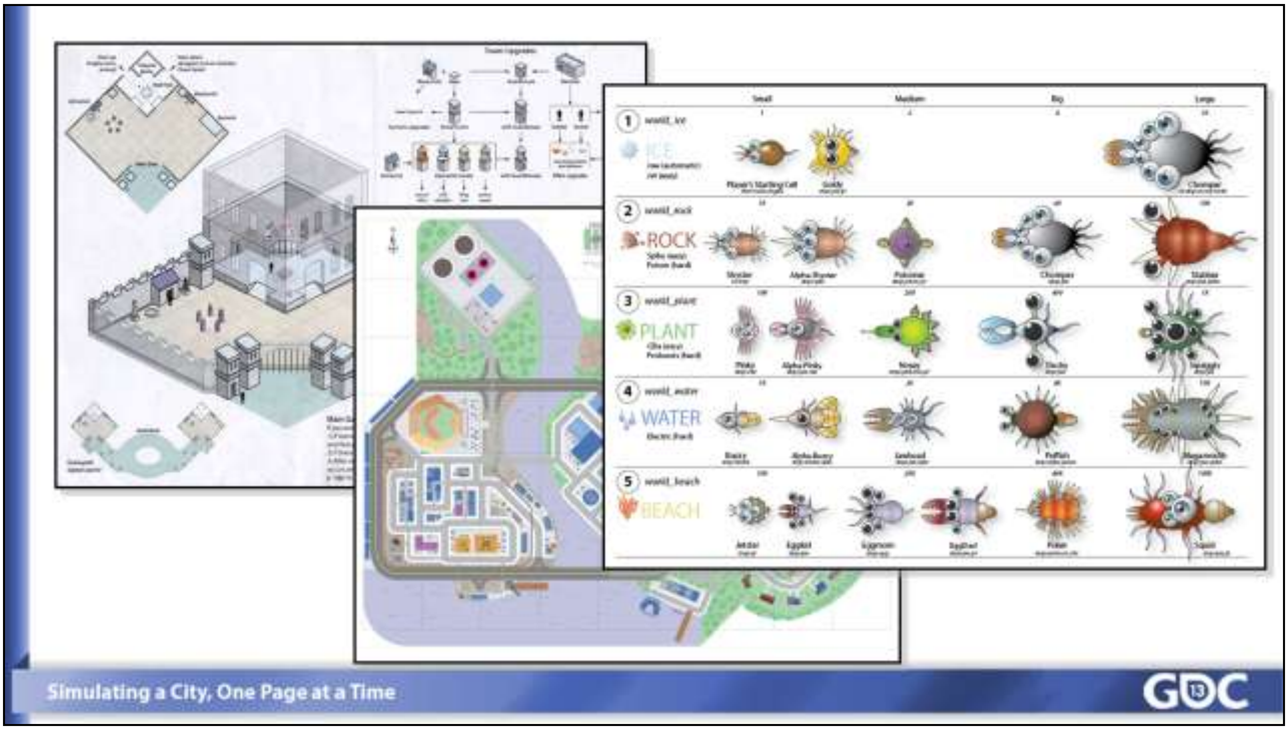

Simulating a City, One Page at a Time

Intro

Three years ago, at GDC 2010, I gave a talk about one-page designs. In that talk I showed several examples of one-page designs from other games I have worked on: Diablo 3, Simpsons and Spore. I don't have time today to go over the topics that I discussed in that lecture, but if you are interested you can download the slides here: http://www.stonetronix.com/gdc-2010/ , or watch the talk on the GDC Vault: http://gdcvault.com/search.php#&category=free&firstfocus=&keyword=librande&conference_id=280 (requires Vault membership).

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SIMCITY

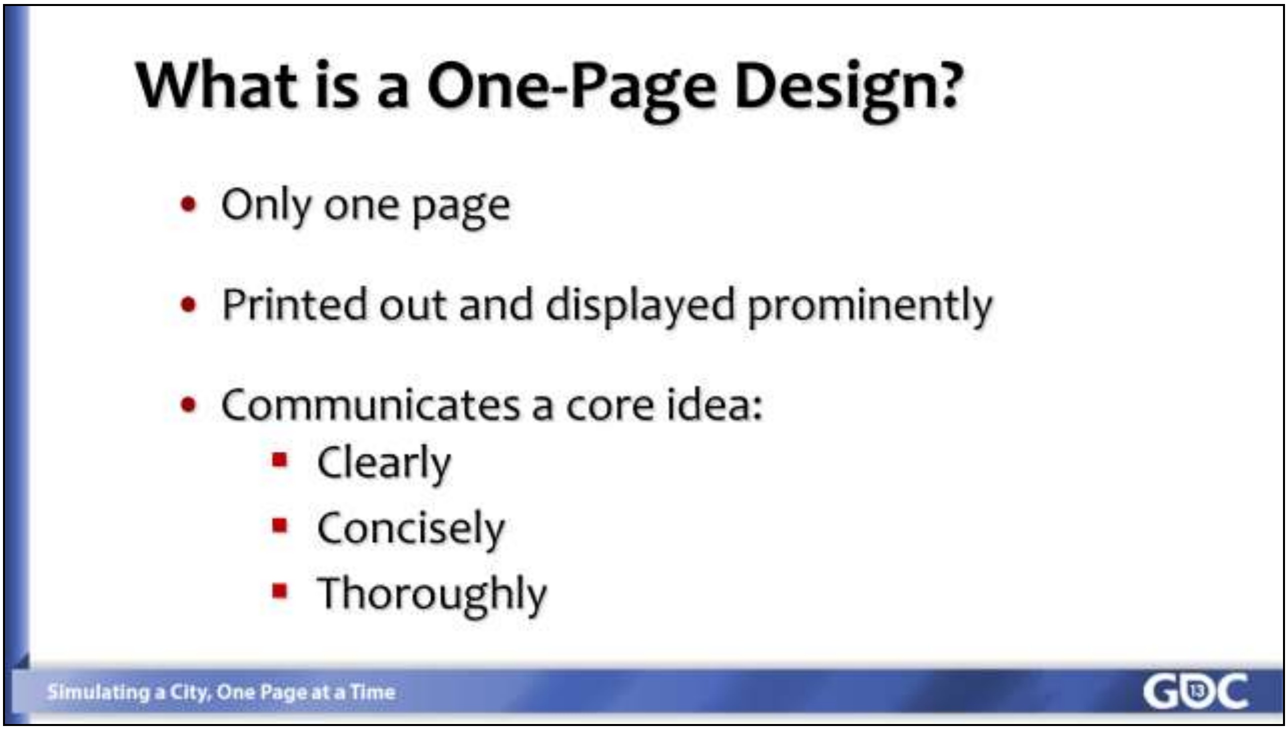
Simulating a City, One Page at a Time

GDC

Intro

I have had a lot of success with one-page design documents, so when I started working on *SimCity*, back when there were only five people on the team, I gave myself a challenge: Could I do ALL of the design work as one-page documents, from initial pre-production all the way up until when we shipped? Well, the short answer is, “No, I couldn’t”. But even though I knew it would be difficult, I wanted to push it as far as I could in an effort to both grow as designer and as a way to see where the one-page design approach would break.

I know that most of you will never work on a game where you have to simulate a city, so even though I’m only going to be showing *SimCity* documentation, I hope that the general ideas behind these documents will be valuable for any design project you are working on.



What is a One-Page Design?

- Only one page
- Printed out and displayed prominently
- Communicates a core idea:
  - Clearly
  - Concisely
  - Thoroughly

Simulating a City, One Page at a Time

What is a One-Page Design?

For those of you who haven’t seen my previous talk, here is a quick review:

Obviously, it is only one page. Nothing is hidden from view. When you staple a page behind another page then you are taking a risk that your audience might not see that information. When you require people to scroll to see the entire design, or to click a hyperlink for more information, then there is a chance that they won’t. A page doesn’t need to by 8.5 x 11, it can be any size and in any orientation.

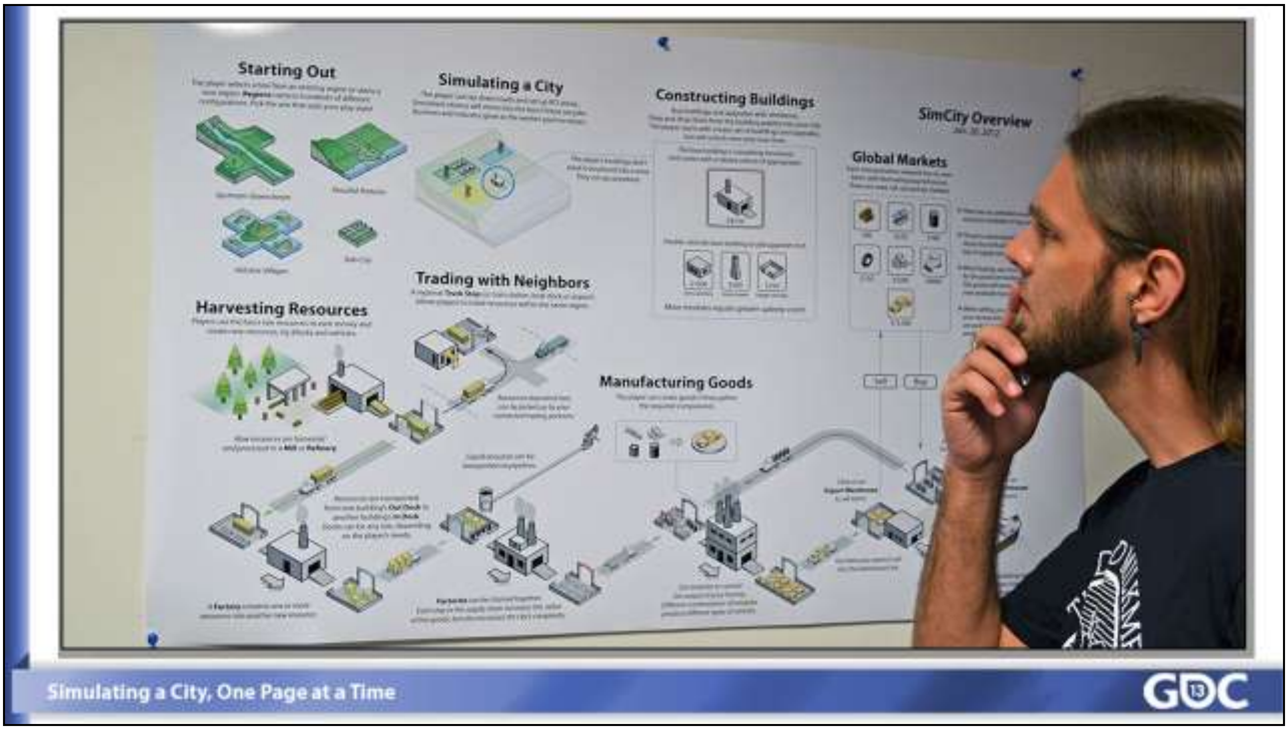
Print it out. Hang it up. Make copies and distribute it around the office. A cryptically named design document buried inside a folder on the server is worthless. You want the ideas out in open for everyone to see. You want to be able to take the page into a meeting and write on it.

Ultimately the reason you are creating designs is to communicate. Just because you are only using one page doesn’t mean that you are communicating effectively. Make sure to:

- Present the core idea as clearly as possible. Make your design approachable, unambiguous and easy to interpret.

- Be concise and focused. Don’t put too many ideas on one page.

-Try to answer as many questions as possible. This sometimes puts you at odds with the “concise” and “clear” points. Put as much information as you can into the document, but not at the cost of making the document unwieldy to read. Finding the sweet spot may take some trial and error but it is worth the effort.

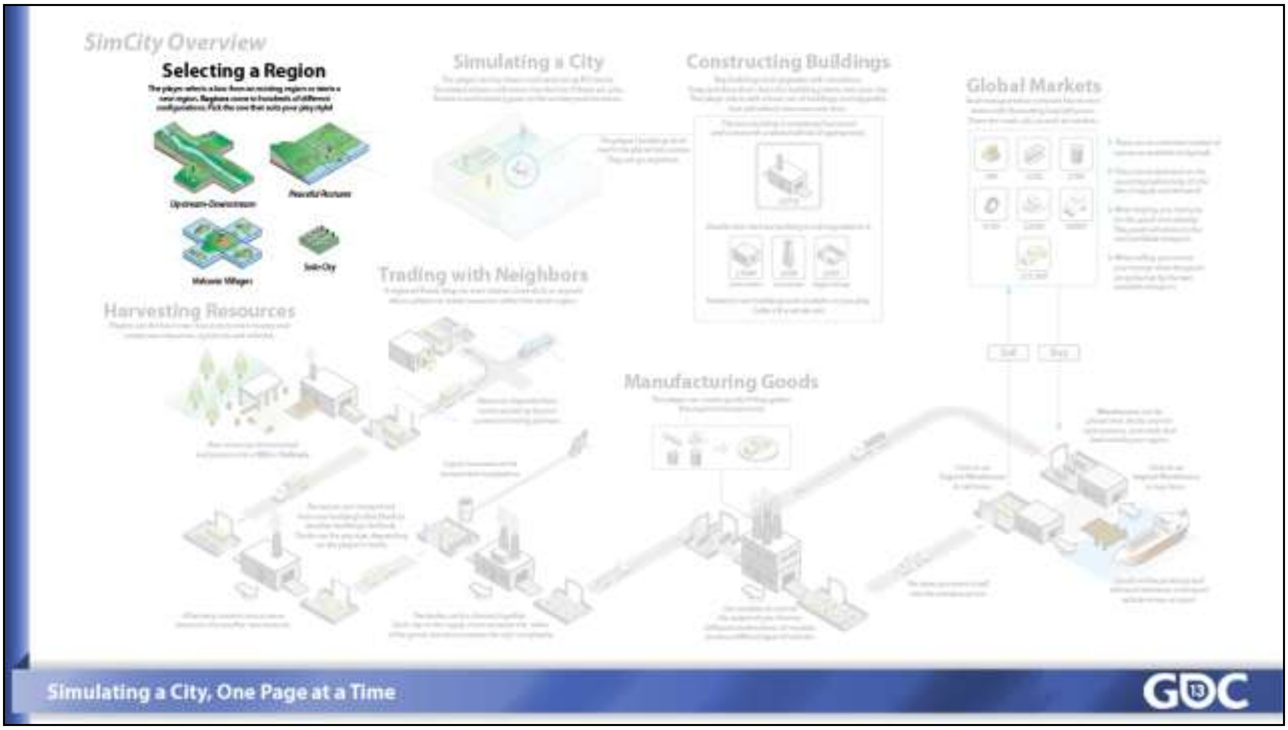


Simulating a City, One Page at a Time

What is a One-Page Design?

Here’s an example of a large one-page document (with Maxis designer, Brian Bartram, pretending to look intrigued). This is one of the first documents produced for the project and it’s hung up where many people will see it. I like to use our plotter because it’s a lot easier to make a one-page document if you have a big piece of paper!

I should note that it’s impossible to show you the actual paper documents in a PowerPoint presentation. The resolution is too low (96 ppi, compared to 1200 ppi from a laser printer), and the aspect ratio is forced to be 16:9. So throughout this presentation I’ll be showing you many diagrams that have had to be reworked for PowerPoint’s aspect ratio. After the talk feel free to come up front and check out the actual physical illustrations that I brought along with me today.



SimCity Overview

Selecting a Region

The player selects a lot from an existing region or starts a new region. Regions come in hundreds of different configurations. Pick the one that suits your play style!

Simulating a City, One Page at a Time

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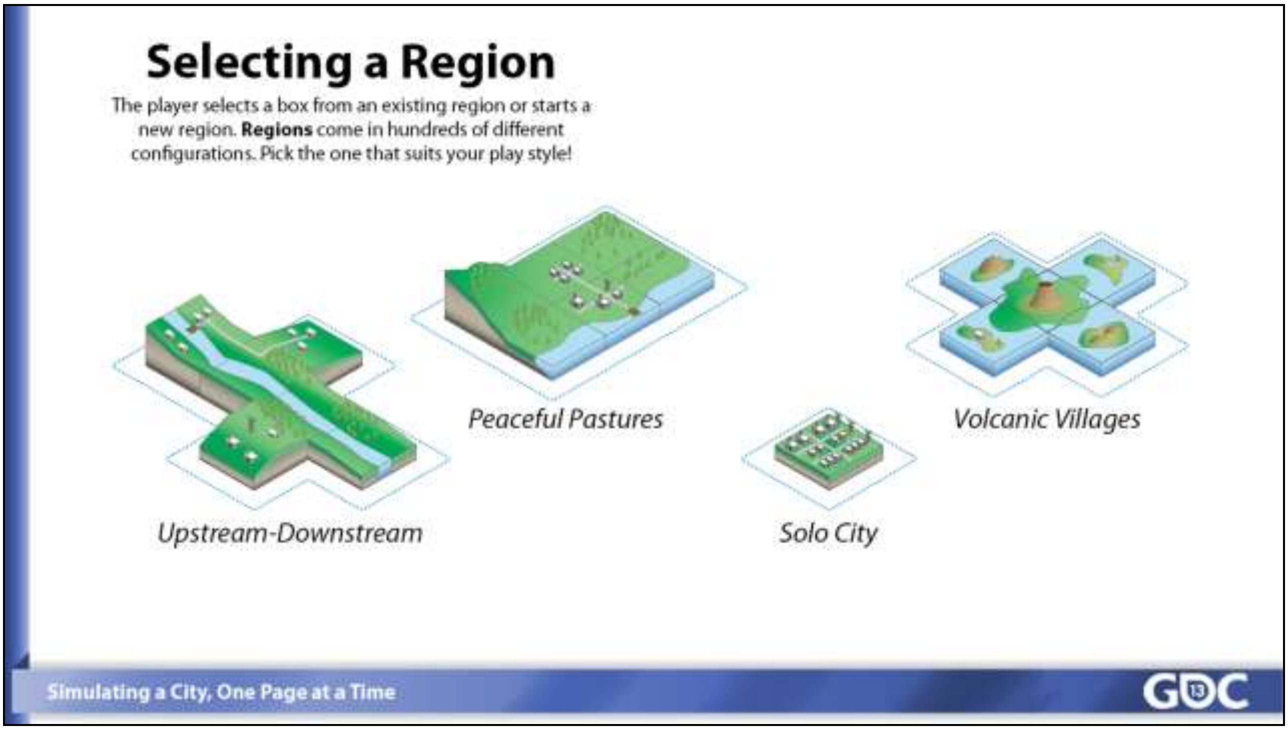
SimCity Overview

This overview diagram was one of the first ones created for *SimCity*, about three and a half years ago (Sept. 2009). It's purpose was to lock down the high level features of the game. Think of it as an outline for the entire game, where each bold heading describes a feature set. There's not a lot of detail about each feature, because back then I didn't know the details. But this gave the team a sense of what work we were going to be doing and kept us from wandering off-course.

The diagram turned out to be a good way to organize this talk, since the majority of the design documents that I'll be showing will fit into one of the categories listed here.

It's interesting to note that we consistently touted *SimCity* as a "bottom up" simulation (meaning that the high level simulation was not predetermined, but happened organically based on the aggregate actions of each individual citizens). However the entire design process was heavily "top down". We started with this overview document and over the course of the project continuously drilled down into the details of each section.

In order to explain how this worked, let's start out here with "Selecting a Region".



Selecting a Region

The player selects a box from an existing region or starts a new region. **Regions** come in hundreds of different configurations. Pick the one that suits your play style!

Simulating a City, One Page at a Time

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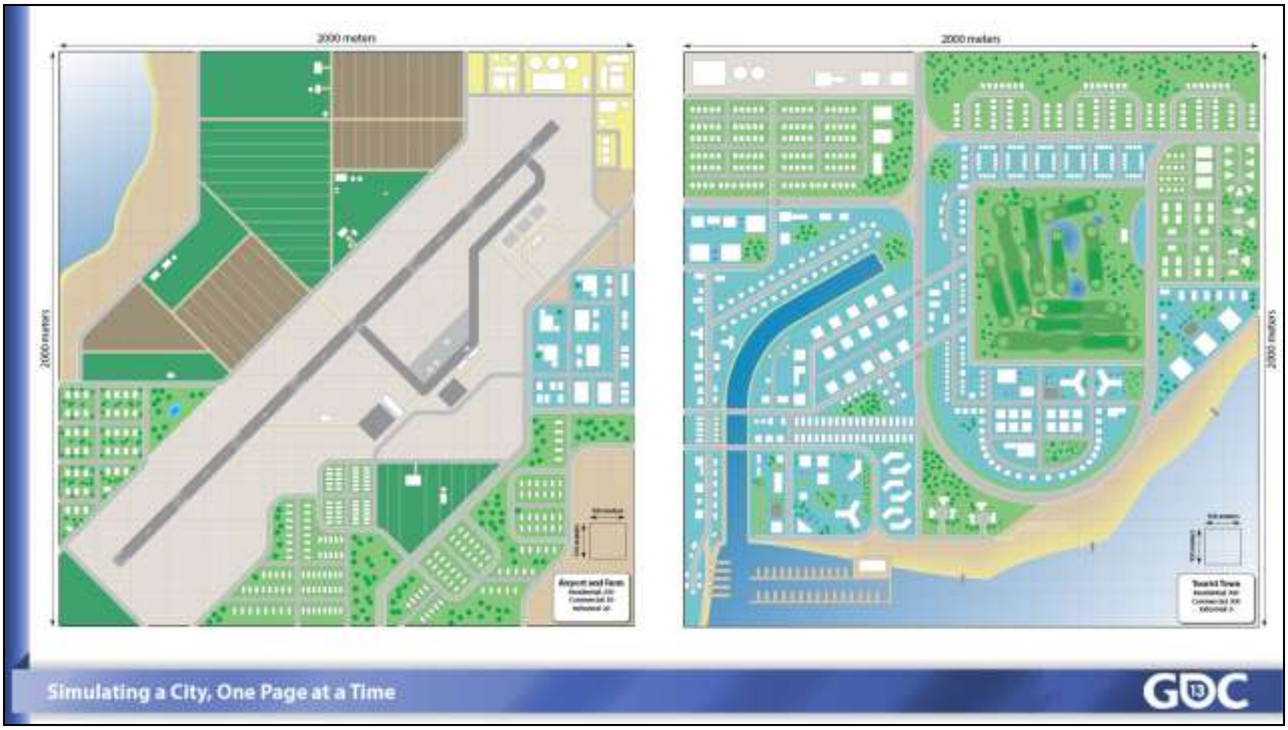
Selecting a Region

We knew that we wanted to make large regions where multiple people could get together and play simultaneously. Here are a few early examples showing how different region configurations would promote different types of play.



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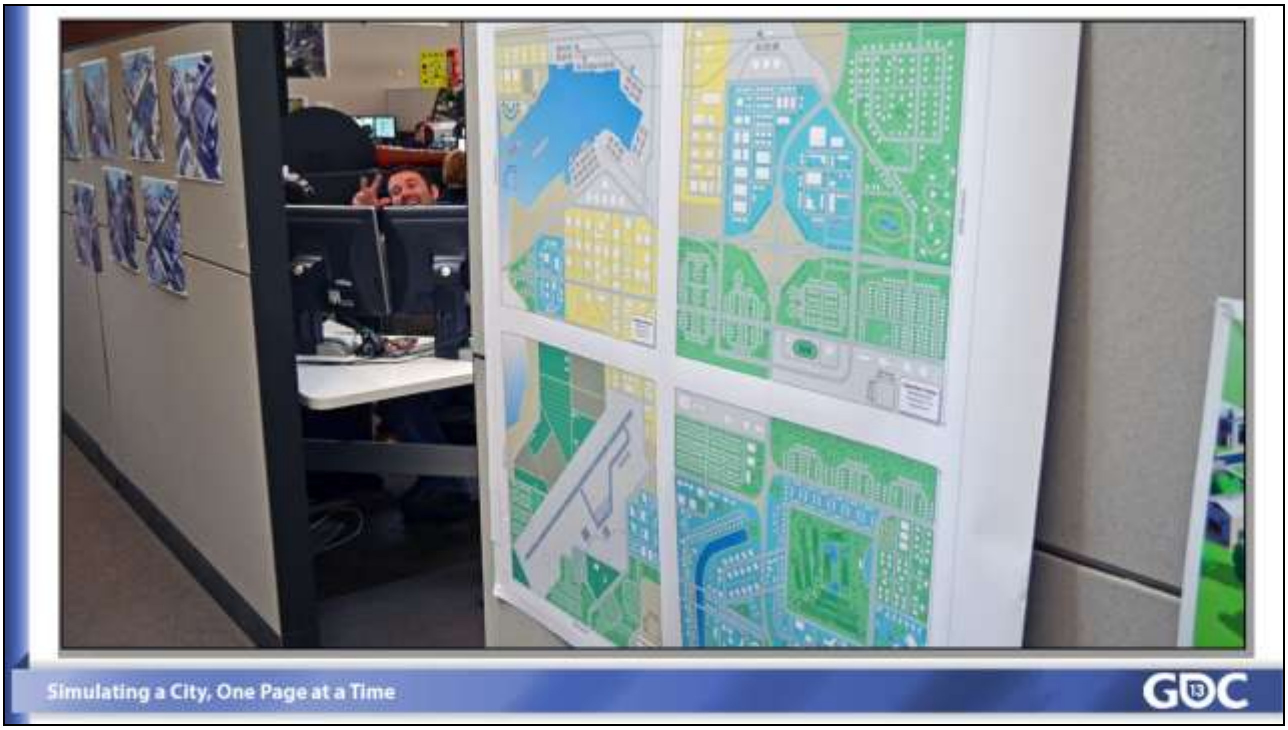
Scale Maps

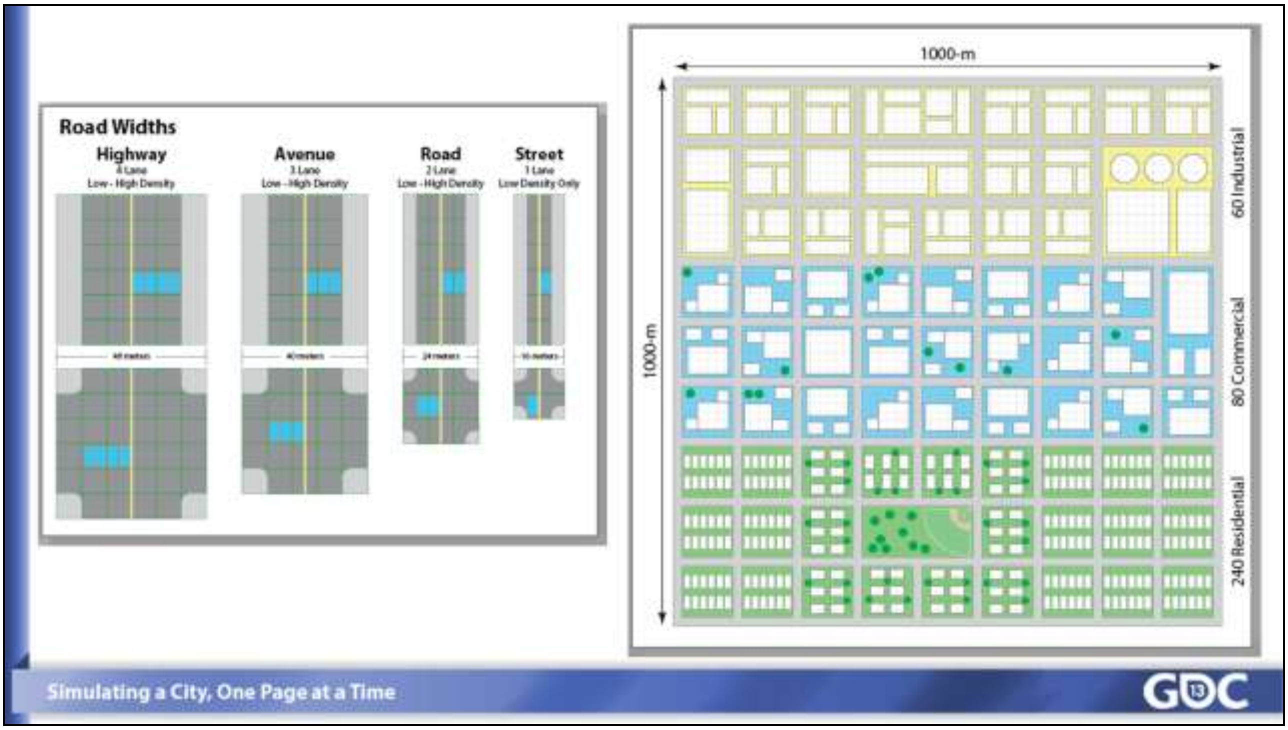
Some of the first diagrams I made were scale representations of actual cities. The engineering team had calculated that to run on our min-spec computer we should target 2K x 2K size areas, which is the size of a medium city in *SimCity 4*. In order to make it apparent to the team what that meant, I made some simple illustrations of different types of cities based on Google Earth view of real cities. In many ways I was already playing a non-simulating form of *SimCity* in Adobe Illustrator at this point in time, long before the engine was ready.

1) Here you see an industrial shipping yard
2) Here's a suburban area with many houses, a school, parks and a small central commercial district
3) This one is a farming town with a municipal airport
4) And the last one is a hotel-filled beach resort.



Simulating a City, One Page at a Time

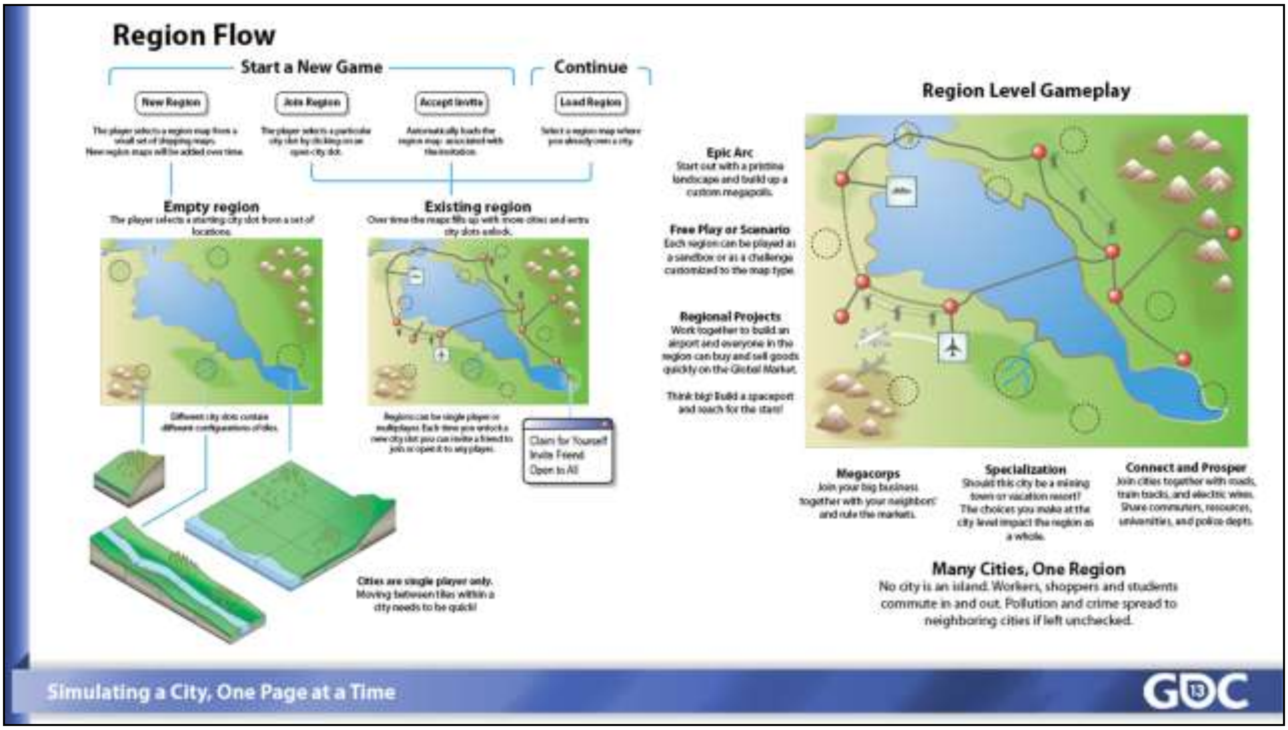
Overview Scale Maps
Here is a picture of all four cities together, printed out and hung up in the hallway (and photobombed by scripter John Giordano). Even though this document has no words, it is really easy to understand at a glance one of the key features of our game: that cities could be specialized, and that individual cities would work together to make up a larger region.



Simulating a City, One Page at a Time

Overview Scale Maps

Documents such as these go one level deeper and show individual widths for road types and RCI building approximations for 1K by 1K cities. These were needed by both engineering and art in order to establish the performance benchmarks. There were several of these illustrations that were used to estimate the maximum number of buildings in cities based on different wealth and density levels. (A city made of low-wealth skyscrapers has fewer buildings than a city of wealthy single-story mansions.)



Region Flow

Start a New Game

New Region

The player selects a region map from a small set of shipping maps.
New region maps will be added over time.

Join Region

The player selects a particular city slot by clicking on an open city slot.

Accept Invite

Automatically loads the region map associated with the invitation.

Continue

Load Region

Select a region map where you already own a city.

Empty region
The player selects a starting city slot from a set of locations.

Existing region
Over time the maps fills up with more cities and extra city slots unlock.

Different city dots contain different configurations of tiles.

Regions can be single player or multiplayer. Each time you unlock a new city slot you can invite a friend to join or open it to any player.

Cities are single player only.
Moving between tiles within a city needs to be quick!

Region Level Gameplay

Epic Arc
Start out with a pristine landscape and build up a custom megapolis.

Free Play or Scenario
Each region can be played as a sandbox or as a challenge customized to the map type.

Regional Projects
Work together to build an airport and everyone in the region can buy and sell goods quickly on the Global Market.

Think big! Build a spaceport and reach for the stars!

Megacorps
Join your big business together with your neighbors' and rule the markets.

Specialization
Should this city be a mining town or vacation resort? The choices you make at the city level impact the region as a whole.

Connect and Prosper
Join cities together with roads, train tracks, and electric wires. Share commuters, resources, universities, and police depts.

Many Cities, One Region
No city is an island. Workers, shoppers and students commute in and out. Pollution and crime spread to neighboring cities if left unchecked.

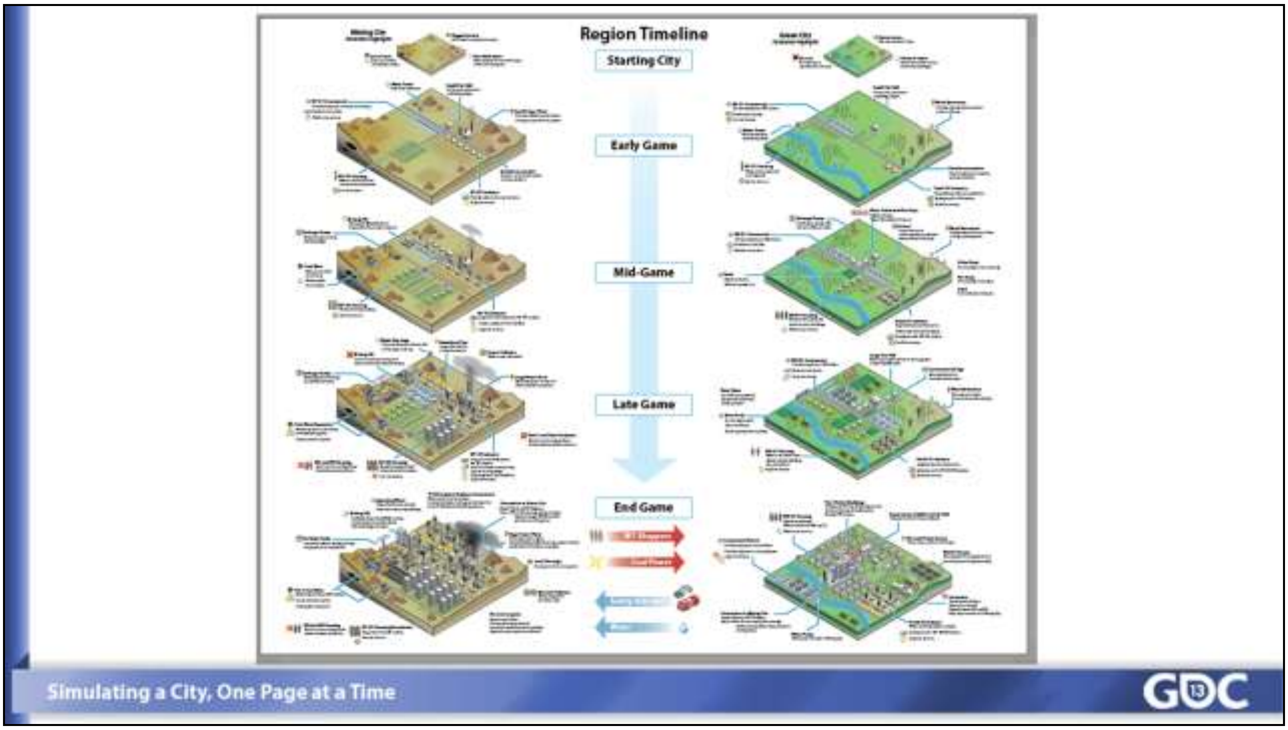
Simulating a City, One Page at a Time

Region Flow

The previous documents were useful for determining engineering and art metrics, but this design is about the player experience.

This diagram shows the UI options, as well as the reasons why the player will care. High level gameplay activities are listed around the diagram. (Like many of the examples I’m showing today, the printed document has a long vertical layout and is meant to be read from top to bottom, instead of from left to right as you see it here.)

By coming at the problem from both ends (developer’s view and player’s view) it helps the team understand the problem fully.



Simulating a City, One Page at a Time

Region Timeline

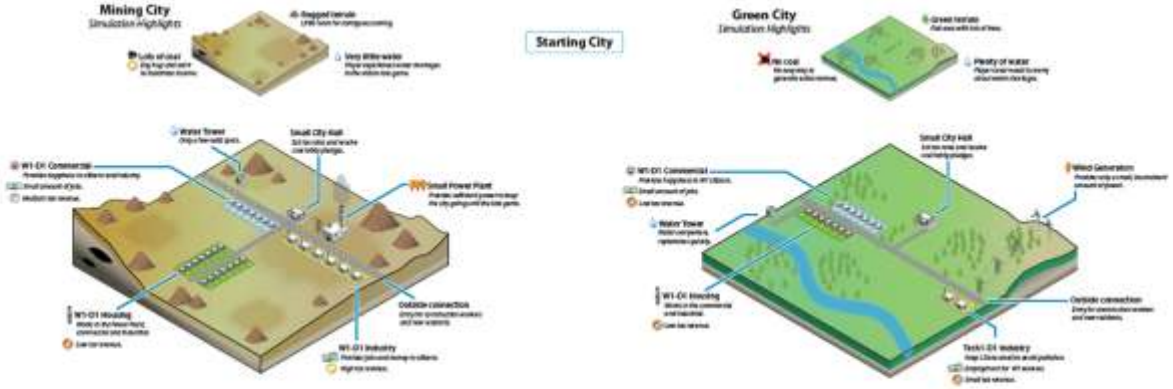
This is one of my favorite diagrams from the project. It describes play patterns in more detail and how they change through time. I strongly believe that every game designer should make a timeline like this early in the development process. At this phase in the project we didn’t have exact timings figured out, but we can still approximate it by breaking up the gameplay into early, mid, late and end game phases.

Most games have a very linear structure, which means that it will be simpler to create a traditonal timeline. Unfortunately, there is no “right way” to play SimCity which made the process much more difficult. One timeline can’t represent the thousands of ways that a player can construct a city.

To get around that problem, I decided to show off two extreme cases as book ends. If we can understand the extremes then we can assume that most cities will be shades of these extremes in varying proportions.

I know that it is difficult to see the detail (another reason why you should print out the documents instead of keeping them online) so let’s zoom in…

Early Game



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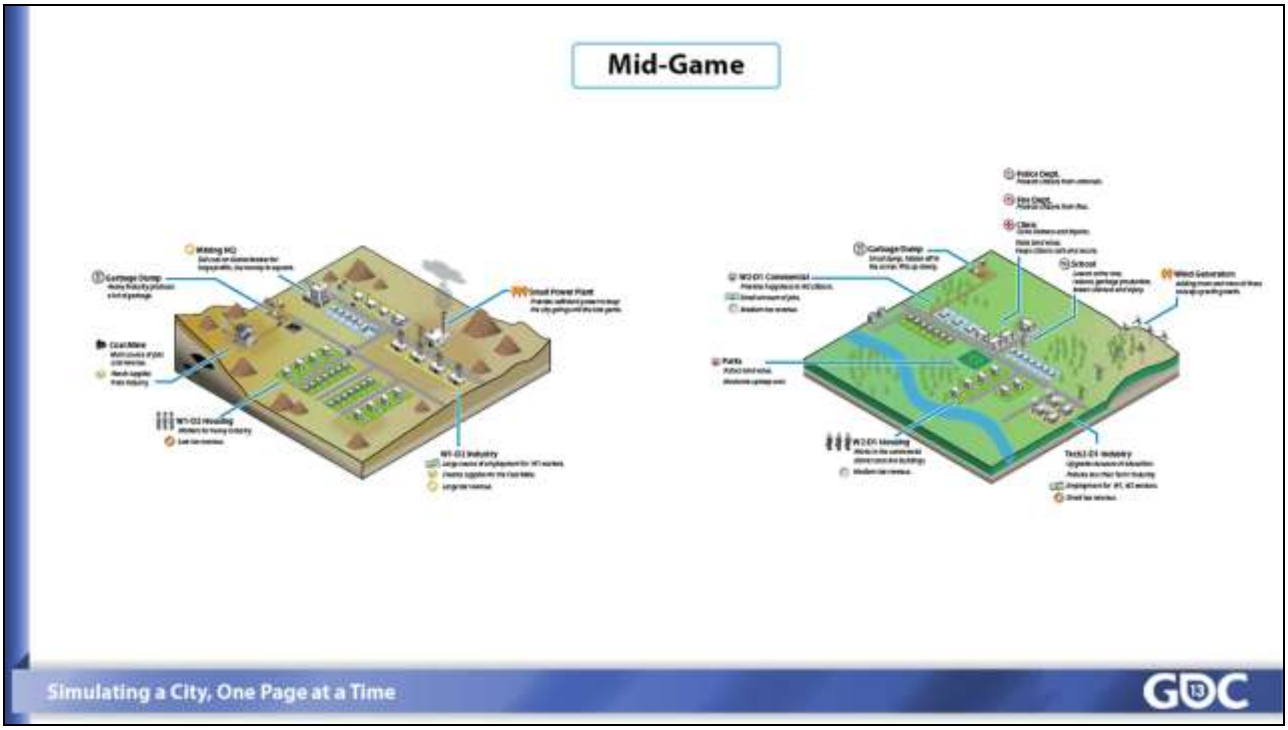
Region Timeline

There are two cities. The one on the left has little water and a lot of minerals (we called it “Pittsburgh”). The one on the right has plenty of water, but no natural resources (we called it “Berkeley”). Despite the differences, both players begin the same way: they lay out roads and zones. Pittsburgh favors industry and coal power, while Berkeley favors commercial and wind power.



Mid-Game

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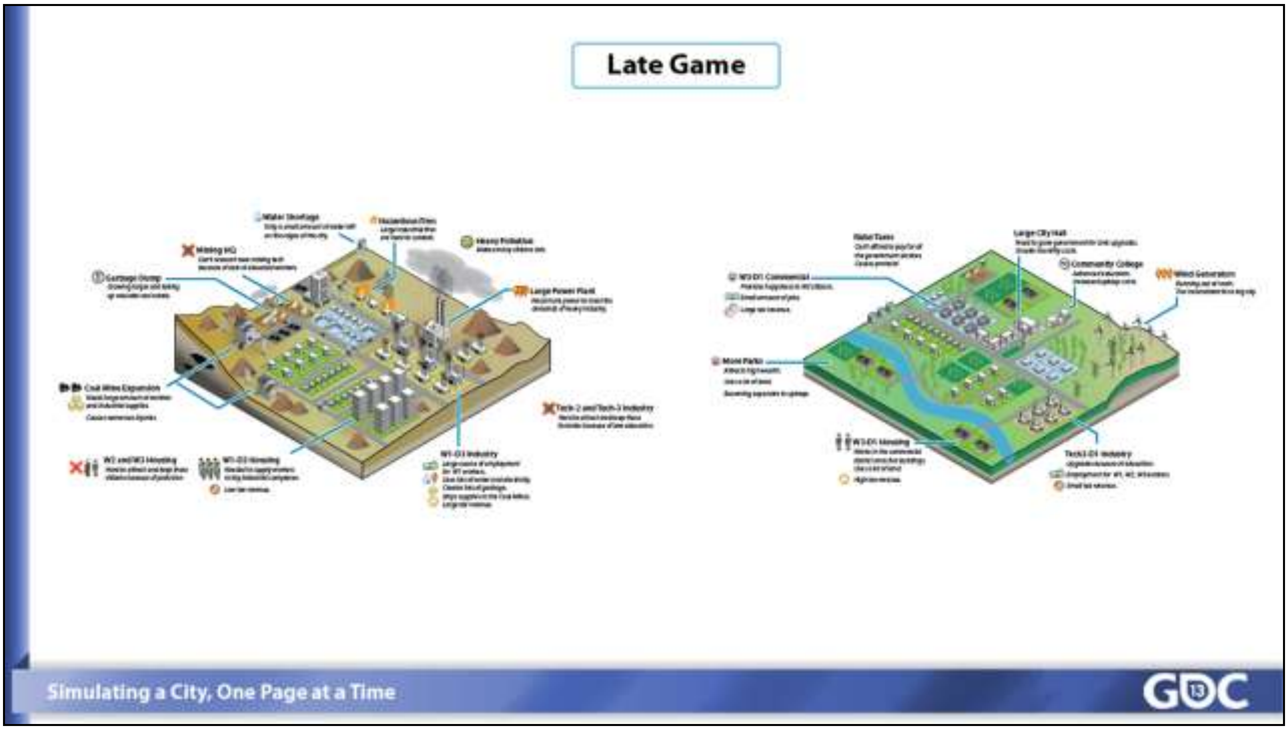
Region Timeline

In the mid-game the players are starting to specialize. Pittsburgh starts mining coal and builds lots of houses for low wealth workers. Berkeley is encouraging higher wealth workers and education.



Late Game

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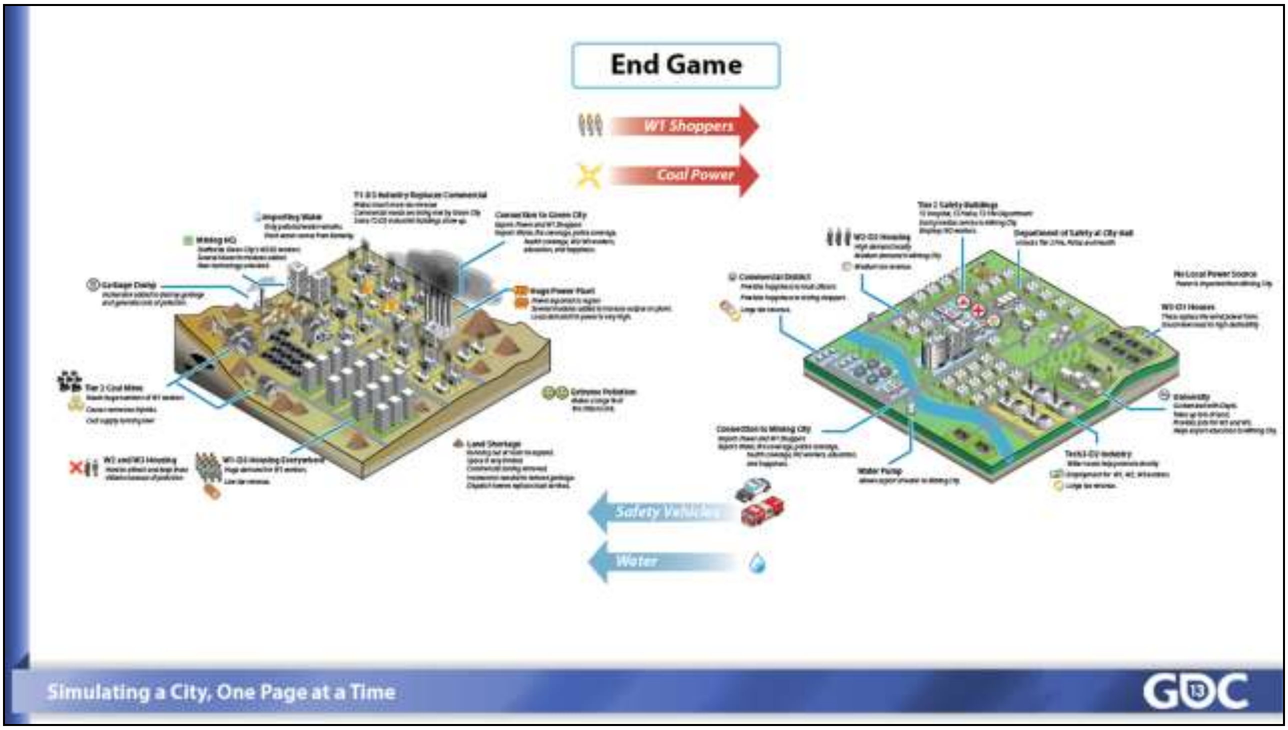
Region Timeline

In the late game the cities are very specialized. Pittsburgh has expanded the coal production and now has low wealth high-rises. Pollution is a problem and the dumps are filling up.

Berkeley has to use a lot of space for wind power because the wealthy houses and shops are demanding more electricity. As the education level rises the factories “tech up”. Berkeley is usually low on money because it has to pay upkeep on the many government services.



End Game

Simulating a City, One Page at a Time

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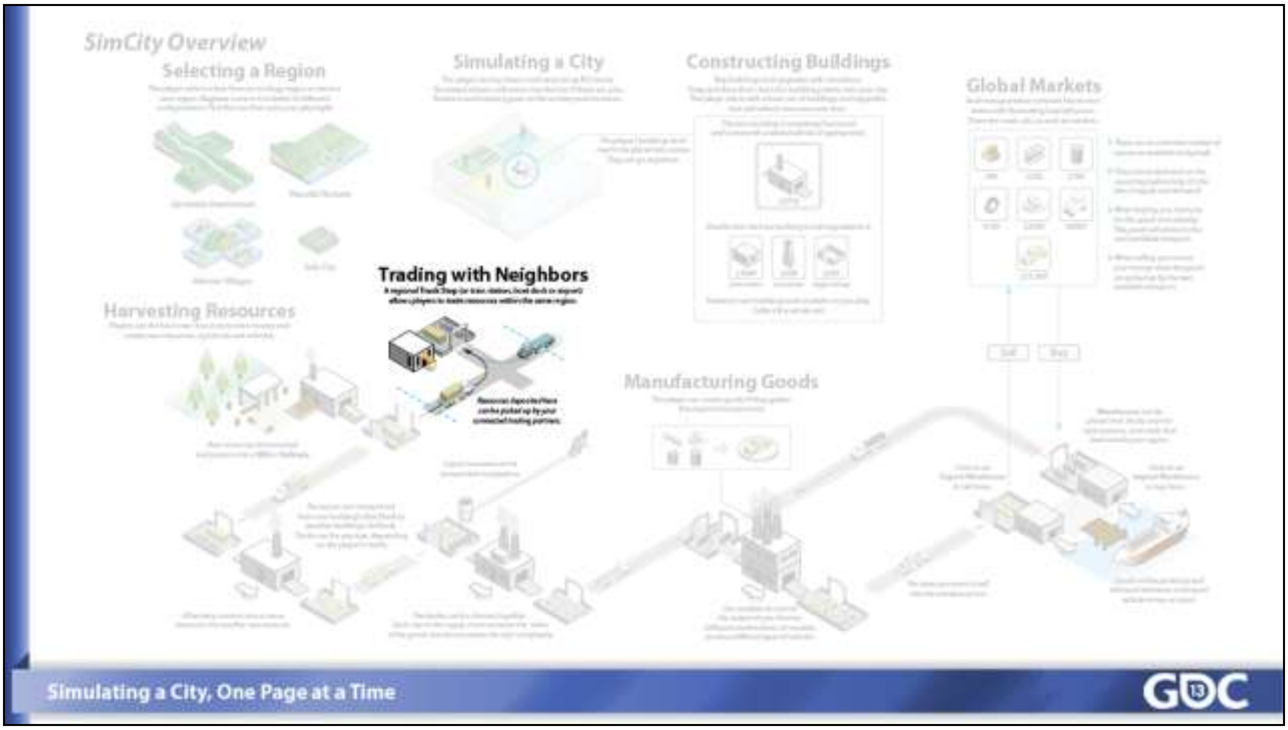
Region Timeline

In the end game both cities are facing crises. There is too much pollution and sickness in Pittsburgh and to make matters worse they are running out of water. There is too little money and electricity in Berkeley. However, if they work together they can solve each other’s problems by sharing commuters, utilities and services.

There are a lot of other details in these diagrams, but for the purposes of this talk it is not important. The main take away here is that you should always be looking at your game as arcs over time and attempt to document the important points that occur along the way. Figuring this out early on paper means that you won’t waste a lot of artist and programmer time later.



SimCity Overview

Selecting a Region

Simulating a City

Constructing Buildings

Global Markets

Trading with Neighbors

A regional Trade Depot (or train station, boat dock or airport) allows players to trade resources within the same region.

Resources deposited here can be picked up by your connected trading partners.

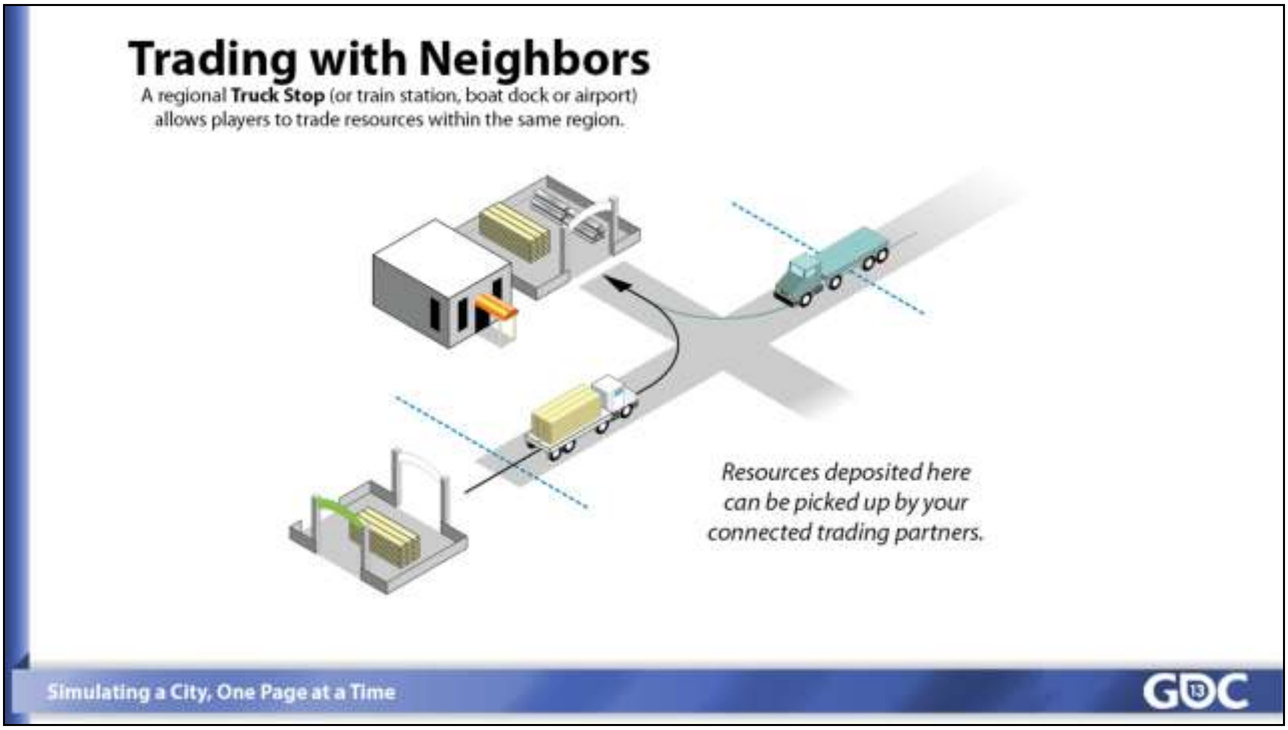
Harvesting Resources

Manufacturing Goods

Simulating a City, One Page at a Time

Trading with Neighbors

We knew that cities would be trading with each other, but when I first put this overview together I didn’t think it would be a big feature.



Trading with Neighbors

A regional **Truck Stop** (or train station, boat dock or airport) allows players to trade resources within the same region.

Resources deposited here can be picked up by your connected trading partners.

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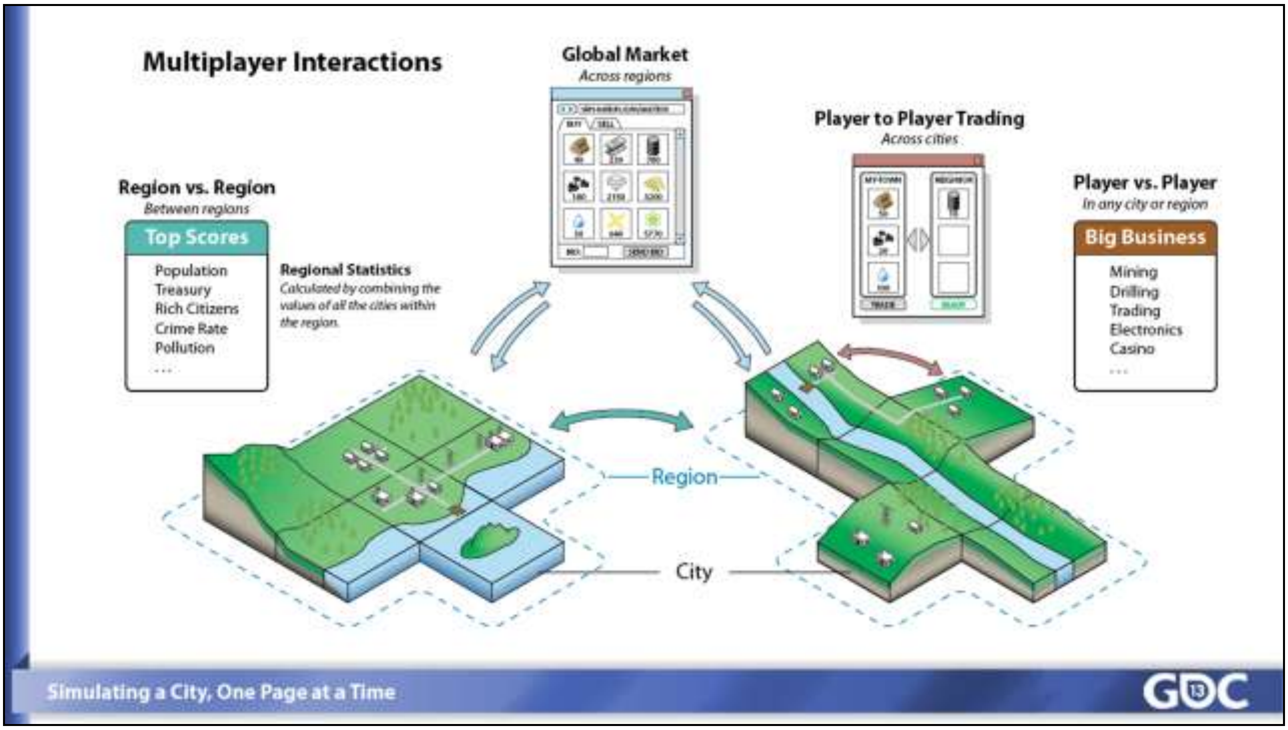
Trading with Neighbors

I imagined it would just be a truck and a trade lot and that players would simply ship goods back forth. But as you just saw in the Pittsburgh/Berkeley example, trading got much more complex as we started discussing all of the possibilities.



Multiplayer Interactions

Global Market
Across regions

Player to Player Trading
Across cities

Region vs. Region
Between regions

Top Scores

Population
Treasury
Rich Citizens
Crime Rate
Pollution
...

Regional Statistics
Calculated by combining the values of all the cities within the region.

Player vs. Player
In any city or region

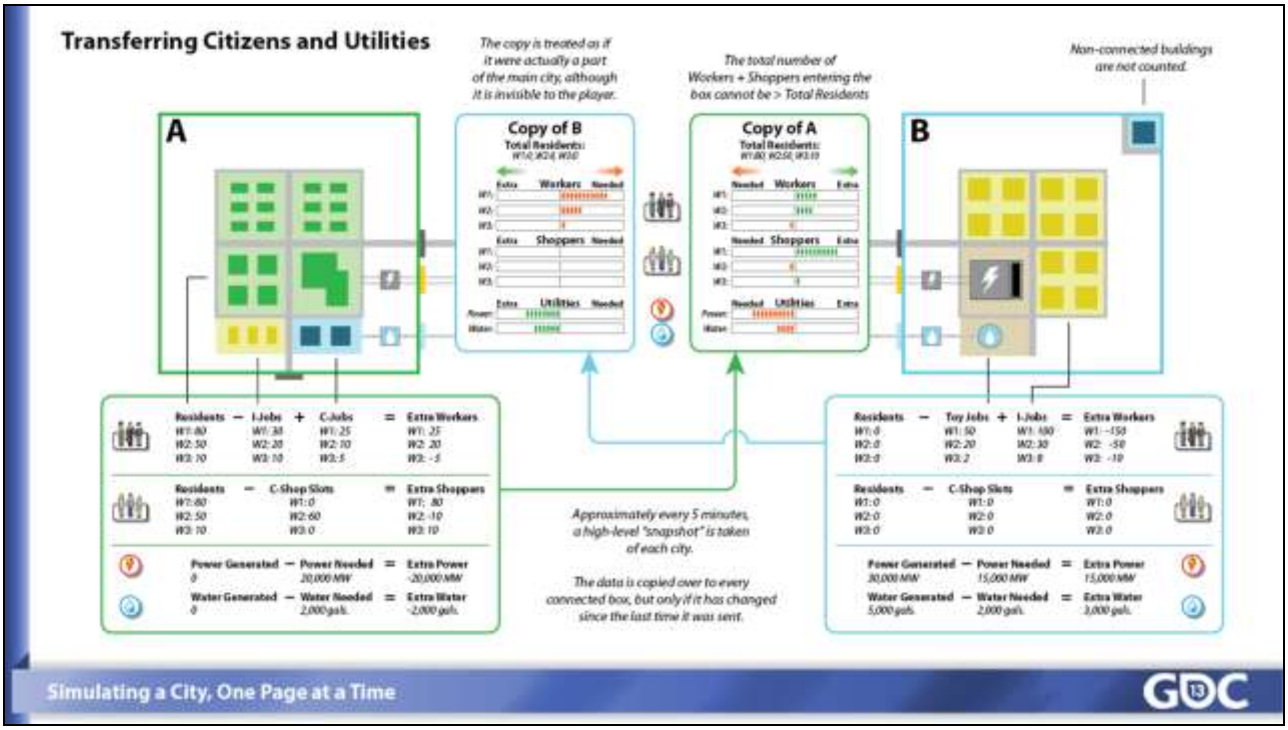
Big Business

Mining
Drilling
Trading
Electronics
Casino
...

Simulating a City, One Page at a Time

Multiplayer Interactions

The first thing that needed to be documented was all the ways that players could interact with other players: city to city, region to region, globally and personally. This was an early diagram that showed high level interaction relationships. As we started digging into the details the model became increasingly complex…



Transferring Citizens and Utilities

The copy is treated as if it were actually a part of the main city, although it is invisible to the player.

The total number of Workers + Shoppers entering the box cannot be > Total Residents

Non-connected buildings are not counted.

Residents	− I-Jobs	+ C-Jobs	= Extra Workers
W1: 80	W1: 38	W1: 25	W1: 25
W2: 50	W2: 20	W2: 10	W2: 20
W3: 10	W3: 10	W3: 5	W3: -5

Residents	− C-Shop Slots	= Extra Shoppers
W1: 80	W1: 0	W1: 80
W2: 50	W2: 60	W2: -10
W3: 10	W3: 0	W3: 10

Power Generated	− Power Needed	= Extra Power
0	20,000 MW	-20,000 MW

Water Generated	− Water Needed	= Extra Water
0	2,000 gals.	-2,000 gals.

Approximately every 5 minutes, a high-level "snapshot" is taken of each city.

The data is copied over to every connected box, but only if it has changed since the last time it was sent.

Residents	− Toy Jobs	+ I-Jobs	= Extra Workers
W1: 0	W1: 50	W1: 100	W1: -150
W2: 0	W2: 20	W2: 30	W2: -50
W3: 0	W3: 2	W3: 8	W3: -10

Residents	− C-Shop Slots	= Extra Shoppers
W1: 0	W1: 0	W1: 0
W2: 0	W2: 0	W2: 0
W3: 0	W3: 0	W3: 0

Power Generated	− Power Needed	= Extra Power
30,000 MW	15,000 MW	15,000 MW

Water Generated	− Water Needed	= Extra Water
5,000 gals.	2,000 gals.	3,000 gals.

Simulating a City, One Page at a Time

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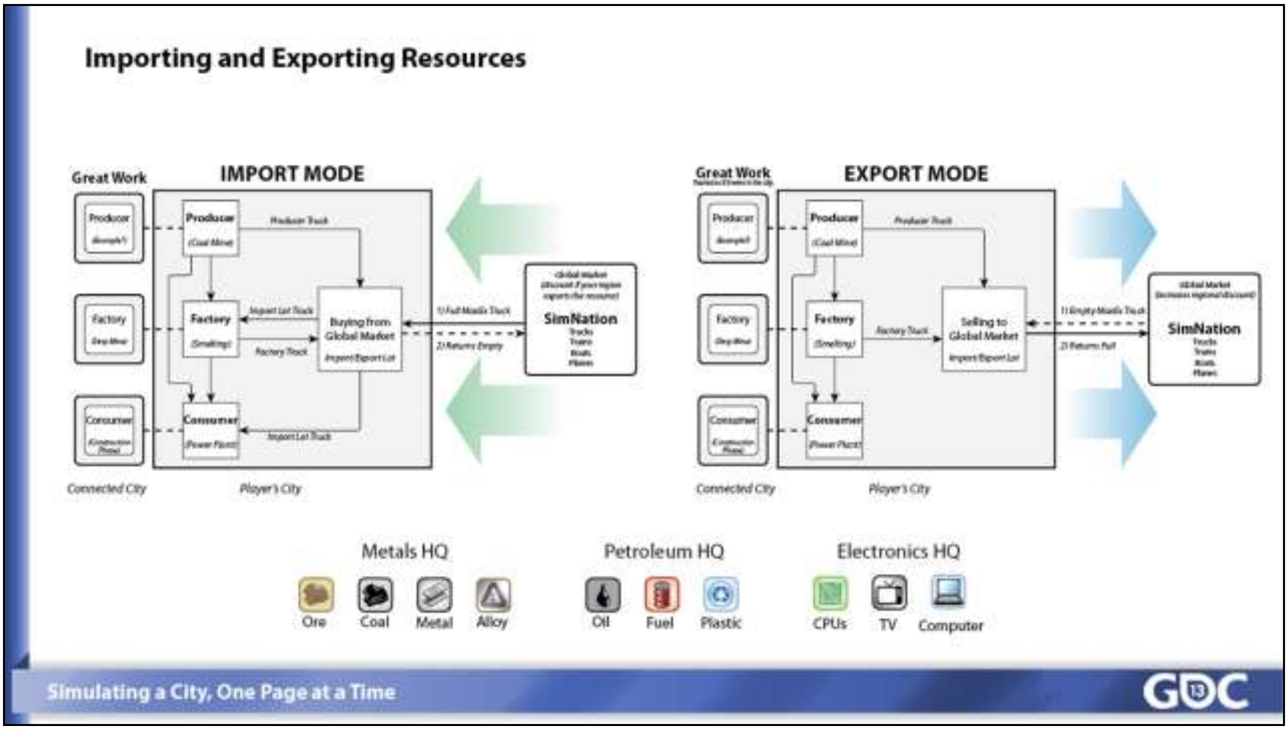
Transferring Citizens and Utilities

This chart is an attempt at trying to capture the intricate flows of city-to-city trading. It is difficult to understand, but don't worry about the details. In brief, this chart shows how City A is simulating next to a copy of City B and vice-versa. (In *SimCity*, players are only interacting with copies, not actual cities. This is necessary because the game can be played asynchronously, while one city is online and another one is offline. We don't want to simulate a city when its owner is offline because we didn't want a player to exit from a healthy city and come back later to find it in ruins.)

Given the engineering constraints of the Glassbox system, I was unable to come up with a more elegant design and we shipped the game with this system in it. Based on feedback that we have received, it is clear that players have a difficult time understanding how this system works.

What is important to note here is that if your design diagram is complex and can't be easily understood, then there is a good chance your players (and your fellow developers) won't understand it either. You may be better off changing the underlying design instead of iterating on the layout of the diagram.



Importing and Exporting Resources

IMPORT MODE

Great Work

Producer

Factory

Consumer

Connected City

Producer
(Coal Mine)

Producer Truck

Factory
(Smelting)

Import Lot Truck

Factory Truck

Buying from Global Market
Import/Export Lot

Consumer
(Power Plant)

Import Lot Truck

Player's City

1) Full Missile Truck

2) Returns Empty

SimNation
Trucks
Trains
Boats
Planes

EXPORT MODE

Great Work

Producer

Factory

Consumer

Connected City

Producer
(Coal Mine)

Producer Truck

Factory
(Smelting)

Factory Truck

Selling to Global Market
Import/Export Lot

Consumer
(Power Plant)

Player's City

1) Empty Missile Truck

2) Returns Full

Global Market

SimNation
Trucks
Trains
Boats
Planes

Metals HQ: Ore, Coal, Metal, Alloy

Petroleum HQ: Oil, Fuel, Plastic

Electronics HQ: CPUs, TV, Computer

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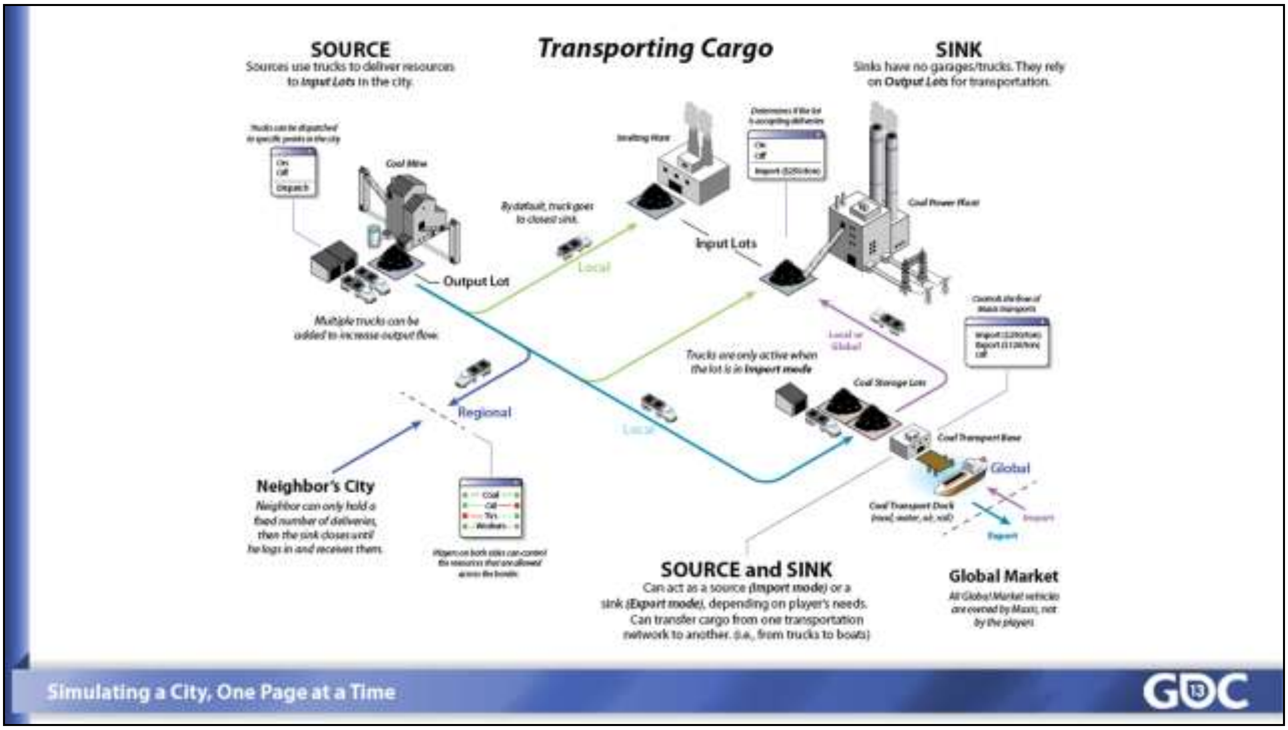
Importing and Exporting Resources

Players can also trade with the Global Market. Unlike the previous slide, this chart doesn't attempt to cover every aspect of trading, so it is much easier to understand. Still, it is rather dry and uninspiring. It was perfect for the one-on-one conversations I had with the scripter who was implementing the feature, but isn't something that would attract much attention if it was hanging on a wall. (I tried "decorating" it by placing colorful resource icons along the bottom, but that didn't make the core flow chart any more compelling.)



Transporting Cargo

SOURCE
Sources use trucks to deliver resources to *Input Lots* in the city.

SINK
Sinks have no garages/trucks. They rely on **Output Lots** for transportation.

Trucks can be dispatched to specific points in the city

Multiple trucks can be added to increase output flow.

By default, truck goes to closest sink.

Determines if the lot is accepting deliveries

*Trucks are only active when the lot is in **Import mode***

Controls the flow of Mass transports

Neighbor's City
Neighbor can only hold a fixed number of deliveries, then the sink closes until he logs in and receives them.

Players on both sides can control the resources that are allowed across the border.

SOURCE and SINK
Can act as a source **(Import mode)** or a sink **(Export mode)**, depending on player's needs. Can transfer cargo from one transportation network to another. (i.e., from trucks to boats)

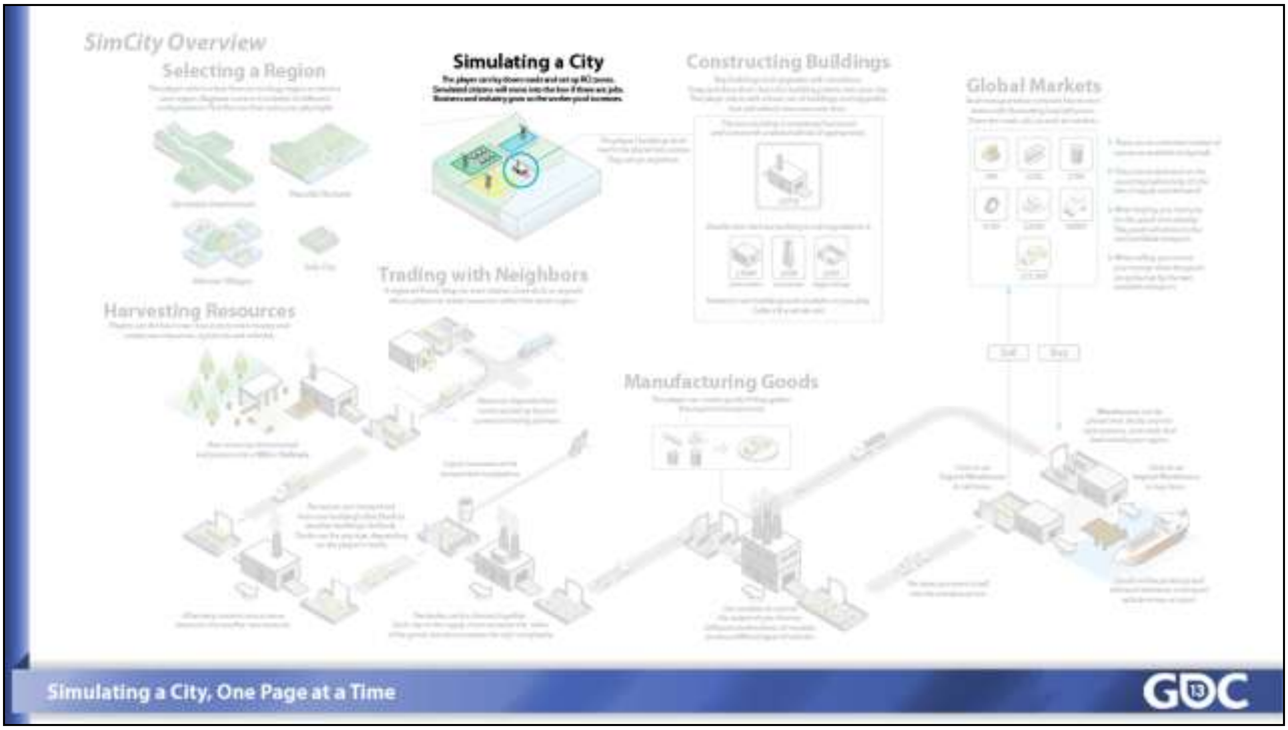
Global Market
All Global Market vehicles are owned by Maxis, not by the players

Simulating a City, One Page at a Time

Transporting Cargo

Here's another attempt at illustrating the same idea. This is essentially the same diagram as the one on the previous slide, but I replaced the 2D boxes with isometric buildings and added trucks along the arrows. Now it is much more compelling to look at. If you hang this up on wall then people will stop to look at it.

You have to be careful when doing this sort of decorating. Make sure that everything you place on the chart reinforces the ideas you are trying to communicate. For instance, I could have drawn in actual roads instead of colored arrows, or placed little trees and houses along the truck routes. This would have made the city look more realistic and appealing but it would have only been a distraction (not to mention more work for me). Edward Tufte calls this "chartjunk" and it should be avoided.


SimCity Overview
Selecting a Region
Simulating a City
The player can lay down roads and set up RCI zones.
Simulated citizens will move into the box if there are jobs.
Business and industry grow as the worker pool increases.
Constructing Buildings
Global Markets
Trading with Neighbors
Harvesting Resources
Manufacturing Goods
Sell
Buy
Simulating a City, One Page at a Time
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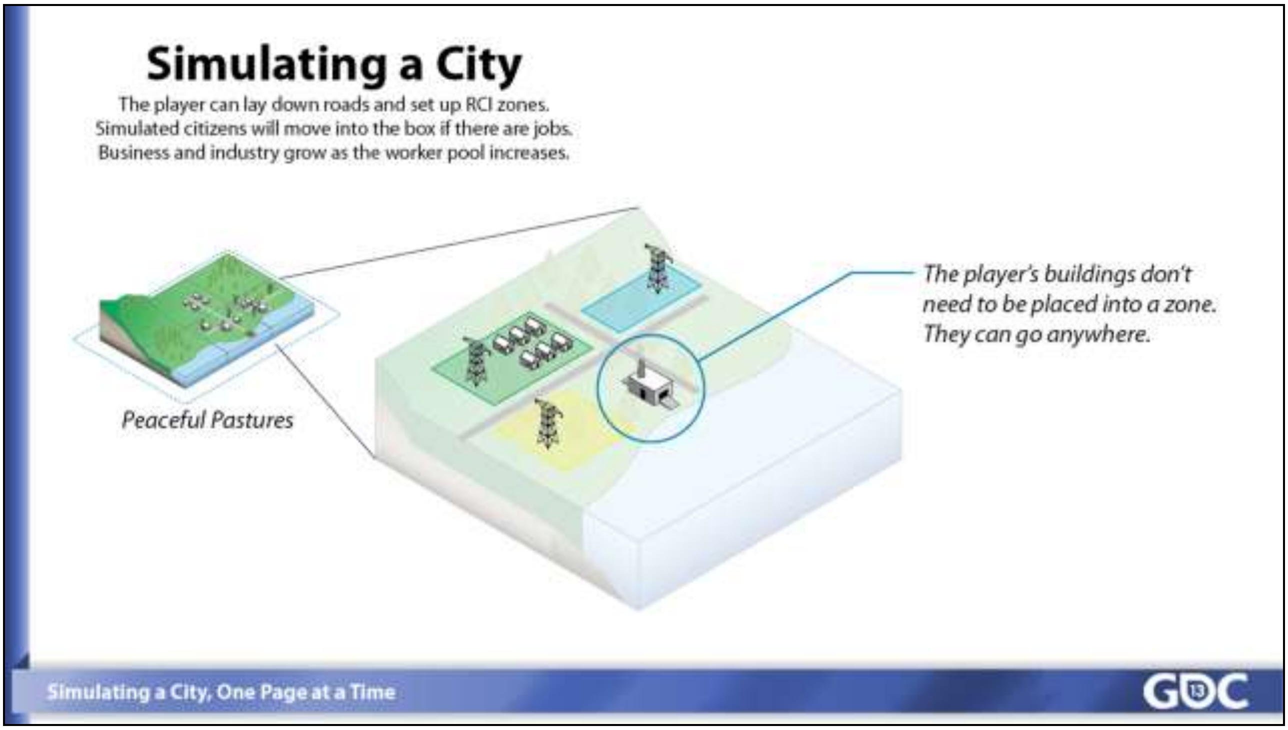
Simulating a City

This next section of the overview chart is all about the core simulation. Notice how small it is on the chart. This is because at the time I didn't think there would be much design needed here.



Simulating a City

The player can lay down roads and set up RCI zones.
Simulated citizens will move into the box if there are jobs.
Business and industry grow as the worker pool increases.

Peaceful Pastures

The player's buildings don't need to be placed into a zone. They can go anywhere.

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GDC

Simulating a City

There have already been four other *SimCity* games, so I assumed that the simulation aspects were well understood and that we could just refer to the past games themselves for design knowledge. It turns out I was very wrong.

1989 1994 1999 2003

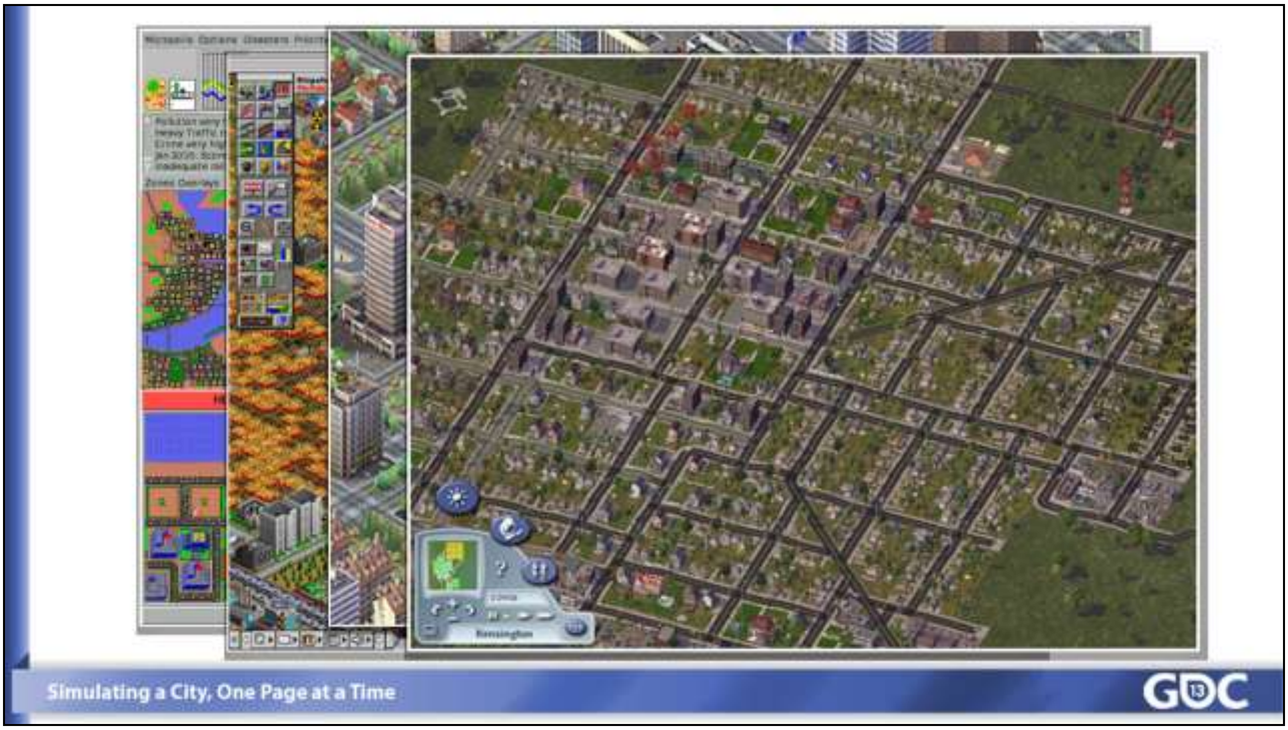
Simulating a City, One Page at a Time

SimCity
SIM CITY 2000
SIMCITY 3000
SIMCITY 4
GDC 13

Previous SimCity Games

To understand why, let me spend a moment talking about how the previous SimCity games simulated a city.

(As an aside, the first SimCity game was 2 MB. For comparison, this PowerPoint is over 20 MB.)

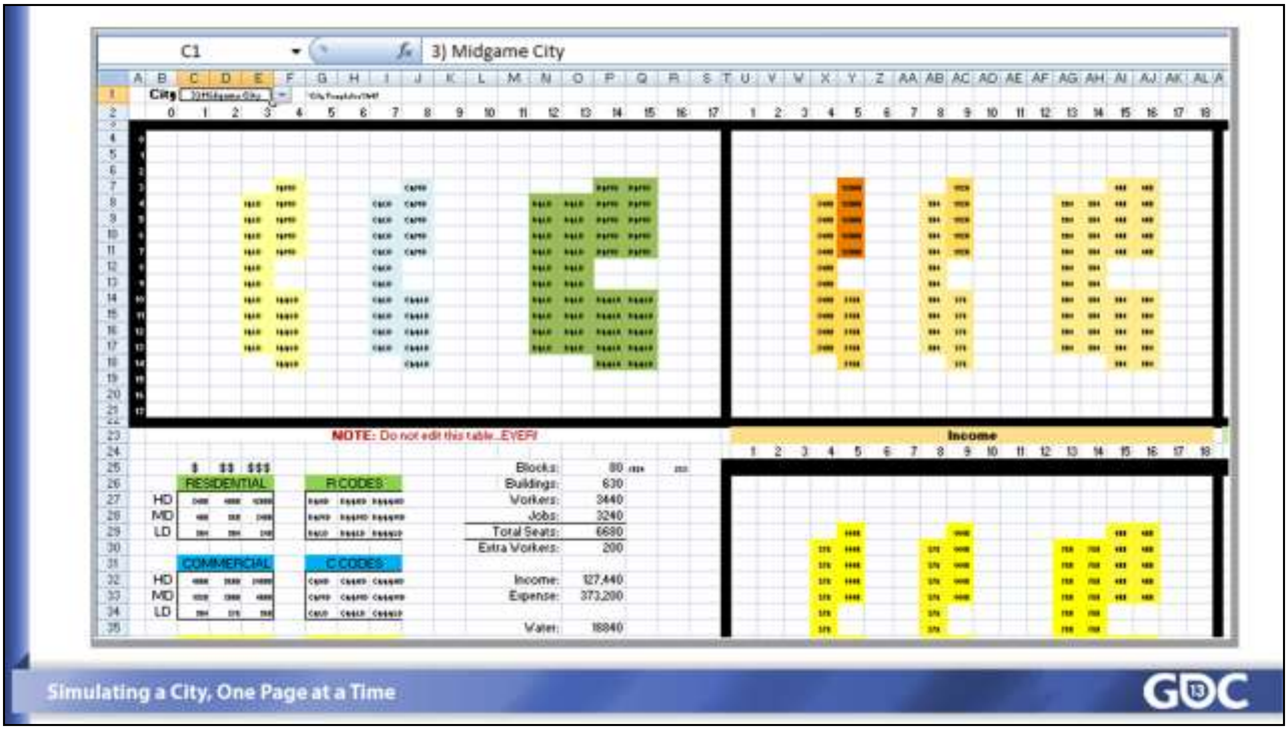


Simulating a City, One Page at a Time

Previous SimCity Games

Previous versions of *SimCity* were graphical spreadsheets where every cell's state was determined statistically by looking at the influences of other nearby cells.

A building could spread influence through maps (usually in a radius). Even though the graphics improved over time the underlying grid-based simulation remained the same.



C1 3) Midgame City

City 3) Midgame City

NOTE: Do not edit this table...EVER!

Income

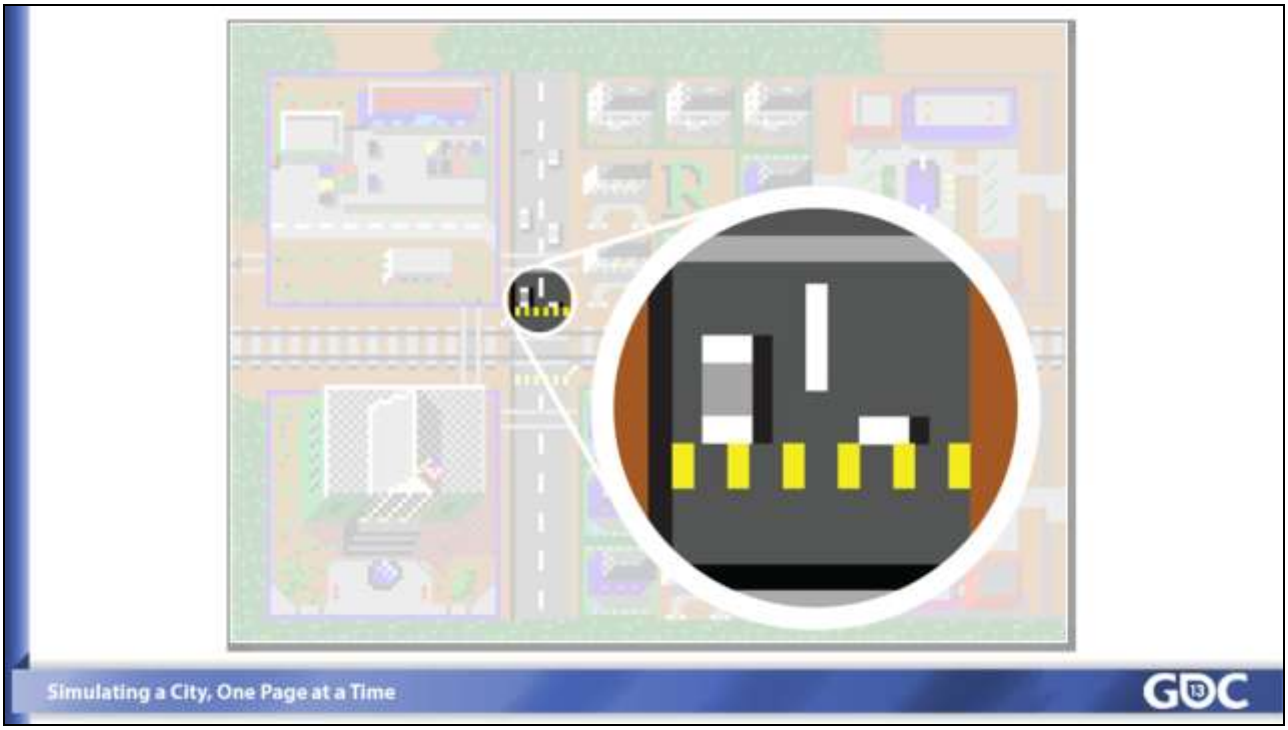
	$	$$	$$$
	RESIDENTIAL		
HD	[illegible]	[illegible]	[illegible]
MD	[illegible]	[illegible]	[illegible]
LD	[illegible]	[illegible]	[illegible]
	COMMERCIAL		
HD	[illegible]	[illegible]	[illegible]
MD	[illegible]	[illegible]	[illegible]
LD	[illegible]	[illegible]	[illegible]

Blocks:	80
Buildings:	630
Workers:	3440
Jobs:	3240
Total Seats:	6680
Extra Workers:	200
Income:	127,440
Expense:	373,200
Water:	18840

Simulating a City, One Page at a Time

Excel Simulation

Essentially, past *SimCity* games were just pretty spreadsheets. In fact, one of the first things I did when I started working on *SimCity* was to model it in a spreadsheet. While this was statistically interesting and valuable for tuning, it didn't help as much as I hoped because the newest *SimCity* game isn't based on an underlying cell grid; it uses agents. This changes everything.



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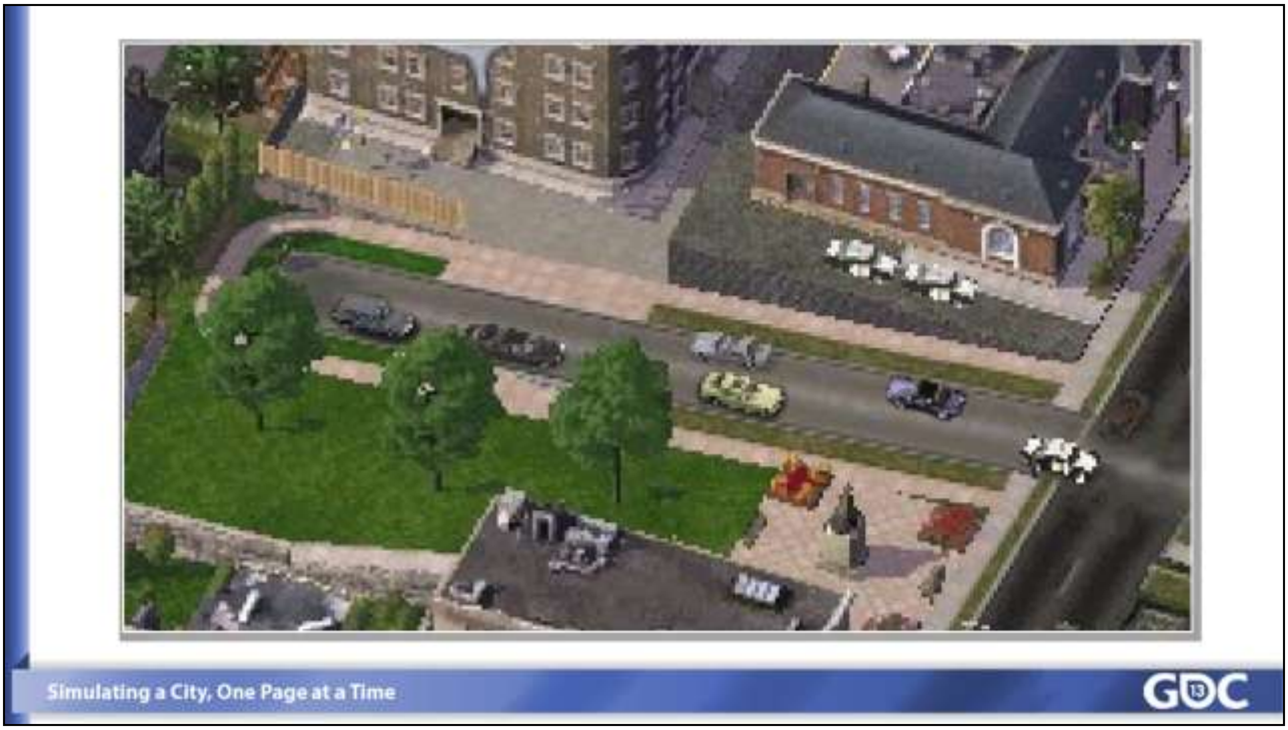
Agents and Previous SimCity Games

Many people believe that the previous *SimCity* games were agent-based. That’s because if you look close you see little cars moving around. But if you try to follow one of them around the town you quickly realize they disappear shortly after leaving the block they started on.

In reality the streets are just showing the state of the adjacent buildings. The cars are simply graphical feedback and aren’t actually part of the simulation. If I zoom in you can see the hood of car on the right side of the road appearing out of a crosswalk. This is because the game thinks that cars should be on the street in front of the northern buildings, but not in front of the buildings directly to the south.



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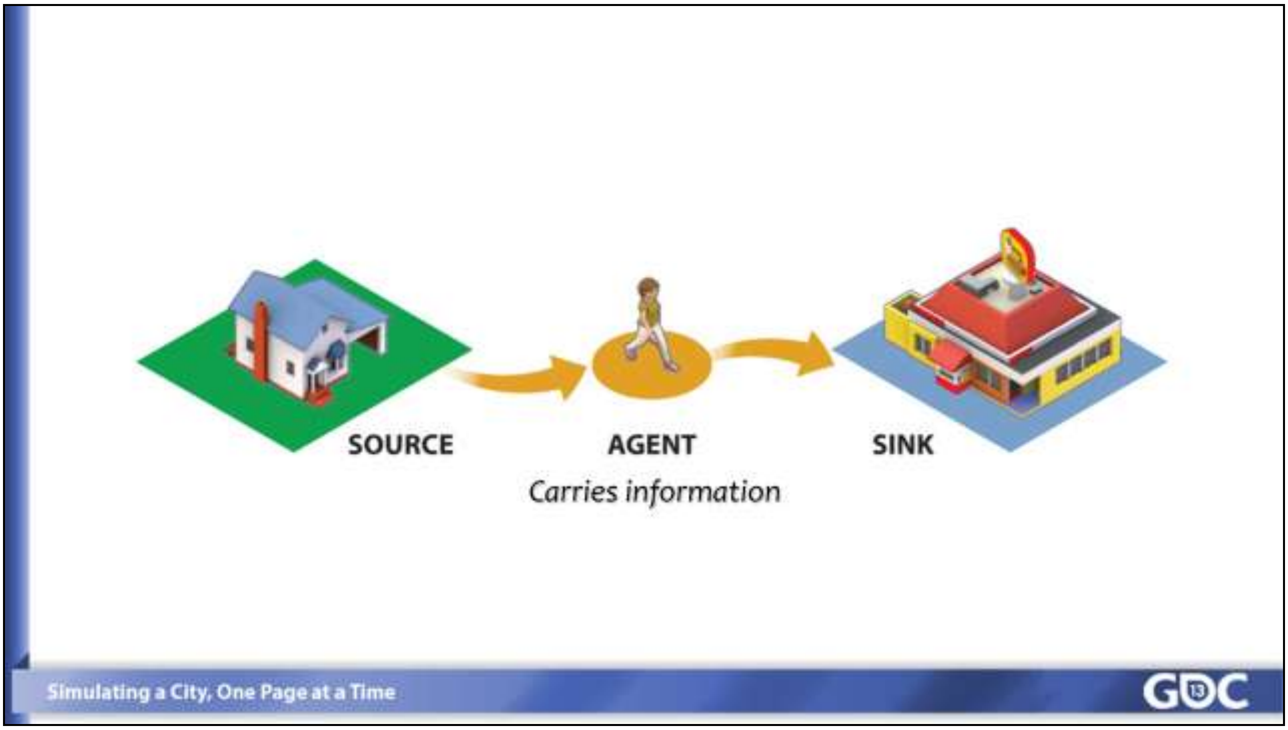
Agents and Previous SimCity Games

Even in *SimCity 4* you would often see cars disappear at the end of a road segment, and then reappear as a different car type a few moments later.



SOURCE

AGENT

SINK

Carries information

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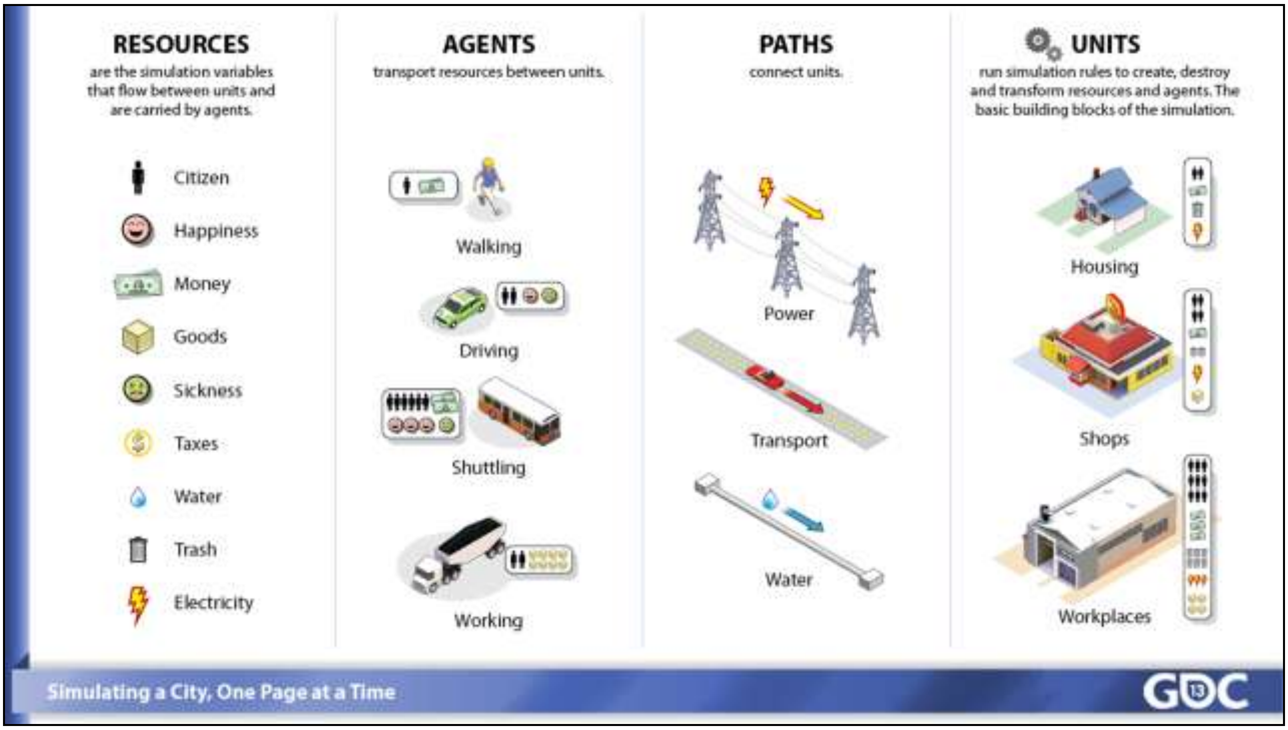
Basic Agent Behavior

But this version of *SimCity* doesn’t operate in the same way. Every sim (or “agent”) is actually carrying information through the city as they go from one place to another.

What you are looking at is a one-page design that was printed out and hung up for everyone to see. Notice how simple it is. It has one purpose: to educate the team on three vocabulary words—source, agent and sink—and the relationship between them. It was critical that everyone on the team understood this relationship because our entire game is based on this concept.

Remember that your designs don’t need to be complex to be effective. They only need to be as complex as the idea you are trying to communicate.



RESOURCES

are the simulation variables that flow between units and are carried by agents.

Citizen

Happiness

Money

Goods

Sickness

Taxes

Water

Trash

Electricity

AGENTS

transport resources between units.

Walking

Driving

Shuttling

Working

PATHS

connect units.

Power

Transport

Water

UNITS

run simulation rules to create, destroy and transform resources and agents. The basic building blocks of the simulation.

Housing

Shops

Workplaces

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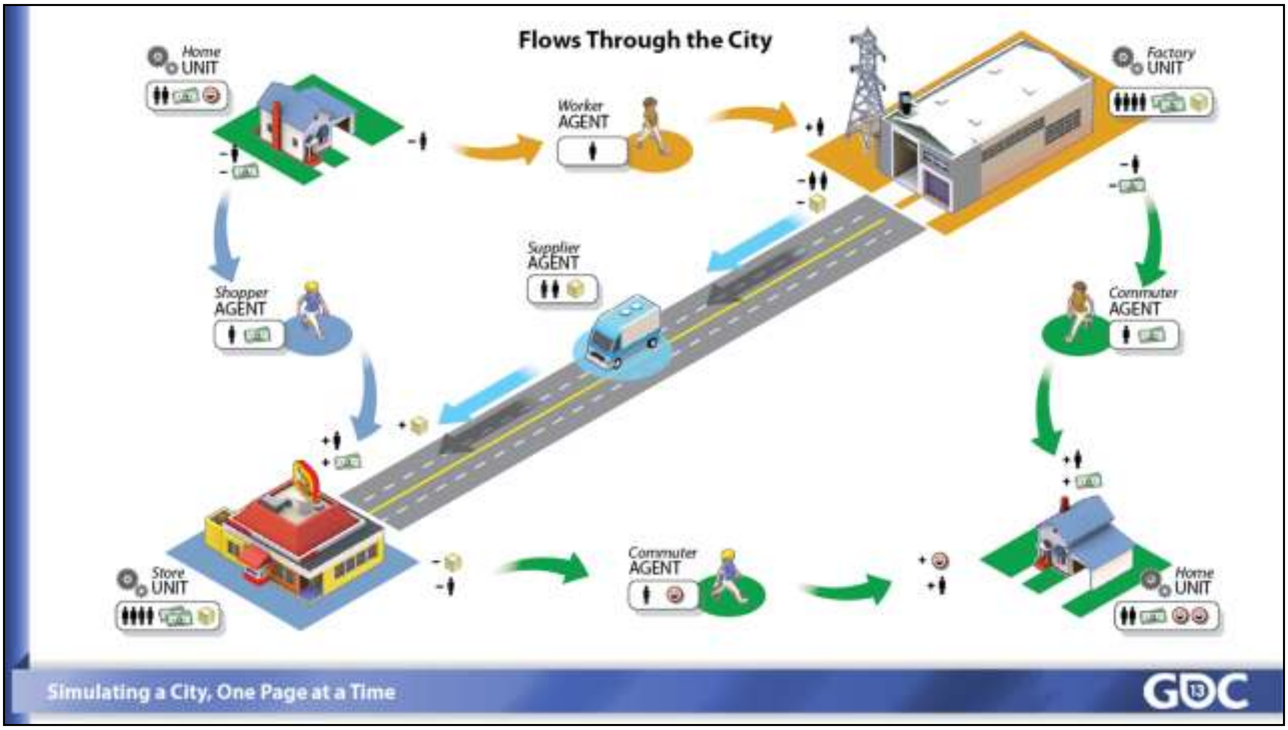
Agent Definitions

Once that idea had been communicated then I could move on to more advanced concepts. This diagram shows how agents can carry many different types of resources down paths and into units.

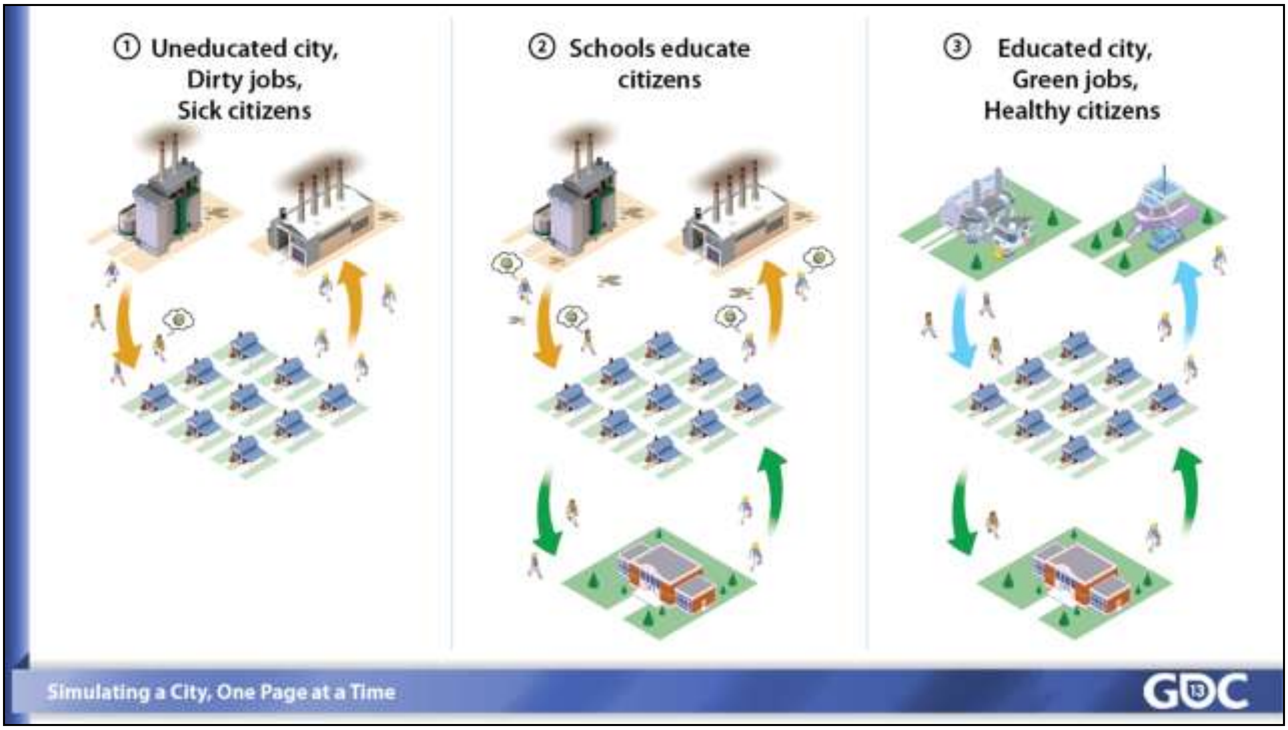


Flows Through the City

Simulating a City, One Page at a Time

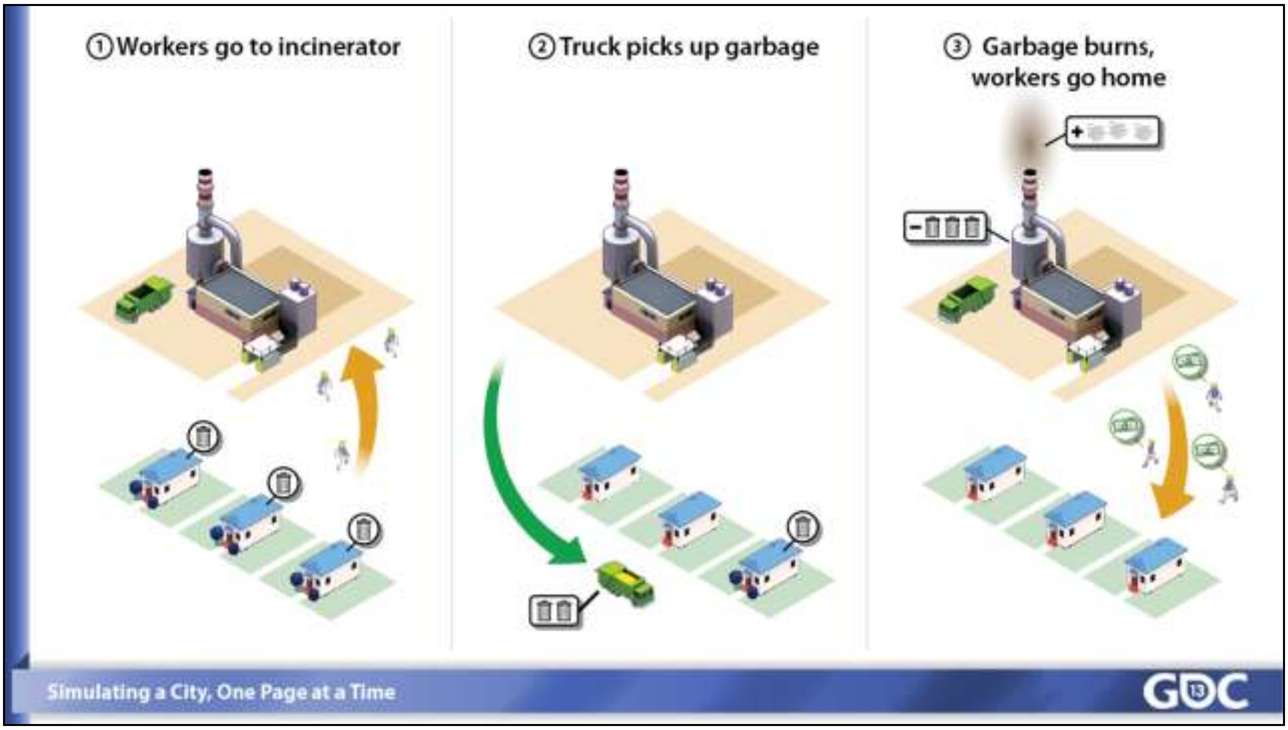
Agent Flows Through the City

Now that I had established the basic vocabulary and iconography, it was easy to build up more complex examples. Here is a simple diagram showing how agents might flow around a small town. We can now start to drill down to the next layer of vocabulary. In this case, agents can be typed as shoppers, workers and commuters. Units can be typed as factories, stores and houses.



Education Flow

Now I have enough pieces to build up higher level concepts. This diagram shows how agents might use education to reduce pollution by increasing the tech level of the factories.



① Workers go to incinerator

② Truck picks up garbage

③ Garbage burns, workers go home

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Garbage Flow

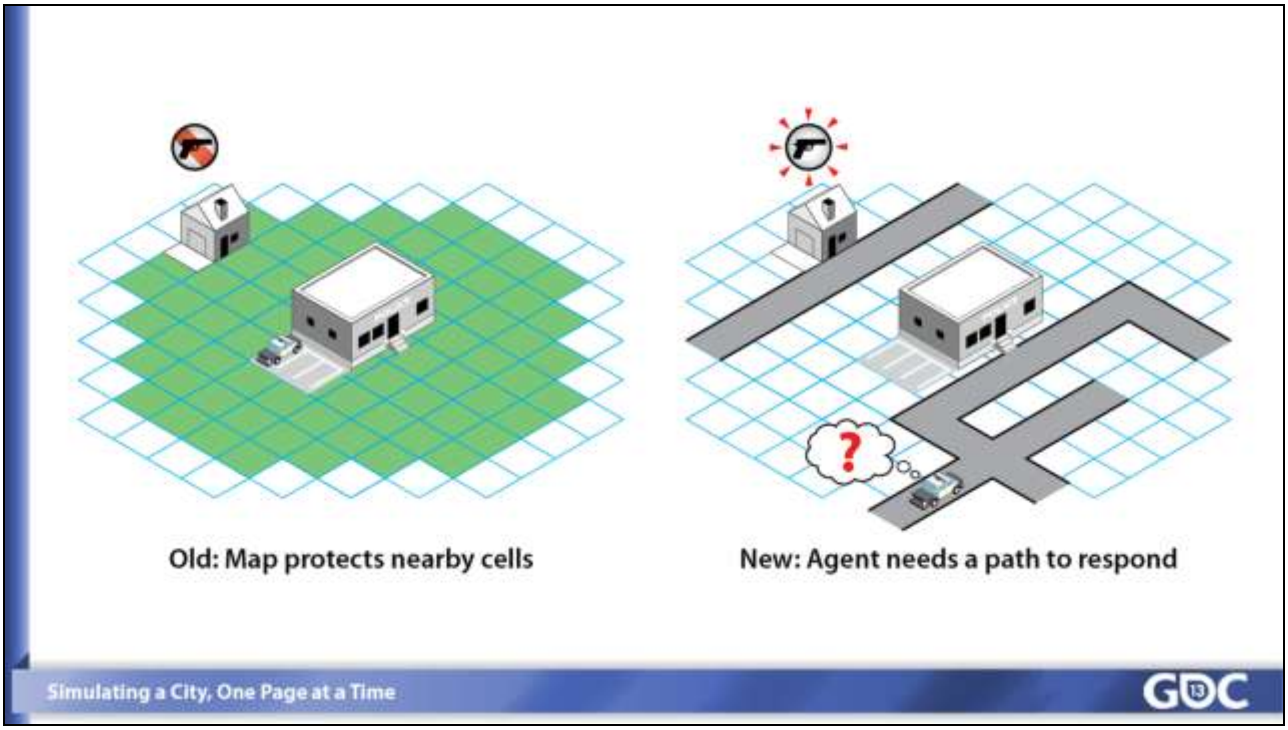
This one shows how agents might travel back and forth from work to the garbage dump. They put out their garbage in the morning and go to work. They pick up the garbage, take it back to the dump and burn it. Then they get paid and go back home. (Presumably to buy more garbage and repeat the cycle.)

This is still one of my favorite documents, because out of context it seems like a subversive anti-consumerism propaganda poster. In fact, I thought it would make for some interesting graffiti. So I printed up some stickers…

Simulating a City, One Page at a Time

Bus Stickers

…and started sticking up one-page design propaganda around town. (I have some extra stickers here. Feel free to pick one up after the talk.)



Old: Map protects nearby cells

New: Agent needs a path to respond

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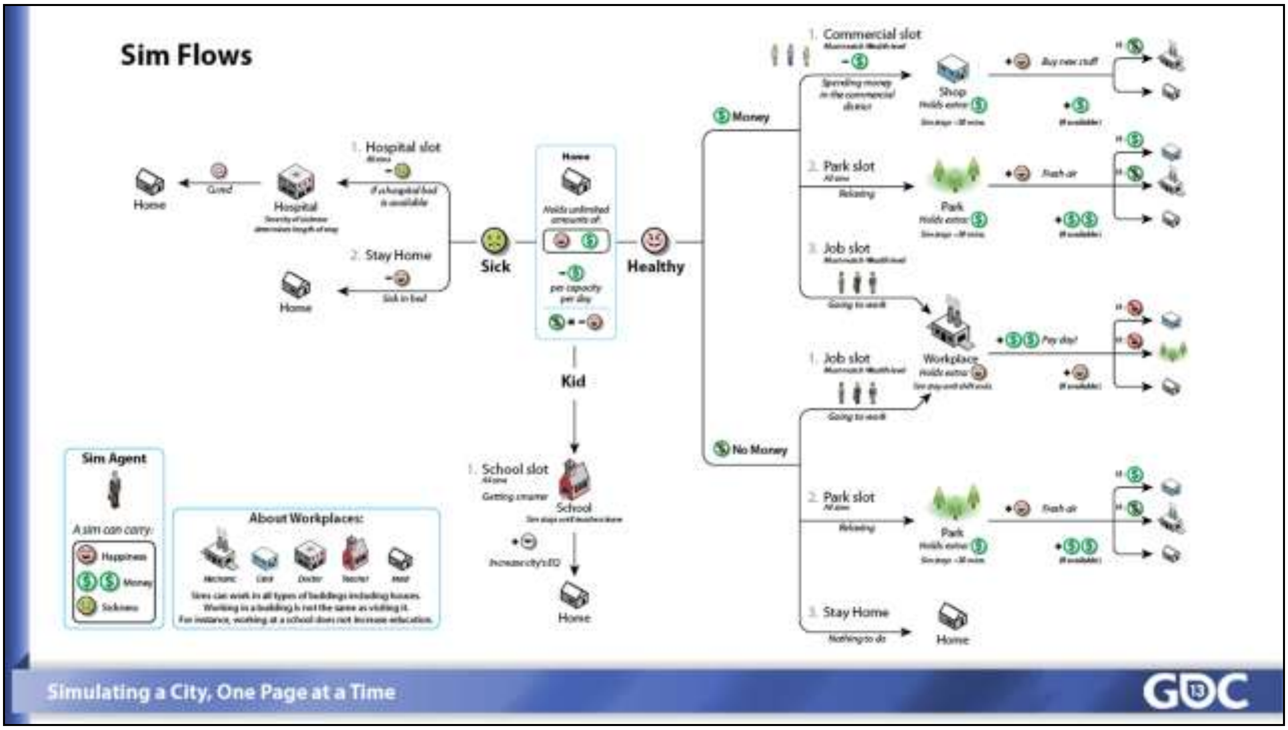
Maps vs. Paths

Here is another simple design diagram meant to show the difference between how previous versions of *SimCity* handled crime vs. how our new version would handle it. On the left the house is protected from crime just because it happens to be close to the police station. On the left, the crime happens because the police car can't find a way to get to the house.

These simple agent flow diagrams worked well as visual explanations, and they were effective at communicating the core simulation ideas to the team. But they aren't adequate as plans to build the game. I still had to draw up "the master plan". The goal was to get all the details of the simulation on one piece of paper so that I could easily see all the relationships.



Sim Flows

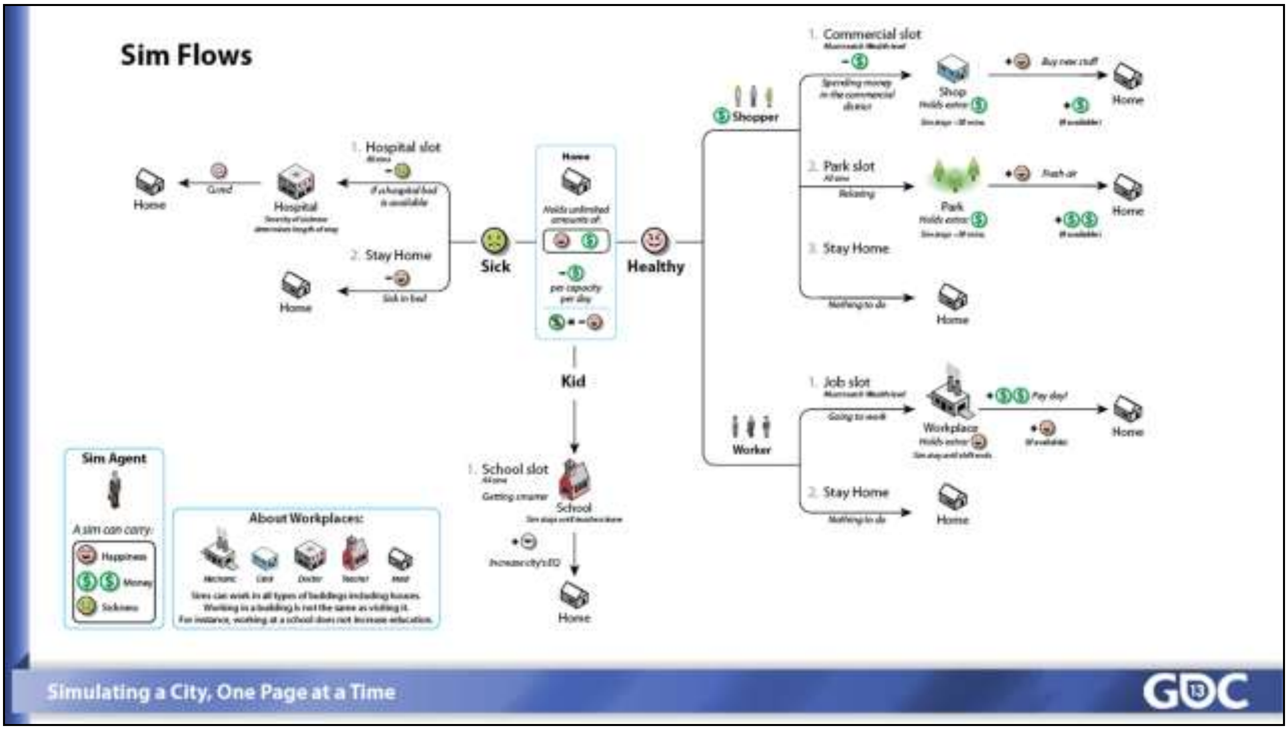
First I needed to understand how a single agent would work. This flow diagram shows the algorithm that one sim uses to move through the city. A sim wakes up in the morning and pays the rent if there is money. If not, they lose happiness.

An adult sim is either sick or healthy (based on how much pollution is in the area). Sick sims try to go to a hospital. If one isn't available they stay home and roll the dice and either get better, stay sick, or die.

Healthy sims look at their wallets. If they have money they immediately try to spend it in a shop. If they can't find a shop they hang out in a park. If they can't find a park they go to work anyway.

If they have no money they try to find a job if they can. Otherwise they slack off in a park or stay home all day.

This diagram is relatively simple to follow, but it turned out to be too complex for the simulation and caused a lot of confusing behaviors. (For instance, some days your city might have too many shoppers and not enough workers, and the next day the opposite might happen.) When I realized we needed to simplify the algorithm it was trivial to do because I could just look at the image and see the problem area…



Sim Flows

Sims can work in all types of buildings including houses.
Working in a building is not the same as visiting it.
For instance, working at a school does not increase education.

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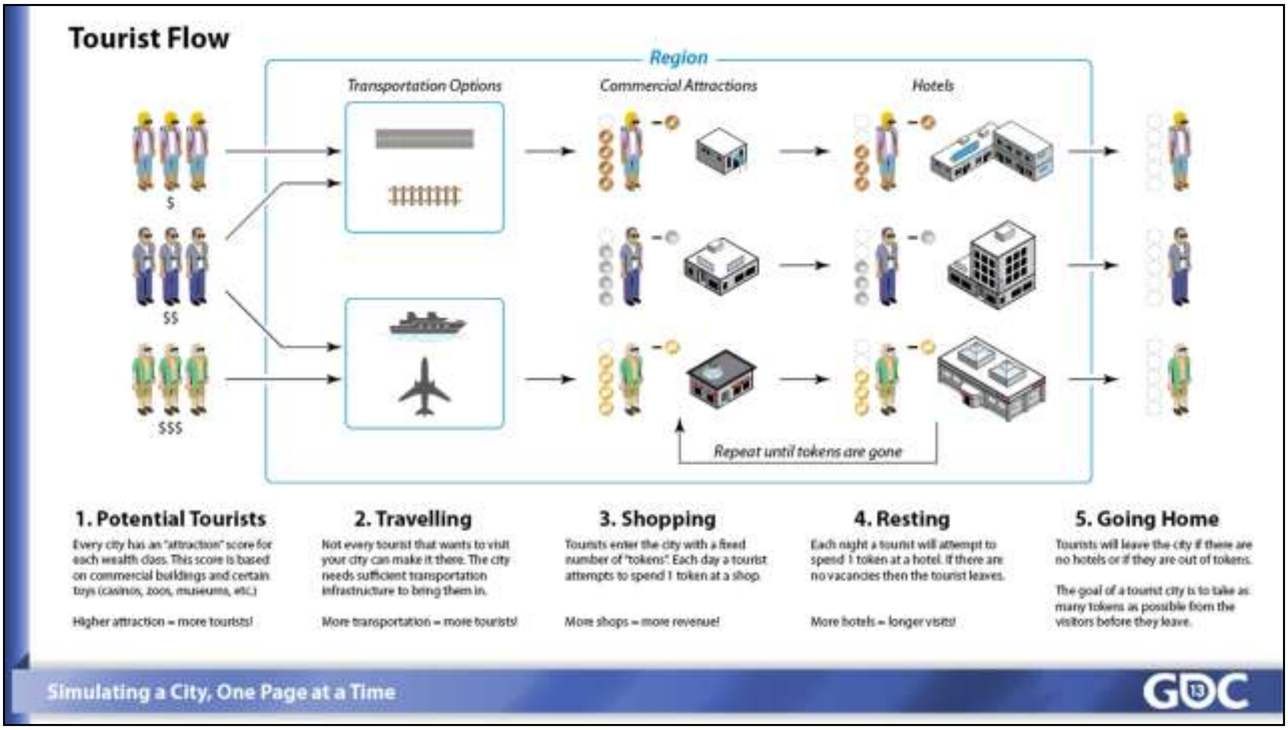
Sim Flows

Instead of having sims decide whether they should work or shop dynamically, we ended up splitting the shoppers and workers into specialized agents with only one purpose. A shopper can never become a worker and vice-versa. [*Compare this slide with previous slide to see how this simplifies the flow chart.*]



Tourist Flow

1. Potential Tourists

Every city has an "attraction" score for each wealth class. This score is based on commercial buildings and certain toys (casinos, zoos, museums, etc.)

Higher attraction = more tourists!

2. Travelling

Not every tourist that wants to visit your city can make it there. The city needs sufficient transportation infrastructure to bring them in.

More transportation = more tourists!

3. Shopping

Tourists enter the city with a fixed number of "tokens". Each day a tourist attempts to spend 1 token at a shop.

More shops = more revenue!

4. Resting

Each night a tourist will attempt to spend 1 token at a hotel. If there are no vacancies then the tourist leaves.

More hotels = longer visits!

5. Going Home

Tourists will leave the city if there are no hotels or if they are out of tokens.

The goal of a tourist city is to take as many tokens as possible from the visitors before they leave.

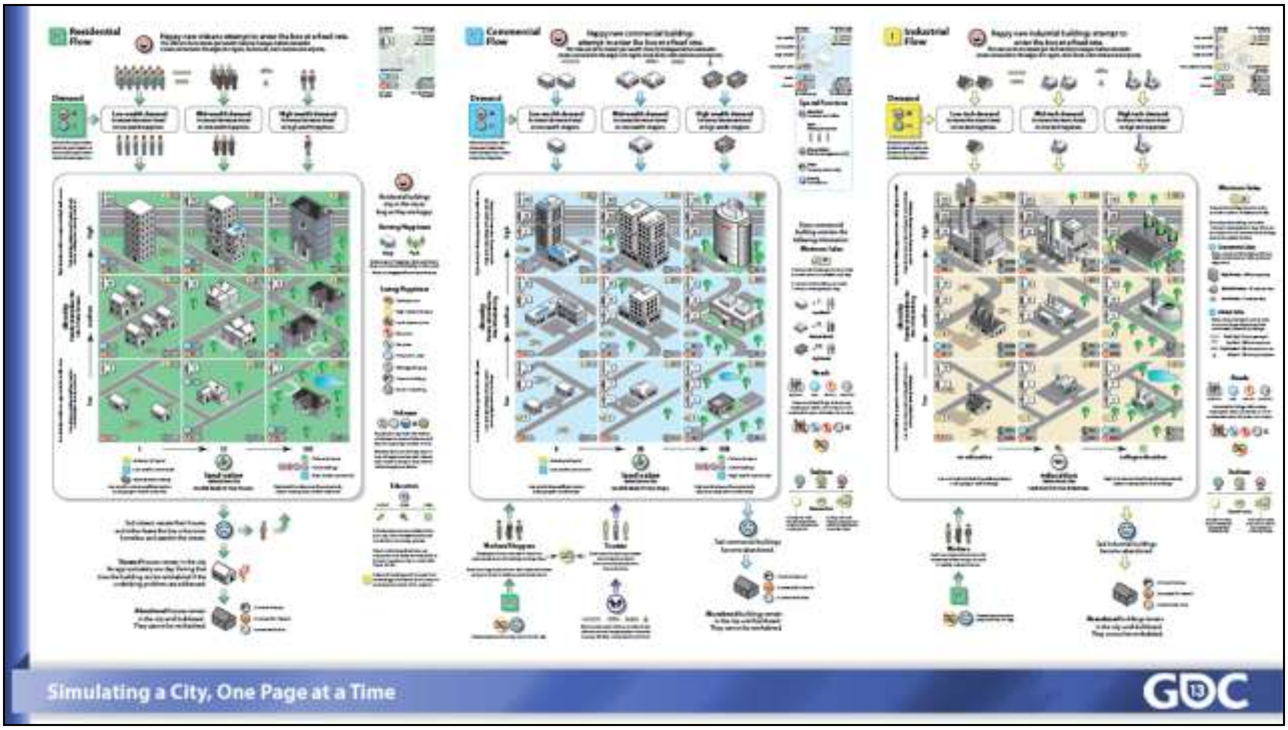
Simulating a City, One Page at a Time

Tourist Flow

I also had to do similar diagrams for the tourist agent flow. They don't go to school, get sick or work so they needed a different diagram. Since all they do is shop and sleep in a hotel their diagram is much simpler.

They come into town, look for an attraction, spend some money, look for a hotel, spend some money, and repeat the loop until their wallets are empty, then they go home.

The diagram for homeless agents looks much like this one, except the shops are replaced with garbage cans and the hotels are replaced with parks and abandoned houses.

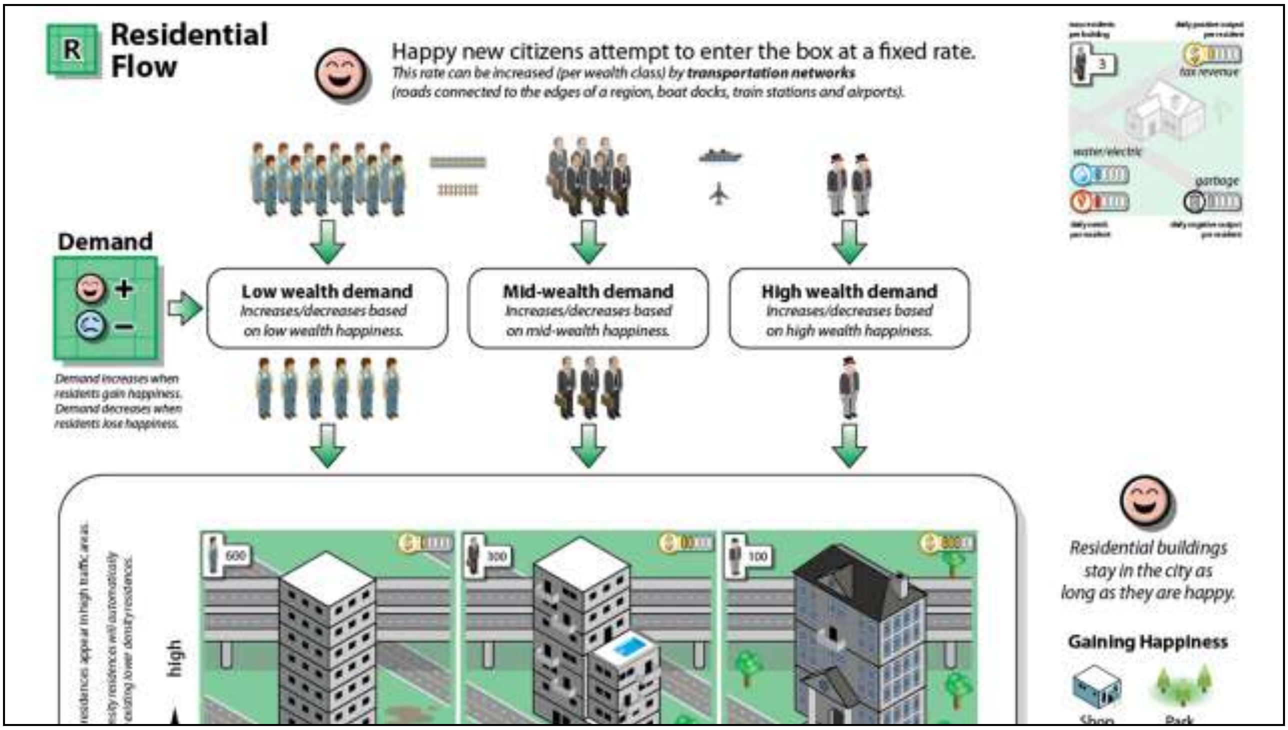


Simulation Master Plan

I know this design is overwhelming at first glance. Don’t worry if this doesn’t make sense to you at the moment. I’m going to break it down piece by piece and it should make sense 5 minutes from now.

After we had a good understanding of an individual agent, I needed to come up with the master plan for dealing with thousands of them flowing around all at once. If the previous flow chart is a diagram for understanding a single pinball, then this diagram can be thought of as a pachinko machine. Thousands of agents drop in from the top, bounce around in the middle (possibly “scoring” you points), and drain out the bottom if they are unhappy.

Let’s zoom in to see the details…



Residential Flow

Happy new citizens attempt to enter the box at a fixed rate.
This rate can be increased (per wealth class) by ***transportation networks***
(roads connected to the edges of a region, boat docks, train stations and airports).

Demand

Demand increases when residents gain happiness. Demand decreases when residents lose happiness.

Low wealth demand
Increases/decreases based on low wealth happiness.

Mid-wealth demand
Increases/decreases based on mid-wealth happiness.

High wealth demand
Increases/decreases based on high wealth happiness.

Residential buildings stay in the city as long as they are happy.

Gaining Happiness

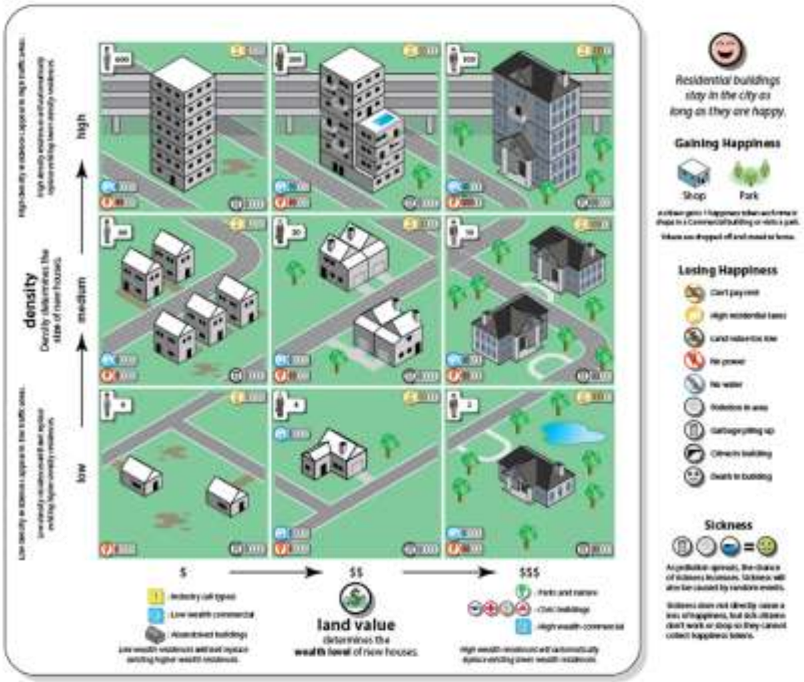
R
+
−
max residents per building
3
daily positive output per resident
tax revenue
water/electric
garbage
daily needs per resident
daily negative output per resident
residences appear in high traffic areas.
sity residences will automatically
existing lower density residences.
high
600
300
100
Shop
Park

Residential Flow

New sims come into the city in 3 wealth classes. The flow of each type can be adjusted by increasing the transportation networks.

Once they enter the city they create buildings of the appropriate wealth class.

Notice the legend in the top right corner. It shows the number of residents, tax revenue, water/electricity usage and garbage output. At this point in time during development it isn't important to specify exact numbers, so I just use a bar graph to show relative tuning. Later in the process we'll convert the general bars to specific numbers.


high
medium
low
density
Density determines the size of new houses.
Residential buildings stay in the city as long as they are happy.
Gaining Happiness
Shop
Park
Losing Happiness
Sickness
$
$$
$$$
land value
determines the
wealth level of new houses.

Residential Flow

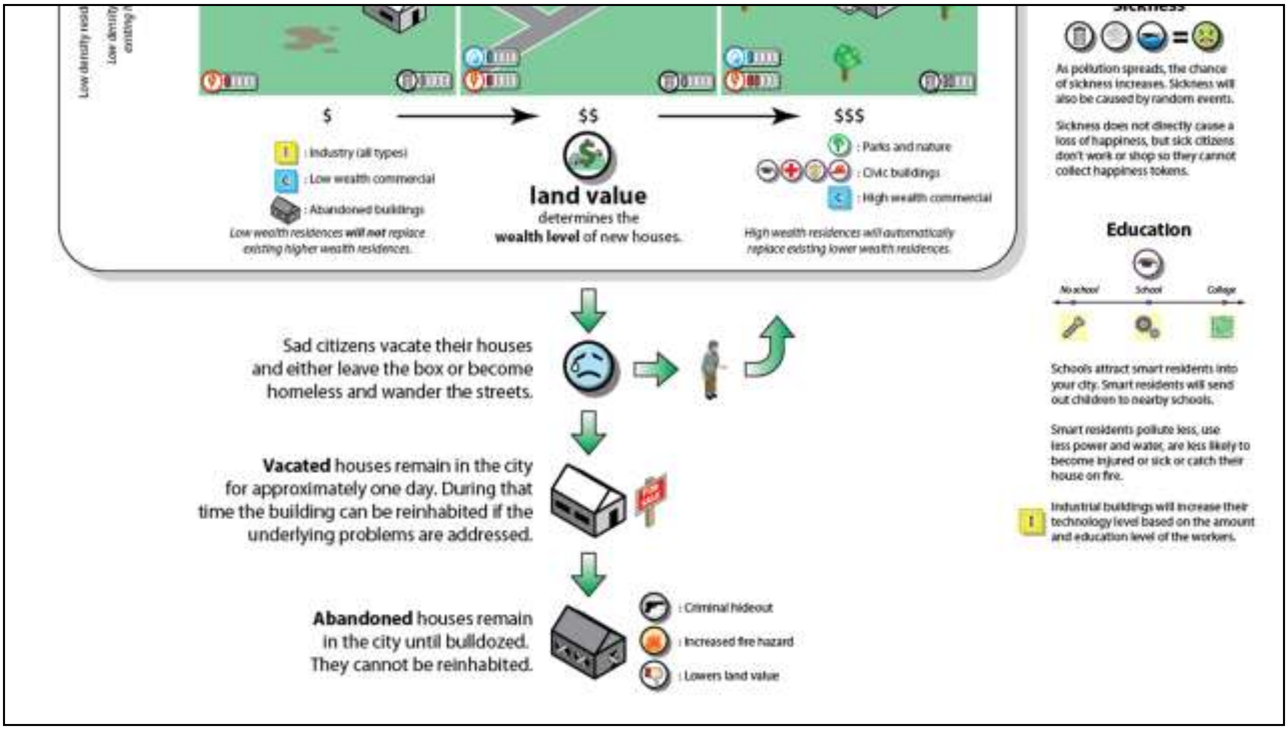
Houses start in the bottom corner (low wealth, low density) and can grow taller or richer, depending on how you place your roads, parks and services. Nothing ever goes backward.

Happiness determines if the sims will stay in the city. Happiness is mostly gained from shopping, but parks can help, too. There are many ways to lose happiness: crime, sickness, no jobs, etc.

Players tend to trick themselves into thinking that they will “win” the game by getting from the lower left corner to the upper right corner (high density/high wealth). But this chart shows that everything has a trade off. The rich need more “elbow room”, so you will lose population as you increase wealth. This results in fewer workers, which can put a strain on your shops and factories. Even worse, most buildings in the game require low wealth workers or they won’t function at all. (Someone has to sweep floors, run assembly lines, and operate cash registers. The rich won’t take those jobs.)

High wealth houses generate more revenue, but in exchange they use much more water and electricity per person, and produce more garbage. They also demand more services (police, schools, etc.). So even though you can make more tax revenue from them, you have to spend more money to keep them around.

The entire *SimCity* design is based heavily around the fact that there is no “right answer”. Every option has positive and negative consequences.



Low wealth residences **will not** replace existing higher wealth residences.

High wealth residences will automatically replace existing lower wealth residences.

Sad citizens vacate their houses and either leave the box or become homeless and wander the streets.

Vacated houses remain in the city for approximately one day. During that time the building can be reinhabited if the underlying problems are addressed.

Abandoned houses remain in the city until bulldozed. They cannot be reinhabited.

As pollution spreads, the chance of sickness increases. Sickness will also be caused by random events.

Sickness does not directly cause a loss of happiness, but sick citizens don't work or shop so they cannot collect happiness tokens.

Schools attract smart residents into your city. Smart residents will send out children to nearby schools.

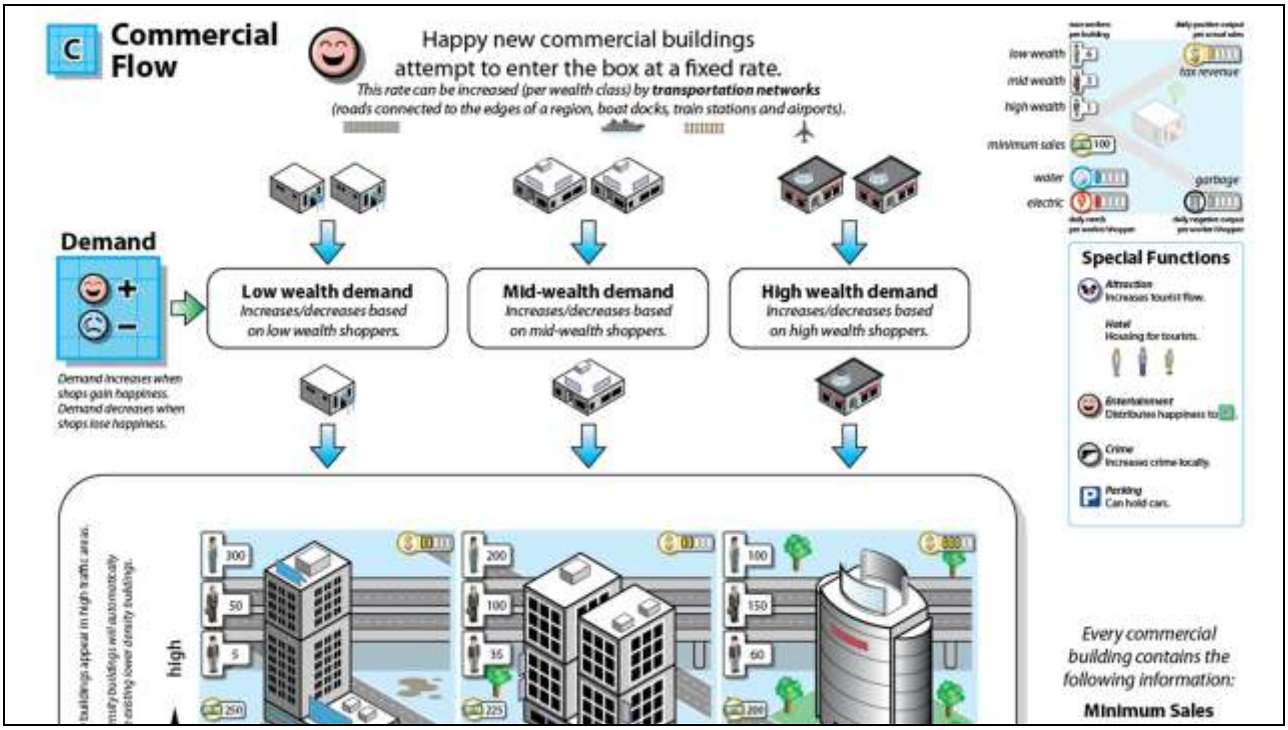
Smart residents pollute less, use less power and water, are less likely to become injured or sick or catch their house on fire.

I Industrial buildings will increase their technology level based on the amount and education level of the workers.

Residential Flow

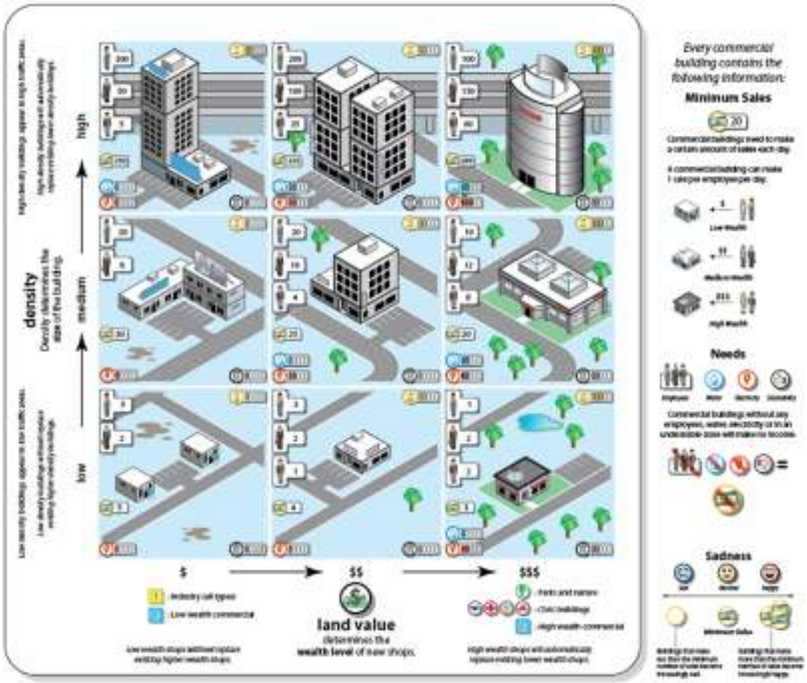
At the bottom of the chart is what happens when sims lose all their happiness and drain out of the city. A small percentage will become homeless and will lose their home but not leave.

Vacated houses will eventually go abandoned, which increases crime and fire risk and lowers land value.


C
Commercial Flow
Happy new commercial buildings attempt to enter the box at a fixed rate.
This rate can be increased (per wealth class) by transportation networks (roads connected to the edges of a region, boat docks, train stations and airports).
Demand
Demand increases when shops gain happiness. Demand decreases when shops lose happiness.
Low wealth demand
Increases/decreases based on low wealth shoppers.
Mid-wealth demand
Increases/decreases based on mid-wealth shoppers.
High wealth demand
Increases/decreases based on high wealth shoppers.
buildings appear in high traffic areas.
nsity buildings will automatically
e existing lower density buildings.
high
300
50
5
250
200
100
35
225
100
150
60
200
max workers per building
daily positive output per actual sales
low wealth
4
mid wealth
3
high wealth
1
tax revenue
minimum sales
100
water
electric
garbage
daily needs per worker/shopper
daily negative output per worker/shopper
Special Functions
Attraction
Increases tourist flow.
Hotel
Housing for tourists.
Entertainment
Distributes happiness to
Crime
Increases crime locally.
Parking
Can hold cars.
Every commercial building contains the following information:
Minimum Sales

Commercial Flow

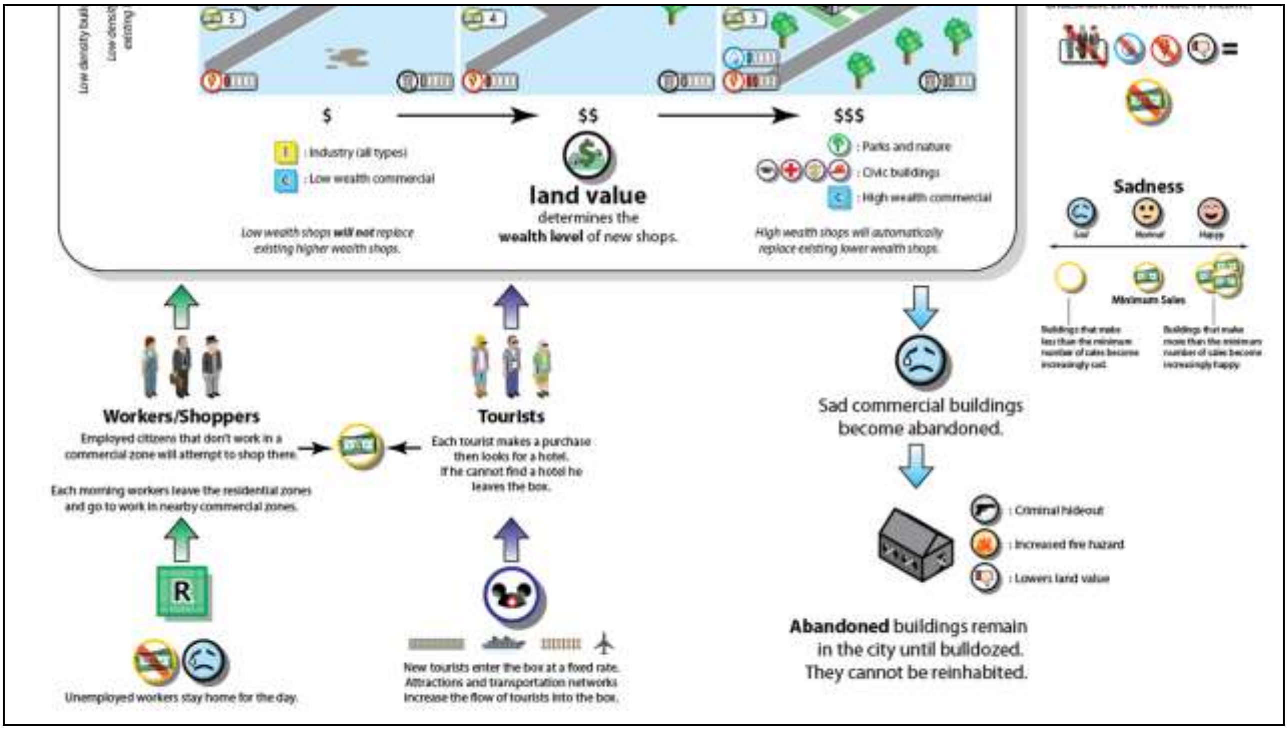
If you followed all of that for the Residential flow, then it's easy to understand the Commercial flow because it is basically the same. Businesses come into the city and are dedicated to servicing only one wealth class of shopper. (However, they need all 3 wealth levels for workers, as shown by the numbers in the upper left corner of each cell.)



Every commercial building contains the following information:
Minimum Sales
20
Commercial buildings need to make a certain amount of sales each day.
A commercial building can make 1 sale per employee per day.
Needs
Sadness
density
Density determines the size of the building.
high
medium
low
$
$$
$$$
land value
determines the wealth level of new shops.

Commercial Flow

Just like the residents, the stores have “happiness”, which is based on profitability. The more sales they make then the happier they will be.

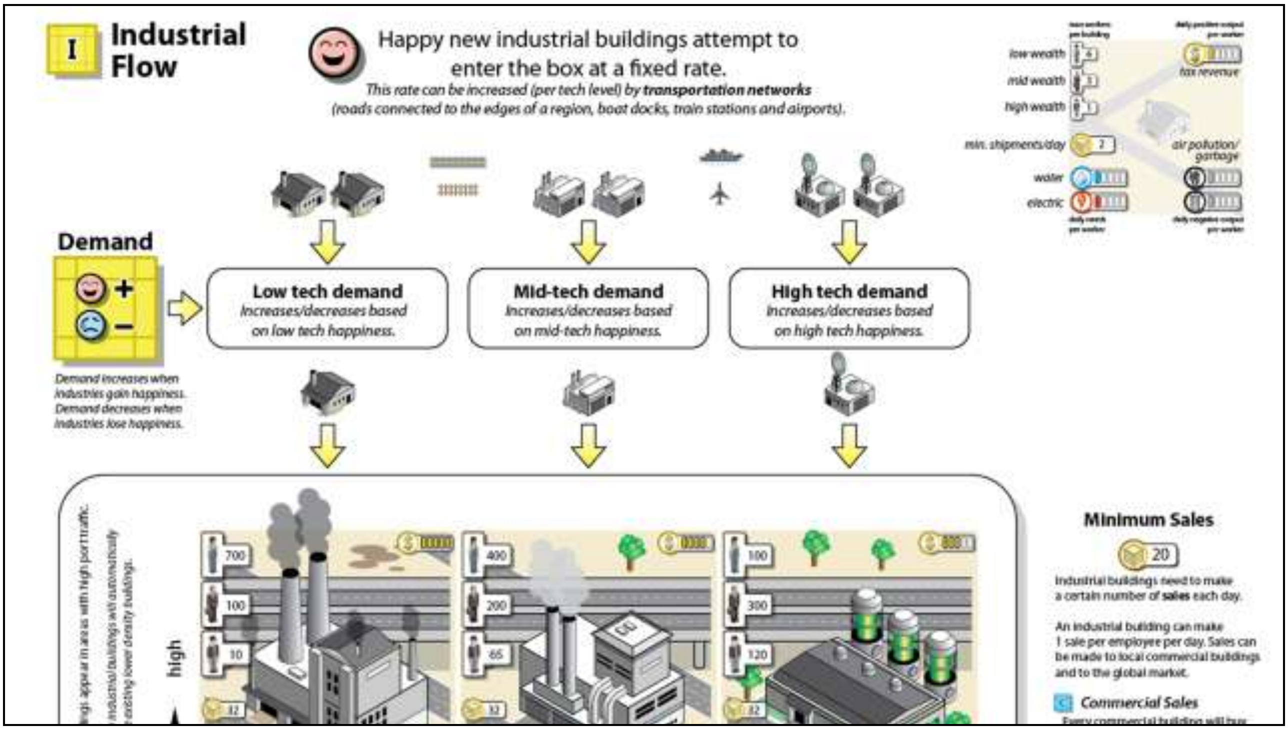

Low density buil
Low densit
existing
5
4
3
$
$$
$$$
I : Industry (all types)
C : Low wealth commercial
Low wealth shops will not replace
existing higher wealth shops.
land value
determines the
wealth level of new shops.
: Parks and nature
: Civic buildings
C : High wealth commercial
High wealth shops will automatically
replace existing lower wealth shops.
=
Sadness
Sad
Normal
Happy
Minimum Sales
Buildings that make
less than the minimum
number of sales become
increasingly sad.
Buildings that make
more than the minimum
number of sales become
increasingly happy.
Workers/Shoppers
Employed citizens that don't work in a
commercial zone will attempt to shop there.
Each morning workers leave the residential zones
and go to work in nearby commercial zones.
R
Unemployed workers stay home for the day.
Tourists
Each tourist makes a purchase
then looks for a hotel.
If he cannot find a hotel he
leaves the box.
New tourists enter the box at a fixed rate.
Attractions and transportation networks
increase the flow of tourists into the box.
Sad commercial buildings
become abandoned.
: Criminal hideout
: Increased fire hazard
: Lowers land value
Abandoned buildings remain
in the city until bulldozed.
They cannot be reinhabited.

Commercial Flow

If they run out of money they will abandon the city.

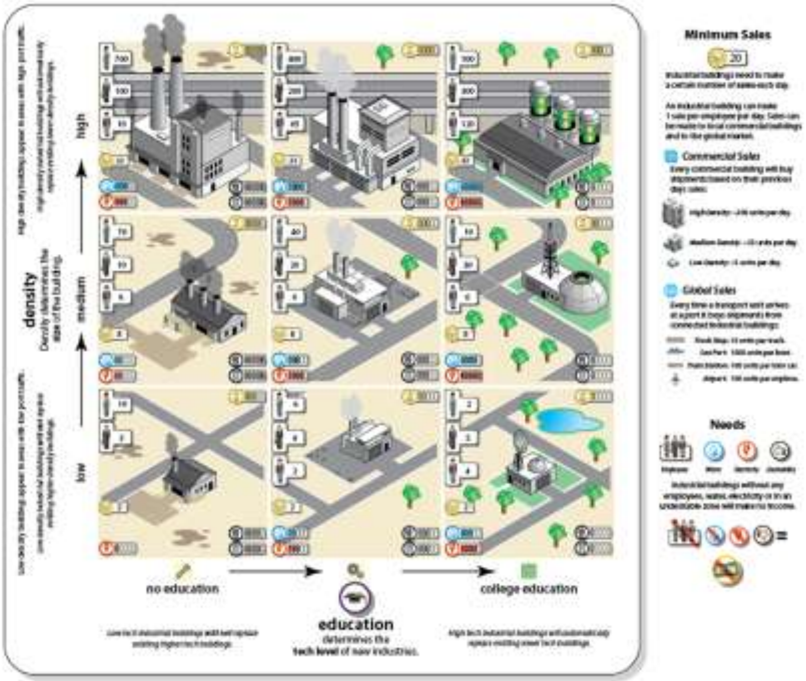
The arrows at the bottom left show that stores need both workers and shoppers, but can also receive profit from tourists.

]


I
Industrial Flow
Happy new industrial buildings attempt to enter the box at a fixed rate.
This rate can be increased (per tech level) by transportation networks (roads connected to the edges of a region, boat docks, train stations and airports).
low wealth
4
mid wealth
3
high wealth
1
tax revenue
min. shipments/day
2
air pollution/ garbage
water
electric
Demand
+
–
Demand increases when industries gain happiness. Demand decreases when industries lose happiness.
Low tech demand
Increases/decreases based on low tech happiness.
Mid-tech demand
Increases/decreases based on mid-tech happiness.
High tech demand
Increases/decreases based on high tech happiness.
high
700
100
10
32
400
200
65
32
100
300
120
32
Minimum Sales
20
Industrial buildings need to make a certain number of sales each day.
An industrial building can make 1 sale per employee per day. Sales can be made to local commercial buildings and to the global market.
C
Commercial Sales

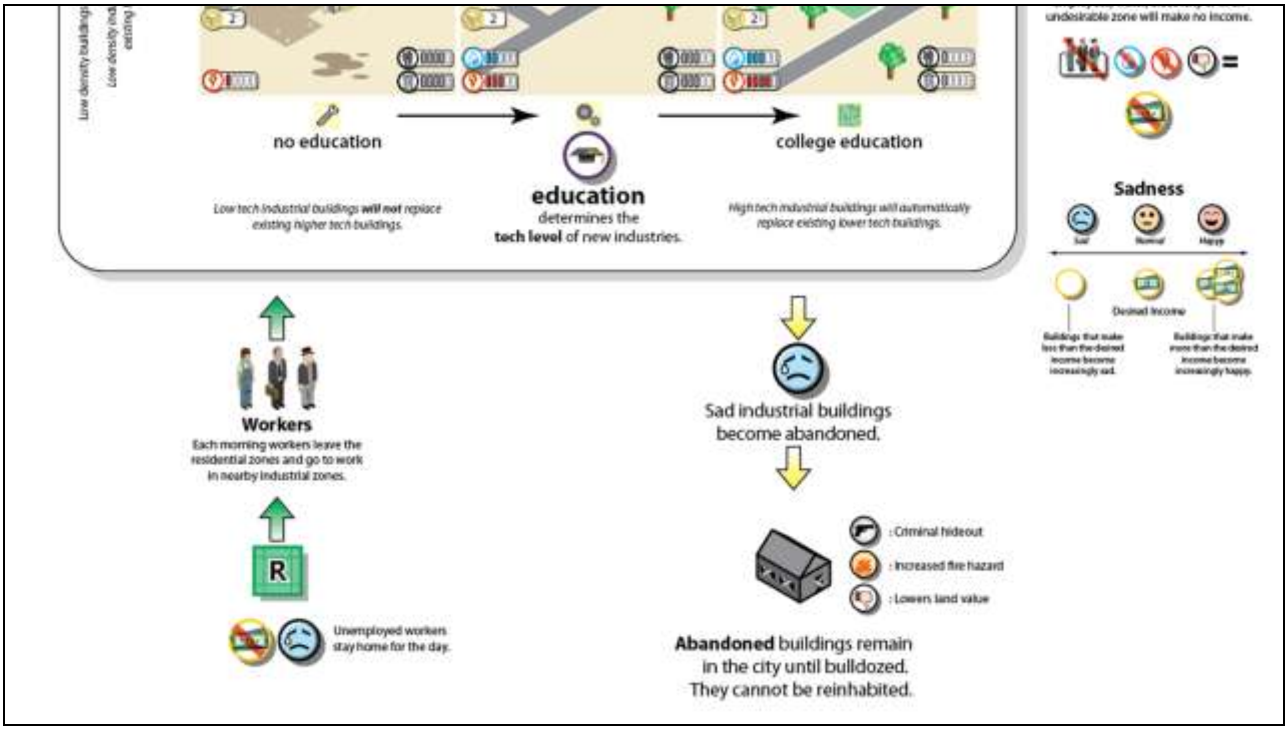
Industrial Flow

The Industry flow is similar, but instead of wealth level it has a tech level that is determined by the schools you have. A Community College will create mid-tech demand and a University will create high-tech demand.



Industrial Flow

Industry gets happiness from shipping freight. It can ship freight to your local commercial buildings in small amounts, or it can ship large quantities to the Global Market through Trade Ports.


Low density buildings
Low density ind
existing
2
no education
education
determines the
tech level of new industries.
college education
Low tech industrial buildings will not replace existing higher tech buildings.
High tech industrial buildings will automatically replace existing lower tech buildings.
undesirable zone will make no income.
=
Sadness
Sad
Normal
Happy
Desired Income
Buildings that make less than the desired income become increasingly sad.
Buildings that make more than the desired income become increasingly happy.
Workers
Each morning workers leave the residential zones and go to work in nearby industrial zones.
R
Unemployed workers stay home for the day.
Sad industrial buildings become abandoned.
: Criminal hideout
: Increased fire hazard
: Lowers land value
Abandoned buildings remain in the city until bulldozed. They cannot be reinhabited.

Industrial Flow

And, like Commercial buildings, Industrial buildings will go abandoned if they can’t make enough money shipping freight.

Simulating a City, One Page at a Time

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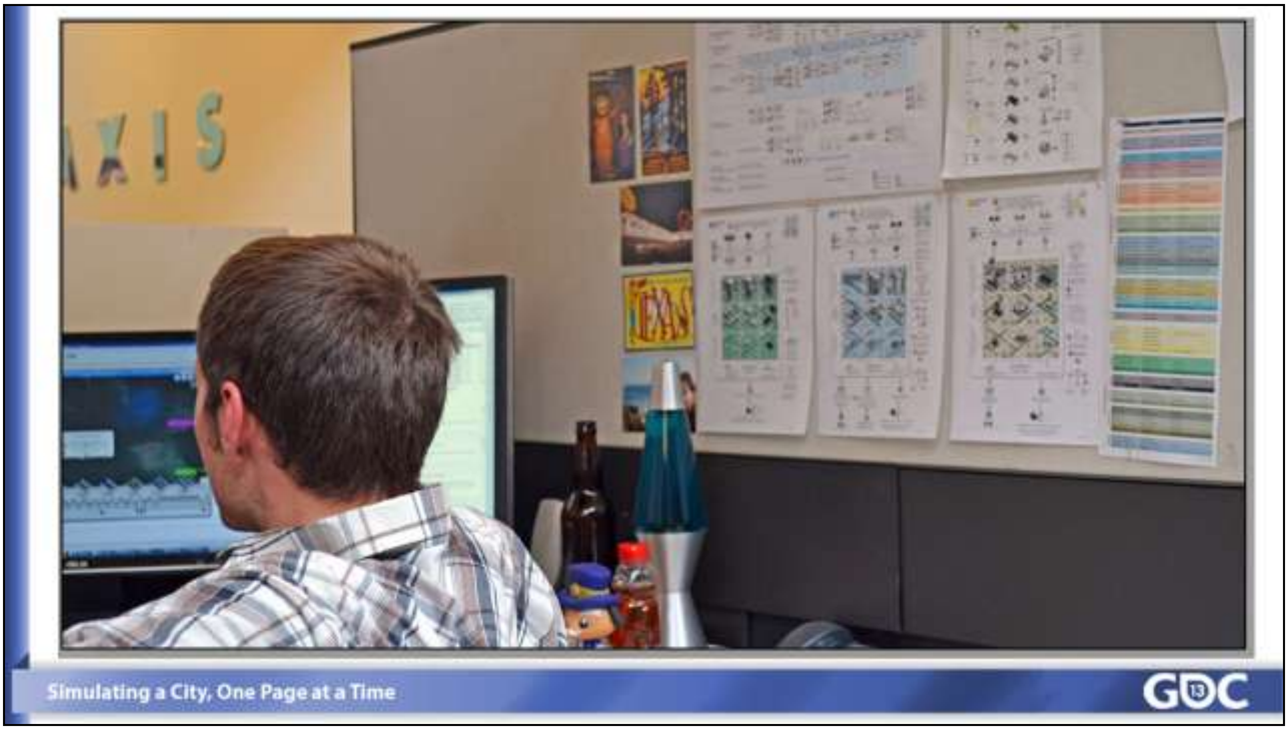
Simulation Overview

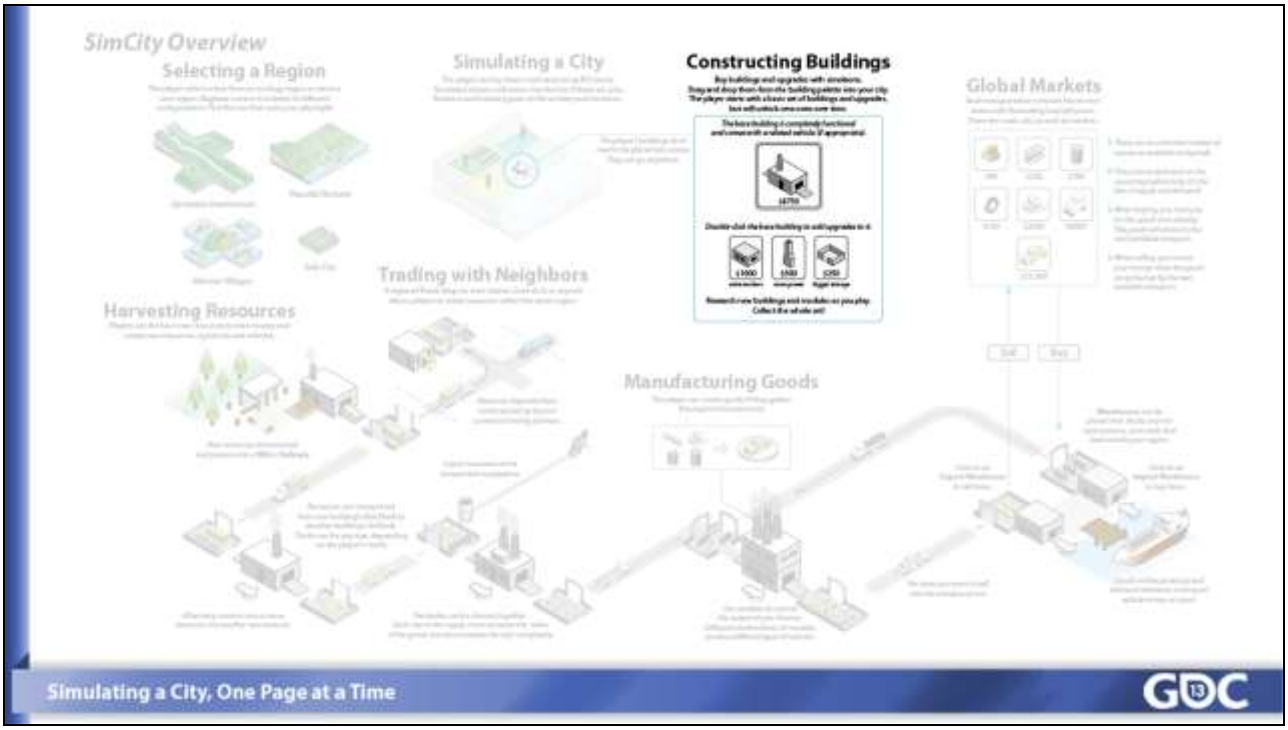
Here’s the whole chart printed out from the plotter. (With software engineer, Conrad Tse looking perplexed.) This was a key diagram for understanding the simulation, so it wasn’t enough to hang up only one giant printout…



Simulating a City, One Page at a Time

Simulation Overview

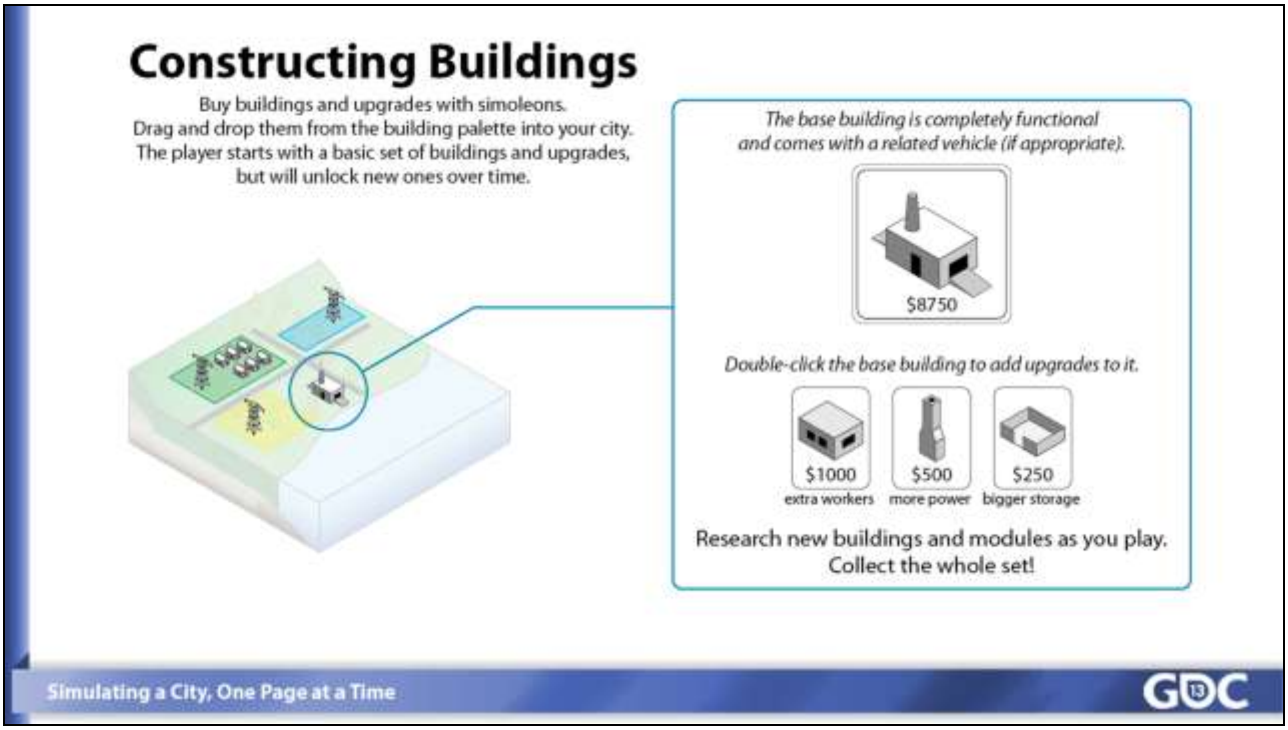
I also printed out a “triptych” on 8.5 x 11 pages and made sure that all the designers and scripters (such as Michael Chrien here) had them close to their desks so they could easily refer to them.



Simulating a City, One Page at a Time

Constructing Buildings

Another new feature of SimCity was the ability to modify buildings over time to suit the needs of your city.



Constructing Buildings

Buy buildings and upgrades with simoleons.
Drag and drop them from the building palette into your city.
The player starts with a basic set of buildings and upgrades, but will unlock new ones over time.

The base building is completely functional and comes with a related vehicle (if appropriate).

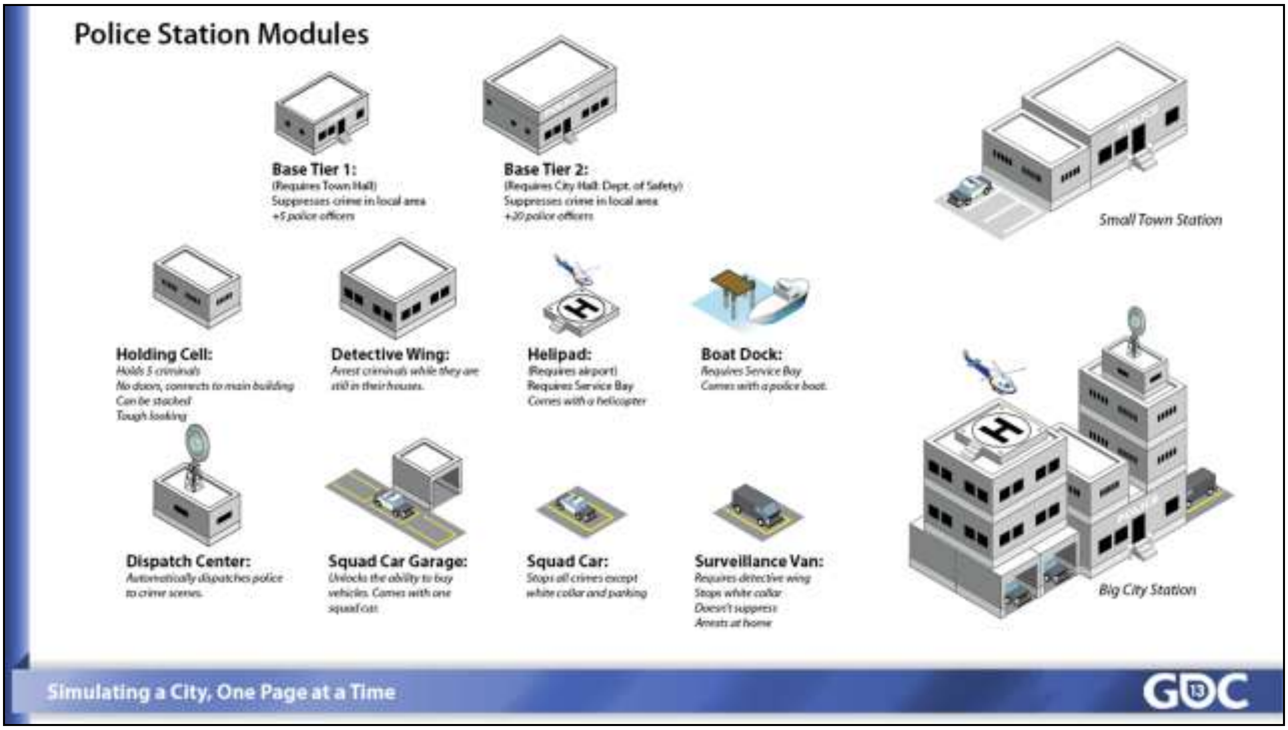
Double-click the base building to add upgrades to it.

Research new buildings and modules as you play.
Collect the whole set!

Simulating a City, One Page at a Time

Constructing Buildings

In previous versions of SimCity the buildings had an abstract “budget slider”. By moving the slider from left to right the player could increase or decrease the effectiveness of the building. In contrast, we wanted the new SimCity to feel more tactile. You could change a building’s functionality by adding or removing modules from it. For instance, if you need more power in your city you don’t build an entirely new power plant. Instead, you simply add a new turbine onto the existing power plant.



Police Station Modules

Base Tier 1:
(Requires Town Hall)
Suppresses crime in local area
+5 police officers

Base Tier 2:
(Requires City Hall: Dept. of Safety)
Suppresses crime in local area
+20 police officers

Holding Cell:
Holds 5 criminals
No doors, connects to main building
Can be stacked
Tough looking

Detective Wing:
Arrest criminals while they are still in their houses.

Helipad:
(Requires airport)
Requires Service Bay
Comes with a helicopter

Boat Dock:
Requires Service Bay
Comes with a police boat.

Dispatch Center:
Automatically dispatches police to crime scenes.

Squad Car Garage:
Unlocks the ability to buy vehicles. Comes with one squad car.

Squad Car:
Stops all crimes except white collar and parking

Surveillance Van:
Requires detective wing
Stops white collar
Doesn't suppress
Arrests at home

Small Town Station

Big City Station

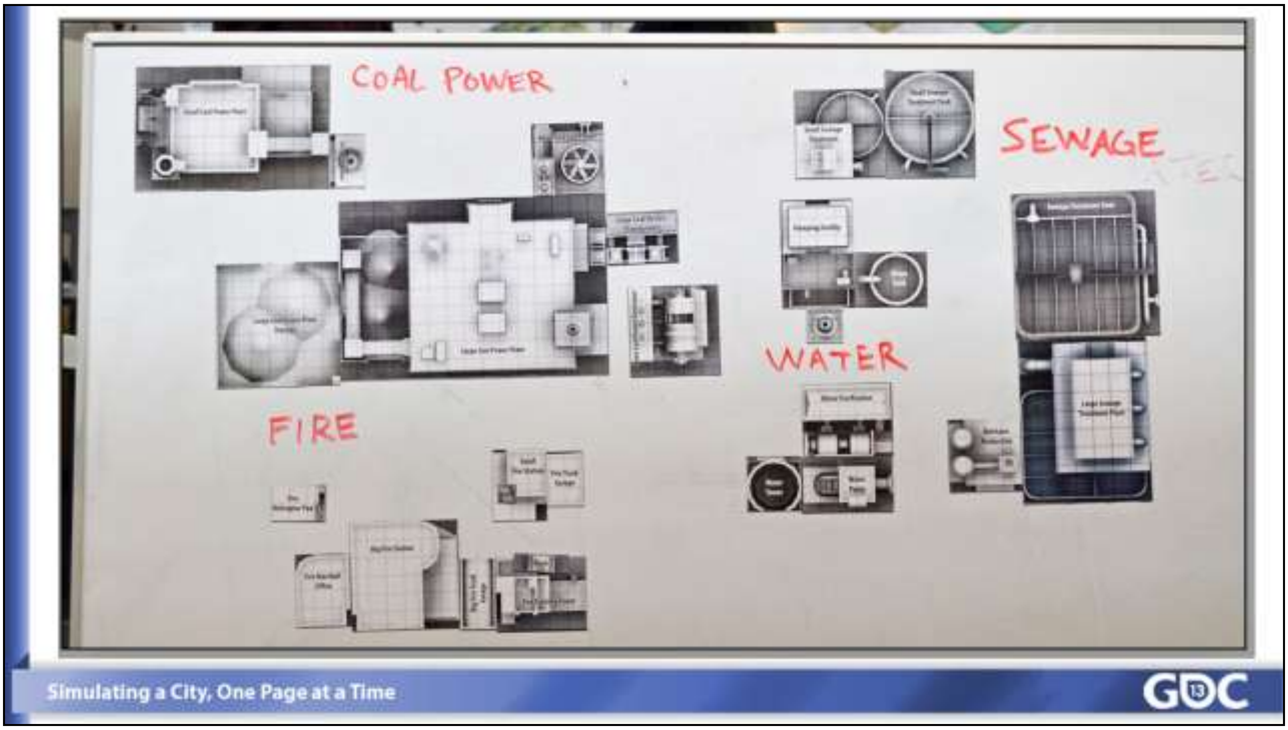
Simulating a City, One Page at a Time

GDC 13

Police Station Modules

The first pass at trying to capture this design was to make a sheet showing all of the modules of a building, the intended gameplay effects, and a couple examples of different buildings that could be created.

This was an adequate representation, but I wanted to add more detailed information for things like tuning, tool tips, and mission triggers. I also had this grand vision that I could represent every building and module in the entire game on one piece of paper.

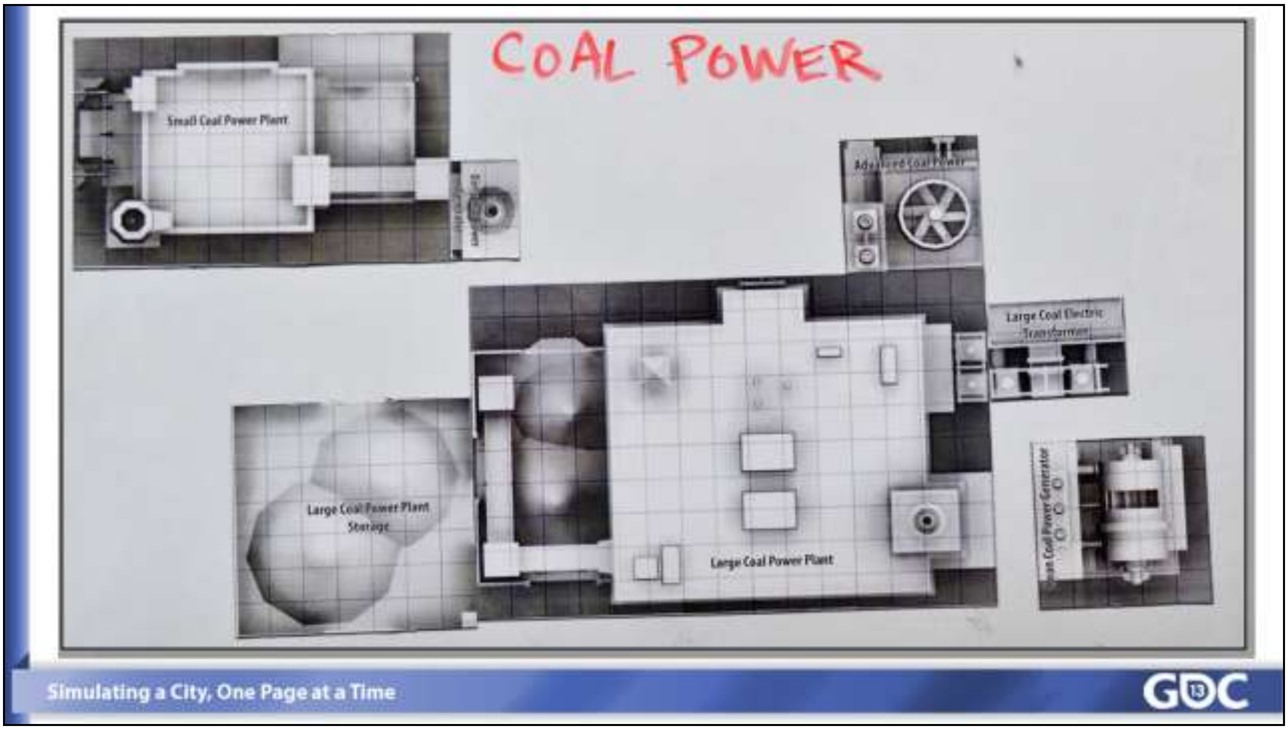


Simulating a City, One Page at a Time

GDC

Magnetic Board

I tried this approach of printing out the buildings and modules on magnetic sheets, cutting them out, and sticking them to a whiteboard.



COAL POWER
Small Coal Power Plant
Advanced Coal Power
Large Coal Electric Transformer
Large Coal Power Plant Storage
Large Coal Power Plant
Clean Coal Power Generator

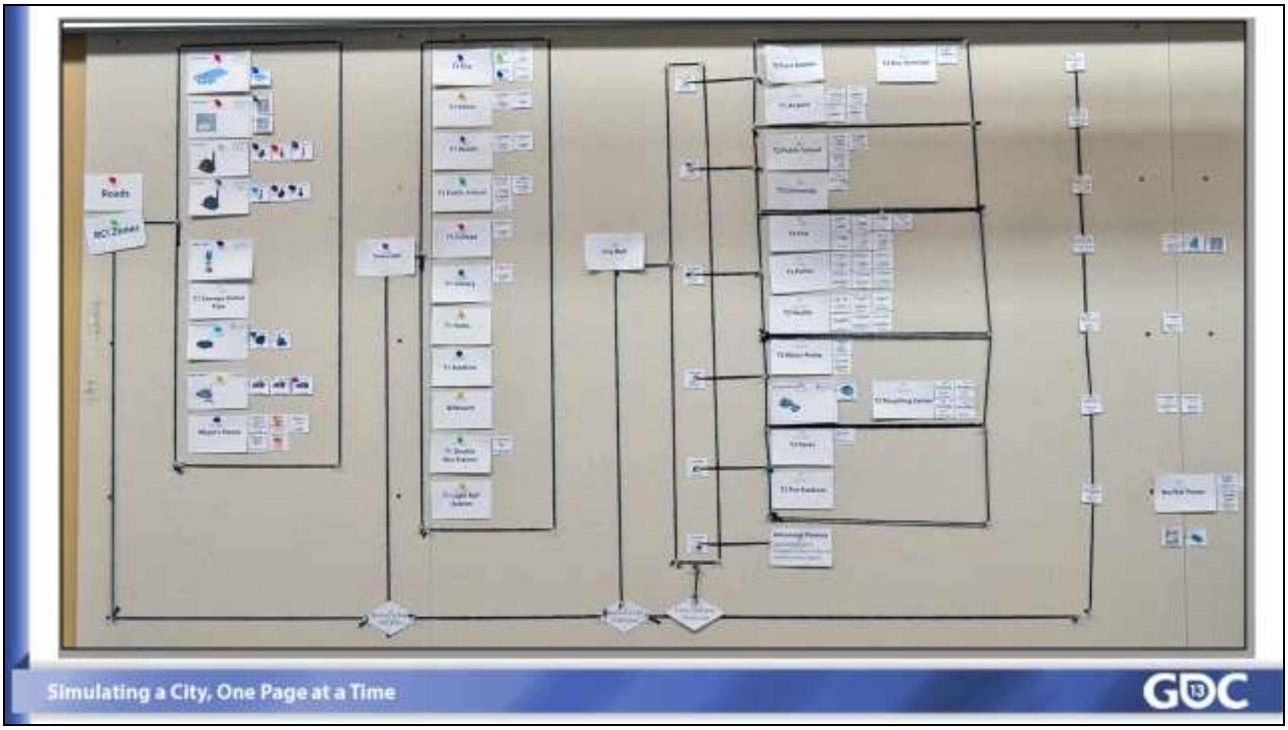
Simulating a City, One Page at a Time

GDC 13

Magnetic Board

This was a lot of fun to play with, but it turned out to be impractical to maintain. Each time the artists created a new white box model I would need to get a top-down image, scale it to a standard grid, print it, and cut it out. After doing several of these I realized that it was going to be too much work.

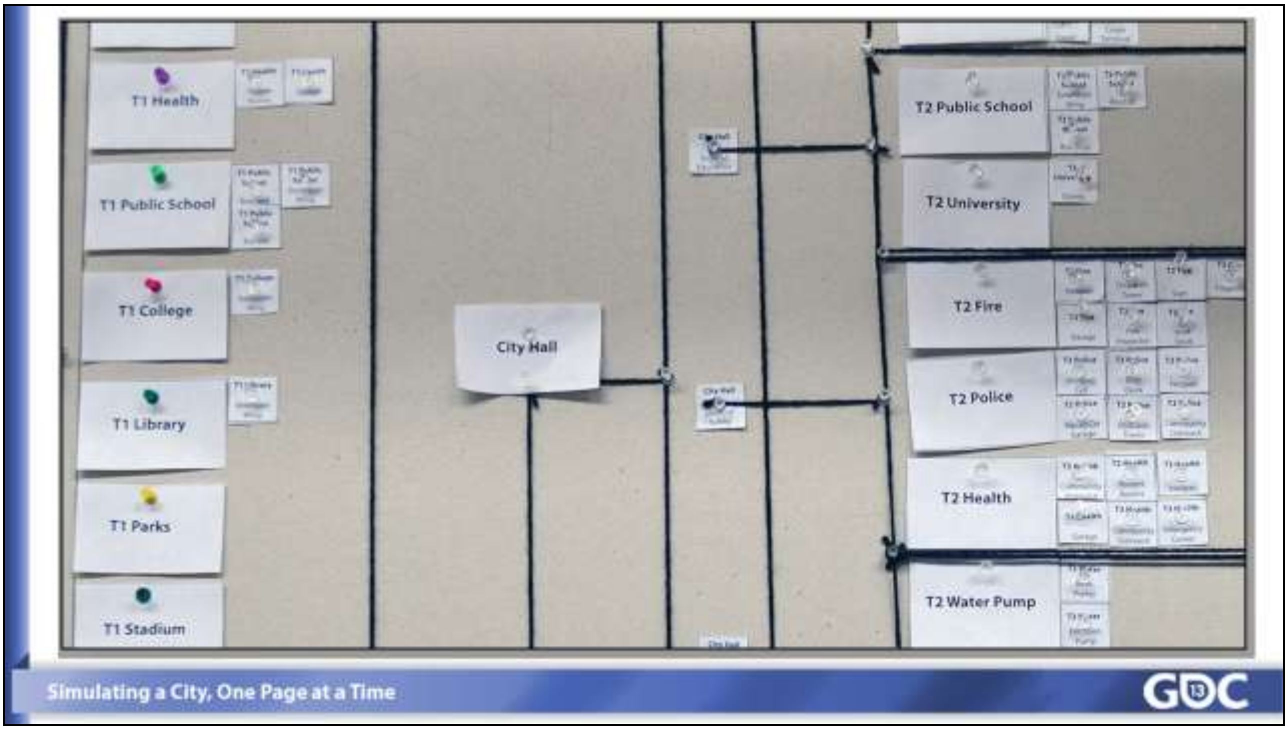
I also realized that I wasn't creating a design document. I was only taking a "snapshot" of the current state of the game. This whiteboard wasn't informing the team about what to do; it was only showing them what had already been done. I'm a big proponent of snapshots, since they are a valuable way of showing progress to the team. But maintaining a snapshot is a task best suited for a producer. Design is most effective when it is at the head of development process.



Simulating a City, One Page at a Time

City System board

We decided that a better approach would be to make simple black and white cards and tack them up onto a large corkboard. Here is the unlock tree for most of the buildings and modules in the game. (Perhaps we were watching too much of "The Wire" back then.)



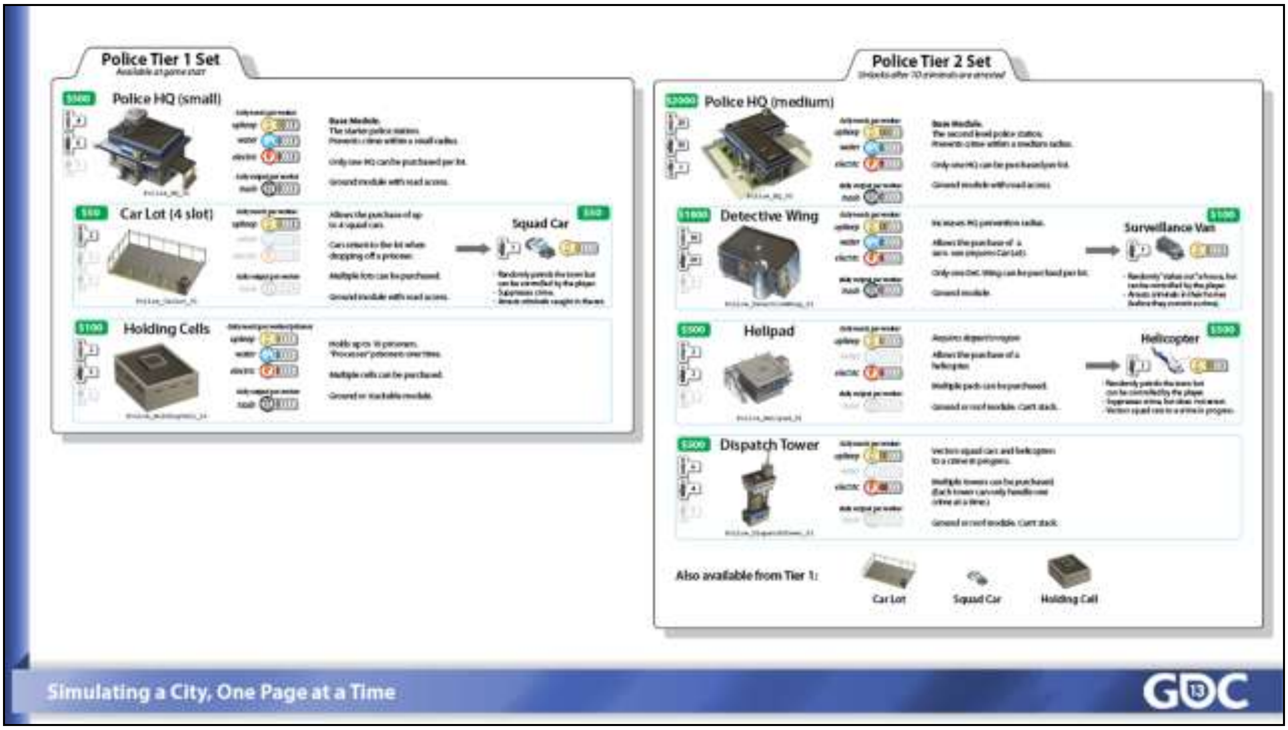
Simulating a City, One Page at a Time

City System board

It was a great idea, but it turned out to be to impractical to maintain. One problem was the physicality: you had to untack the cards and the string and then reroute it. But I think we could have worked around that hassle. The bigger problem was that the board wasn’t in the design area. It was on the back wall in another area behind two artists. In order to change the board you would have to interrupt them and lean over their desks.

The third problem was that this board was hidden from the rest of team. When I was practicing this talk at work many of my coworkers in the audience commented that they had never even seen this wall and had no idea where it was.

You have to get your designs in front of your audience or they have no value.



Police Tier 1 Set

Available at game start

$500 Police HQ (small)

Base Module. The starter police station. Prevents crime within a small radius.

Only one HQ can be purchased per lot.

Ground module with road access.

$50 Car Lot (4 slot)

Allows the purchase of up to 4 squad cars.

Cars return to the lot when dropping off a prisoner.

Multiple lots can be purchased.

Ground module with road access.

Squad Car $50

- Randomly patrols the town but can be controlled by the player.
- Suppresses crime.
- Arrests criminals caught in the act.

$100 Holding Cells

Holds up to 16 prisoners. "Processes" prisoners over time.

Multiple cells can be purchased.

Ground or stackable module.

Police Tier 2 Set

Unlocks after 70 criminals are arrested

$2000 Police HQ (medium)

Base Module. The second level police station. Prevents crime within a medium radius.

Only one HQ can be purchased per lot.

Ground module with road access.

$1800 Detective Wing

Increases HQ prevention radius.

Allows the purchase of a surv. van (requires Car Lot).

Only one Det. Wing can be purchased per lot.

Ground module.

Surveillance Van $100

- Randomly "stakes out" a house, but can be controlled by the player.
- Arrests criminals in their homes before they commit a crime.

$500 Helipad

Requires dispatch tower.

Allows the purchase of a helicopter.

Multiple pads can be purchased.

Ground or roof module. Can't stack.

Helicopter $500

- Randomly patrols the town but can be controlled by the player.
- Suppresses crime, but does not arrest.
- Vectors squad cars to a crime in progress.

$500 Dispatch Tower

Vectors squad cars and helicopters to a crime in progress.

Multiple towers can be purchased. (Each tower can only handle one crime at a time.)

Ground or roof module. Can't stack.

Also available from Tier 1: Car Lot Squad Car Holding Cell

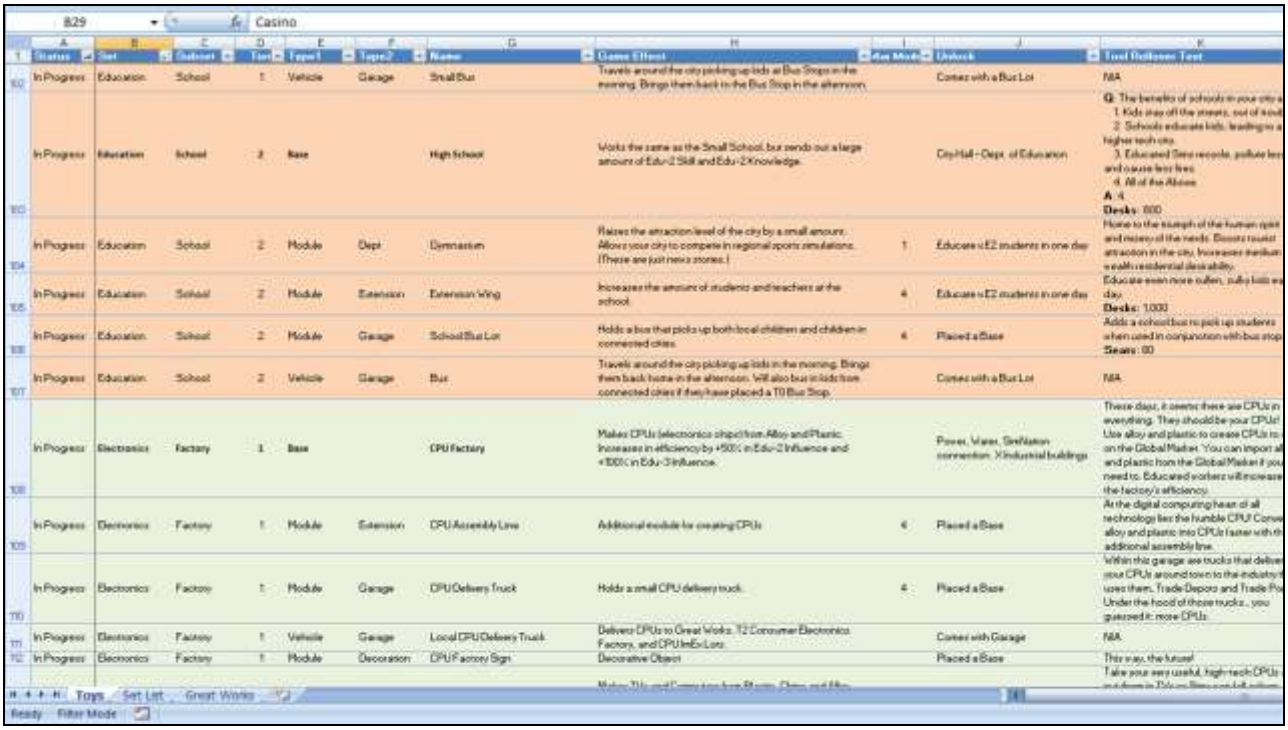
Simulating a City, One Page at a Time

GDC

Police Modules

I also tried making index cards that held all the information about each building set. These cards were great in that they included all the relevant tuning information about each module. Early on, I imagined that I would have a box of these and would quickly flip through them to find the one I needed.

I only ended up making six of these cards before I realized that it would never be feasible.



B29 | Casino

	Status	Set	Subset	Tier	Type1	Type2	Name	Game Effect	Max Mods	Unlock	Tool Rollover Text
102	In Progress	Education	School	1	Vehicle	Garage	Small Bus	Travels around the city picking up kids at Bus Stops in the morning. Brings them back to the Bus Stop in the afternoon.		Comes with a Bus Lot	N/A
103	In Progress	**Education**	**School**	**2**	**Base**		**High School**	Works the same as the Small School, but sends out a large amount of Edu-2 Skill and Edu-2 Knowledge.		City Hall - Dept. of Education	**Q:** The benefits of schools in your city a 1. Kids stay off the streets, out of troubl 2. Schools educate kids, leading to a higher tech city. 3. Educated Sims recycle, pollute les and cause less fires. 4. All of the Above **A:** 4 **Desks:** 800
104	In Progress	Education	School	2	Module	Dept	Gymnasium	Raises the attraction level of the city by a small amount. Allows your city to compete in regional sports simulations. (These are just news stories.)	1	Educate x E2 students in one day	Home to the triumph of the human spirit and misery of the nerds. Boosts tourist attraction in the city. Increases medium wealth residential desirability.
105	In Progress	Education	School	2	Module	Extension	Extension Wing	Increases the amount of students and teachers at the school.	4	Educate x E2 students in one day	Educate even more sullen, pully kids e day. **Desks:** 1000
106	In Progress	Education	School	2	Module	Garage	School Bus Lot	Holds a bus that picks up both local children and children in connected cities.	4	Placed a Base	Adds a school bus to pick up students when used in conjunction with bus stop **Seats:** 00
107	In Progress	Education	School	2	Vehicle	Garage	Bus	Travels around the city picking up kids in the morning. Brings them back home in the afternoon. Will also bus in kids from connected cities if they have placed a T0 Bus Stop.		Comes with a Bus Lot	N/A
108	In Progress	**Electronics**	**Factory**	**1**	**Base**		**CPU Factory**	Makes CPUs (electronics chips) from Alloy and Plastic. Increases in efficiency by +50% in Edu-2 Influence and +100% in Edu-3 Influence.		Power, Water, Sim Nation connection. X Industrial buildings	These days, it seems there are CPUs in everything. They should be your CPUs! Use alloy and plastic to create CPUs to on the Global Market. You can import a and plastic from the Global Market if you need to. Educated workers will increase the factory's efficiency.
109	In Progress	Electronics	Factory	1	Module	Extension	CPU Assembly Line	Additional module for creating CPUs	4	Placed a Base	At the digital computing heart of all technology lies the humble CPU! Conve alloy and plastic into CPUs faster with th additional assembly line.
110	In Progress	Electronics	Factory	1	Module	Garage	CPU Delivery Truck	Holds a small CPU delivery truck.	4	Placed a Base	Within this garage are trucks that delive your CPUs around town to the industry t uses them. Trade Depots and Trade Po Under the hood of those trucks... you guessed it: more CPUs.
111	In Progress	Electronics	Factory	1	Vehicle	Garage	Local CPU Delivery Truck	Delivers CPUs to Great Works, T2 Consumer Electronics Factory, and CPU ImEx Lots.		Comes with Garage	N/A
112	In Progress	Electronics	Factory	1	Module	Decoration	CPU Factory Sign	Decorative Object		Placed a Base	This way, the future!
								Makes TVs and Computers from Plastic, Chips and Allo			Take your very useful, high-tech CPUs

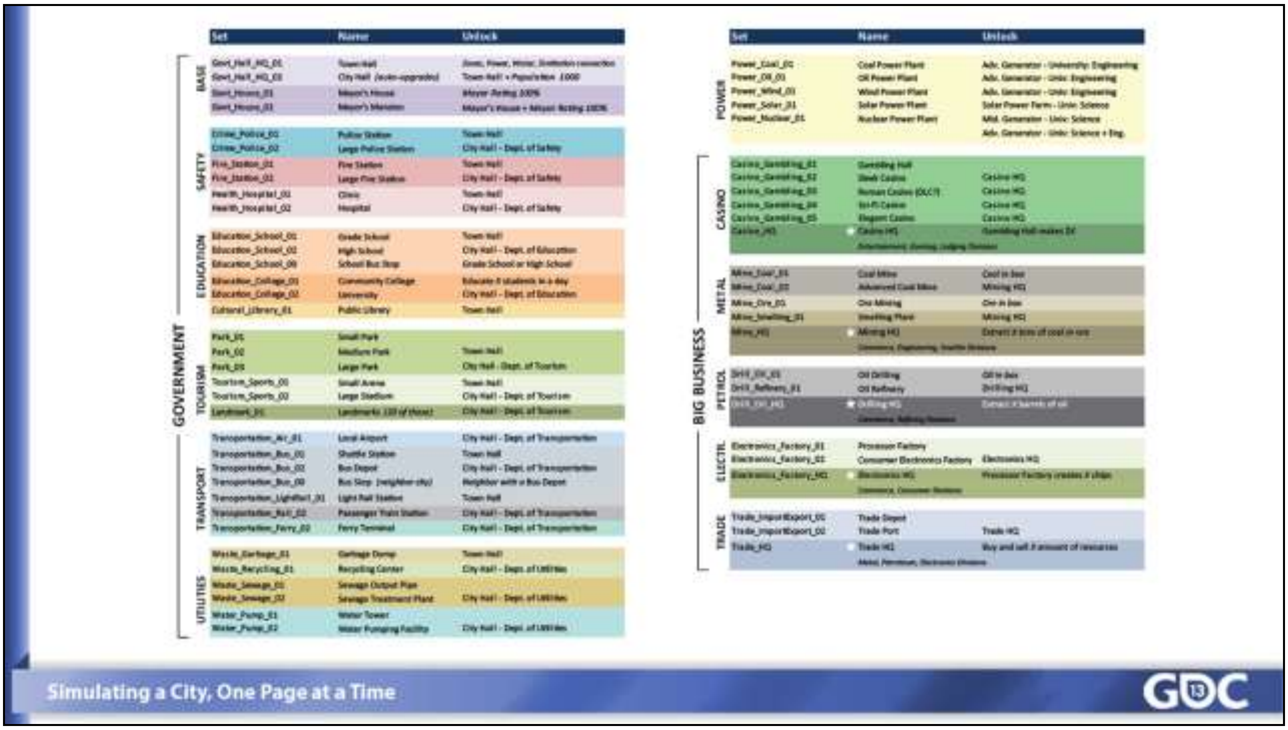
Toys | Set List | Great Works

Ready | Filter Mode

Excel List

I finally broke down and put everything into Excel. In retrospect, I should have done this first. Honestly, I knew I should have done it all along, but I was stubbornly trying to put everything into a one-page design. However, I think the experimentation that I did was worth it though. Throughout this project I was trying to find the limitations of one-page designs and I didn't want to give up without pushing myself.

This Excel document has 650 rows, and needed to be updated almost daily. It was also shared by the content director and our writer. It can be sorted and filtered dynamically and has revision control. Needless to say, if you have this much data then it is best to store it digitally, not print it out on giant piece of paper (or magnetic whiteboard, or cork board, or card catalogue).



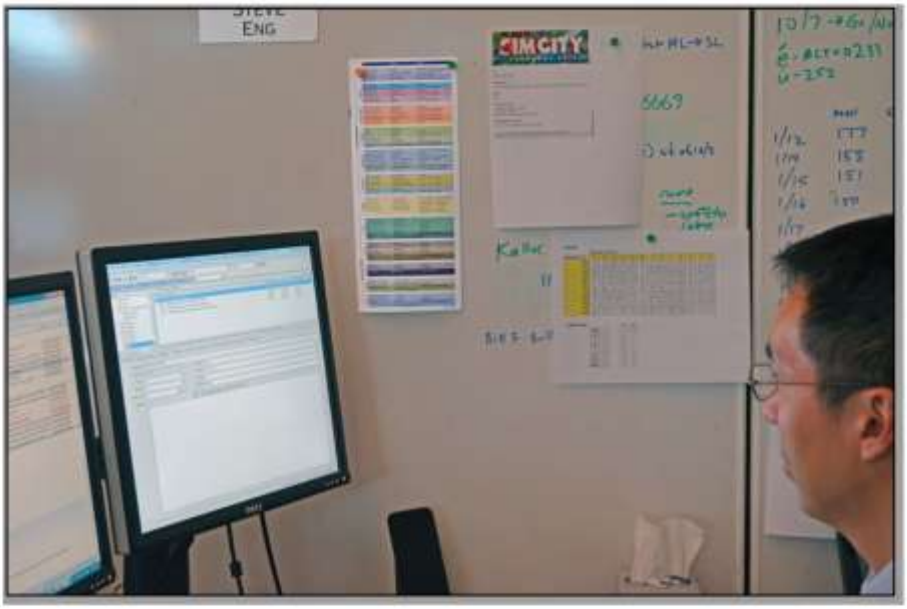
		Set	Name	Unlock
GOVERNMENT	BASE	Govt_Hall_HQ_01	Town Hall	Zones, Power, Water, Sanitation connection
		Govt_Hall_HQ_02	City Hall (auto-upgrades)	Town Hall + Population 1000
		Govt_House_01	Mayor's House	Mayor Rating 100%
		Govt_House_02	Mayor's Mansion	Mayor's House + Mayor Rating 100%
	SAFETY	Crime_Police_01	Police Station	Town Hall
		Crime_Police_02	Large Police Station	City Hall - Dept. of Safety
		Fire_Station_01	Fire Station	Town Hall
		Fire_Station_02	Large Fire Station	City Hall - Dept. of Safety
		Health_Hospital_01	Clinic	Town Hall
		Health_Hospital_02	Hospital	City Hall - Dept. of Safety
	EDUCATION	Education_School_01	Grade School	Town Hall
		Education_School_02	High School	City Hall - Dept. of Education
		Education_School_03	School Bus Stop	Grade School or High School
		Education_College_01	Community College	Educate # students in a day
		Education_College_02	University	City Hall - Dept. of Education
		Cultural_Library_01	Public Library	Town Hall
	TOURISM	Park_01	Small Park	
		Park_02	Medium Park	Town Hall
		Park_03	Large Park	City Hall - Dept. of Tourism
		Tourism_Sports_01	Small Arena	Town Hall
		Tourism_Sports_02	Large Stadium	City Hall - Dept. of Tourism
		Landmark_01	Landmarks (10 of these)	City Hall - Dept. of Tourism
	TRANSPORT	Transportation_Air_01	Local Airport	City Hall - Dept. of Transportation
		Transportation_Bus_01	Shuttle Station	Town Hall
		Transportation_Bus_02	Bus Depot	City Hall - Dept. of Transportation
		Transportation_Bus_03	Bus Stop (neighbor city)	Neighbor with a Bus Depot
		Transportation_LightRail_01	Light Rail Station	Town Hall
		Transportation_Rail_02	Passenger Train Station	City Hall - Dept. of Transportation
		Transportation_Ferry_02	Ferry Terminal	City Hall - Dept. of Transportation
	UTILITIES	Waste_Garbage_01	Garbage Dump	Town Hall
		Waste_Recycling_01	Recycling Center	City Hall - Dept. of Utilities
		Waste_Sewage_01	Sewage Output Pipe	
		Waste_Sewage_02	Sewage Treatment Plant	City Hall - Dept. of Utilities
		Water_Pump_01	Water Tower	
		Water_Pump_02	Water Pumping Facility	City Hall - Dept. of Utilities
	POWER	Power_Coal_01	Coal Power Plant	Adv. Generator - University: Engineering
		Power_Oil_01	Oil Power Plant	Adv. Generator - Univ: Engineering
		Power_Wind_01	Wind Power Plant	Adv. Generator - Univ: Engineering
		Power_Solar_01	Solar Power Plant	Solar Power Farm - Univ: Science
		Power_Nuclear_01	Nuclear Power Plant	Mid. Generator - Univ: Science
				Adv. Generator - Univ: Science + Eng.
BIG BUSINESS	CASINO	Casino_Gambling_01	Gambling Hall	
		Casino_Gambling_02	Sleek Casino	Casino HQ
		Casino_Gambling_03	Roman Casino (DLC?)	Casino HQ
		Casino_Gambling_04	Sci-Fi Casino	Casino HQ
		Casino_Gambling_05	Elegant Casino	Casino HQ
		Casino_HQ	★ Casino HQ	Gambling Hall makes $#
			Entertainment, Gaming, Lodging Division	
	METAL	Mine_Coal_01	Coal Mine	Coal in box
		Mine_Coal_02	Advanced Coal Mine	Mining HQ
		Mine_Ore_01	Ore Mining	Ore in box
		Mine_Smelting_01	Smelting Plant	Mining HQ
		Mine_HQ	★ Mining HQ	Extract # tons of coal or ore
			Commerce, Engineering, Smelting Division	
	PETROL	Drill_Oil_01	Oil Drilling	Oil in box
		Drill_Refinery_01	Oil Refinery	Drilling HQ
		Drill_Oil_HQ	★ Drilling HQ	Extract # barrels of oil
			Commerce, Refining Division	
	ELECTR.	Electronics_Factory_01	Processor Factory	
		Electronics_Factory_02	Consumer Electronics Factory	Electronics HQ
		Electronics_Factory_HQ	★ Electronics HQ	Processor Factory creates # chips
			Commerce, Consumer Division	
	TRADE	Trade_ImportExport_01	Trade Depot	
		Trade_ImportExport_02	Trade Port	Trade HQ
		Trade_HQ	★ Trade HQ	Buy and sell # amount of resources
			Metal, Petroleum, Electronics Divisions	

Simulating a City, One Page at a Time

“Decorated” Excel List

Despite all of that, I realized that all that Excel data was never going to be viewed by the majority of the team. I felt it was important that everyone understood the scope of the game without having to open a giant Excel document and scroll through it.

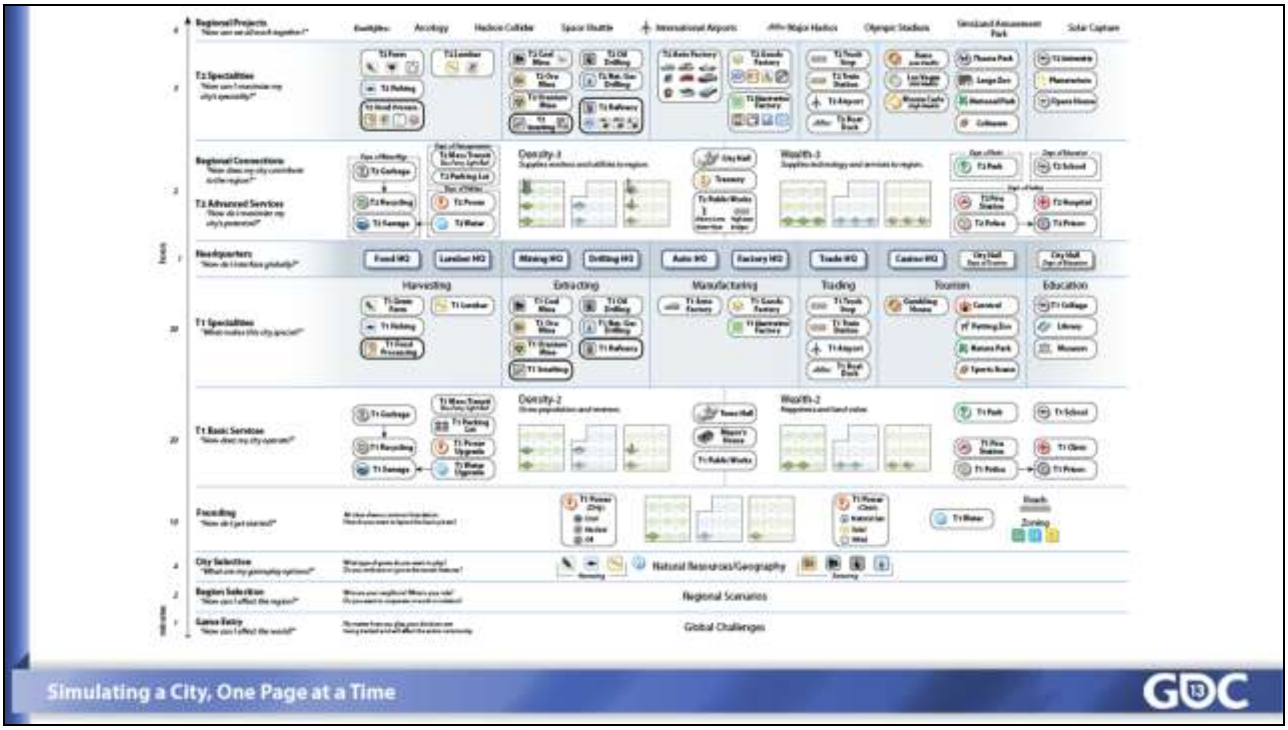
So I printed out the high level base buildings and divided them into the 12 base categories. (This is really just one long sheet, even though I had to cut it into two pieces to get it to fit on the slide.)



“Decorated” Excel List

I printed out over 20 of these lists and hung them up near all the producers’, directors’ (like Steve Eng here), artists’ and designers’ desk. About once a month (or whenever there had a been a significant content change) I would walk around the office, pulling down the old lists and replacing them with the new version.

I also had a copy of this list that I would take into every meeting in order to make sure we had complete data for our discussions. With so many systems it was easy to get bogged down in one of them and forget about how it fit into the city as a whole. This list made it easy to understand the bigger picture.



Simulating a City, One Page at a Time

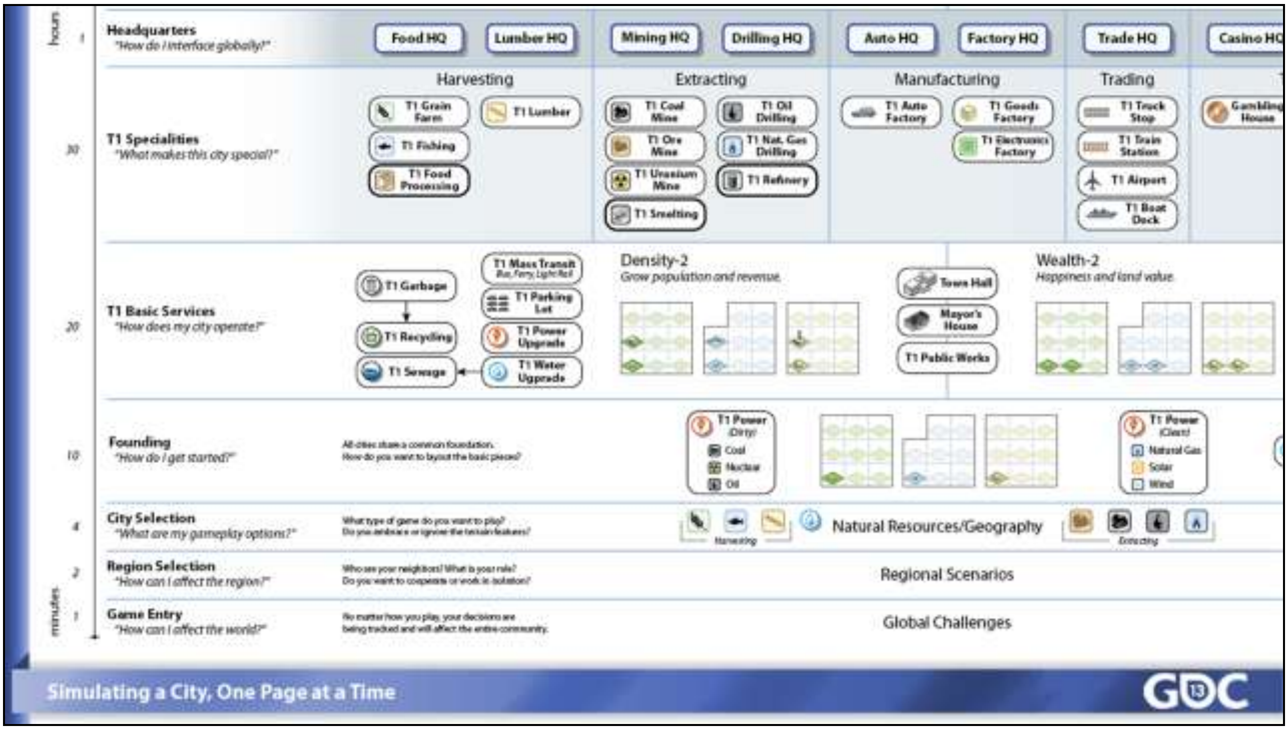
GDC

Overview Timeline

Earlier, I mentioned the importance of gameplay timelines. An “early”, “mid” and “late” game timeline is a good starting point, but it isn’t sufficient later in development when you need more precision.

Most games follow a very linear structure (level 1 content, level 2 content, etc.) and making a timeline is relatively easy. But SimCity doesn’t have a fixed goal which means it can be played in thousands of different (often unpredictable) ways. Instead of notating the play experience as a line, this document treats it more like a branching structure. Imagine the trunk at the bottom and the leaves at the top. The exact order of actions isn’t as important as the types of actions the player will be taking minute-to-minute, hour-to-hour, and session-to-session.

I like to think of charts like these as an orchestral score. The conductor needs to refer to a score in order to get all the different orchestra sections to harmonize together. Similarly, a good gameplay timeline will help you coordinate your development efforts across different departments.



hours

1 Headquarters
"How do I interface globally?"

Food HQ
Lumber HQ
Mining HQ
Drilling HQ
Auto HQ
Factory HQ
Trade HQ
Casino HQ

30 T1 Specialities
"What makes this city special?"

Harvesting
T1 Grain Farm
T1 Lumber
T1 Fishing
T1 Food Processing

Extracting
T1 Coal Mine
T1 Oil Drilling
T1 Ore Mine
T1 Nat. Gas Drilling
T1 Uranium Mine
T1 Refinery
T1 Smelting

Manufacturing
T1 Auto Factory
T1 Goods Factory
T1 Electronics Factory

Trading
T1 Truck Stop
T1 Train Station
T1 Airport
T1 Boat Dock

Gambling House

20 T1 Basic Services
"How does my city operate?"

T1 Garbage
T1 Recycling
T1 Sewage
T1 Mass Transit
Bus, Ferry, Light Rail
T1 Parking Lot
T1 Power Upgrade
T1 Water Upgrade

Density-2
Grow population and revenue.

Town Hall
Mayor's House
T1 Public Works

Wealth-2
Happiness and land value.

10 Founding
"How do I get started?"

All cities share a common foundation.
How do you want to layout the basic pieces?

T1 Power (Dirty)
Coal
Nuclear
Oil

T1 Power (Clean)
Natural Gas
Solar
Wind

4 City Selection
"What are my gameplay options?"

What type of game do you want to play?
Do you embrace or ignore the terrain features?

Harvesting
Natural Resources/Geography
Extracting

2 Region Selection
"How can I affect the region?"

Who are your neighbors? What is your role?
Do you want to cooperate or work in isolation?

Regional Scenarios

1 Game Entry
"How can I affect the world?"

No matter how you play, your decisions are
being tracked and will affect the entire community.

Global Challenges

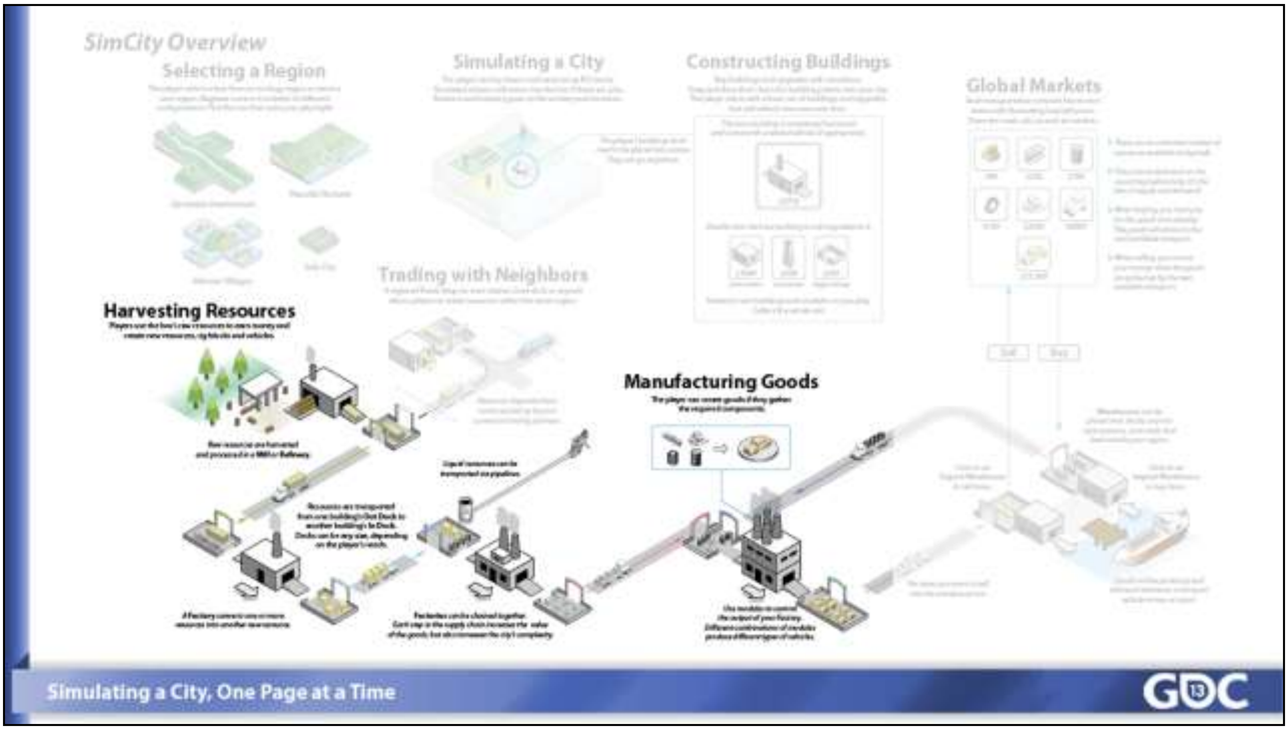
minutes

Simulating a City, One Page at a Time

Overview Timeline

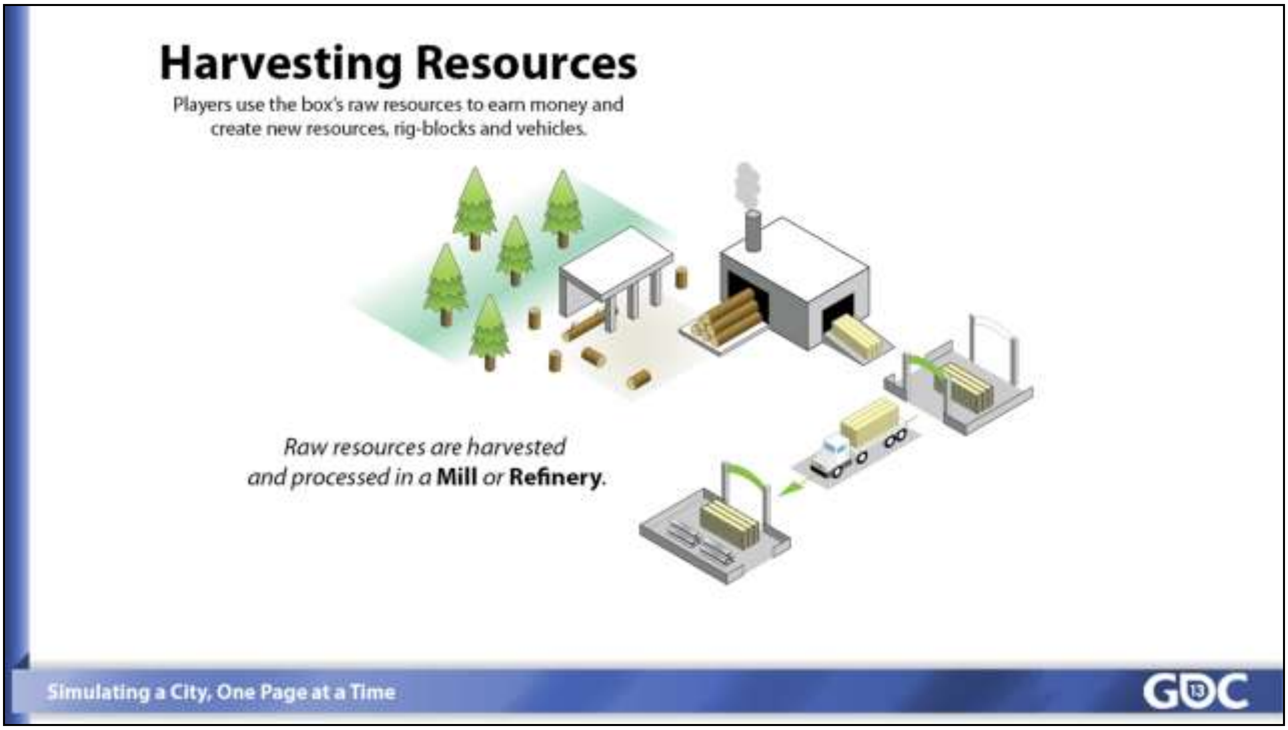
When I created this document the numbers on the side were complete guesses, and my plan was to update them as we accumulated more playtest data. But it turns out that based on telemetry from the final game, the actual times match this first chart on average.

In retrospect, this isn't too surprising, since we frequently referred to this chart to help us tune different aspects of the game.



Harvesting and Manufacturing

Another new feature of SimCity is the supply chain system that allows players to play as the owner of a corporation instead of as a mayor.



Harvesting Resources

Players use the box's raw resources to earn money and create new resources, rig-blocks and vehicles.

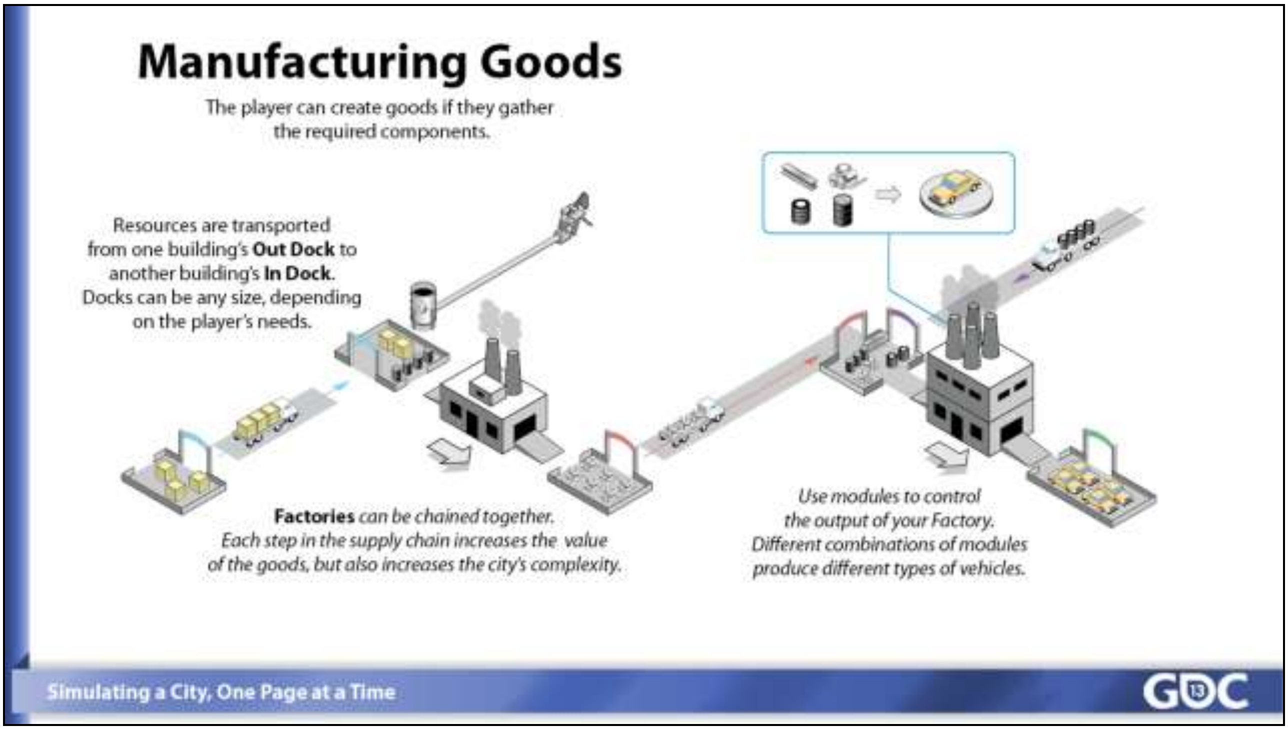
Raw resources are harvested and processed in a **Mill** *or* **Refinery**.

Simulating a City, One Page at a Time

GDC

Harvesting Resources

You could dig up resources, such as coal and oil, out of the ground and sell them for money. (This early document has lumber as a harvestable resource, but it was later scoped out.)



Manufacturing Goods

The player can create goods if they gather the required components.

Resources are transported from one building's **Out Dock** to another building's **In Dock**. Docks can be any size, depending on the player's needs.

Factories *can be chained together. Each step in the supply chain increases the value of the goods, but also increases the city's complexity.*

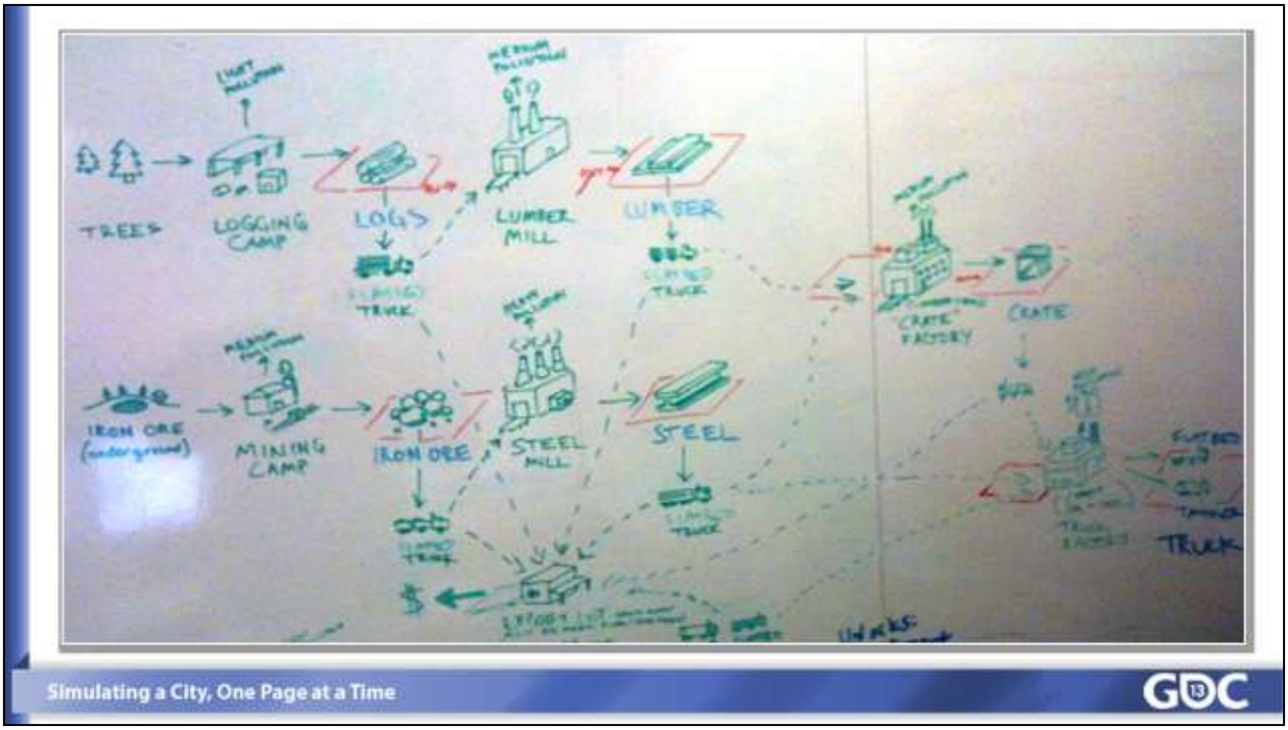
Use modules to control the output of your Factory. Different combinations of modules produce different types of vehicles.

Simulating a City, One Page at a Time

GDC 13

Manufacturing Goods

Once resources are harvested then they can be converted into more expensive goods through manufacturing. For example, oil can be refined into fuel or plastics.



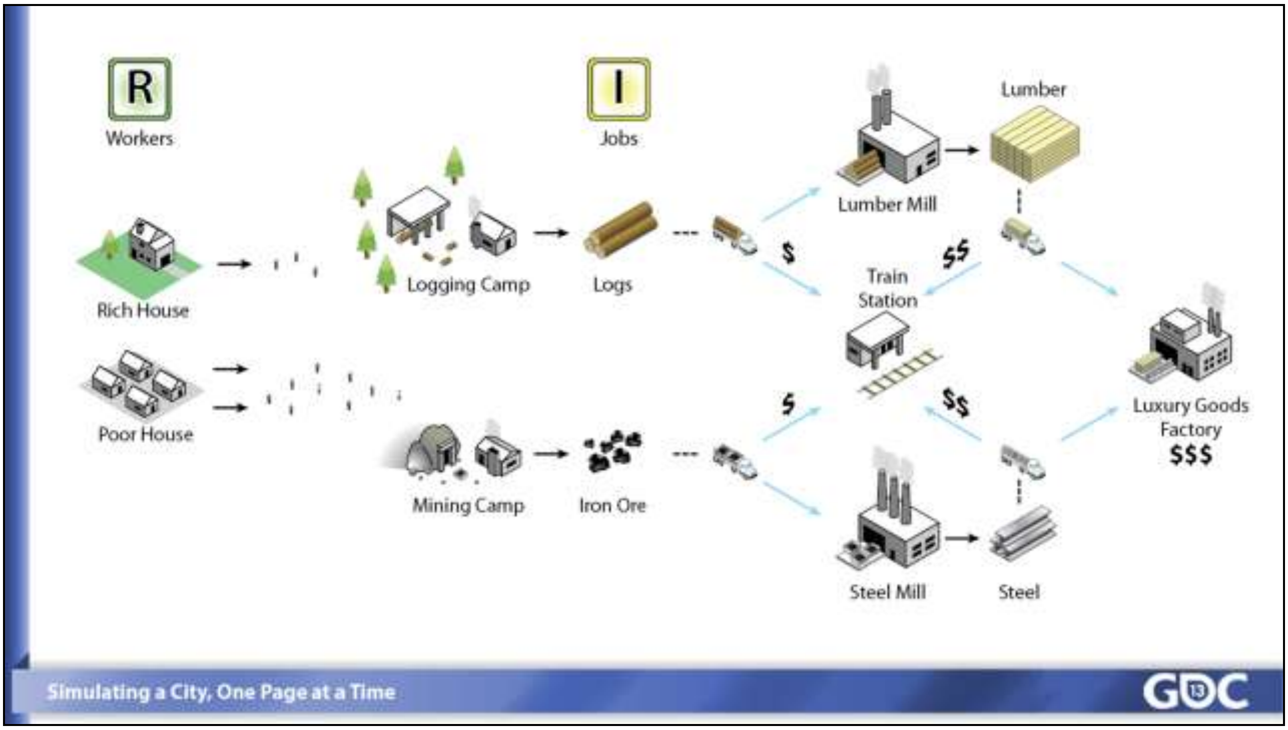
Simulating a City, One Page at a Time

White Board Supply Chain

Coming up with all the resources and the crafting recipes took several iterations. During this phase it was beneficial for me to work on a large whiteboard so that I can think about things quickly and at a high level without getting bogged down by details.

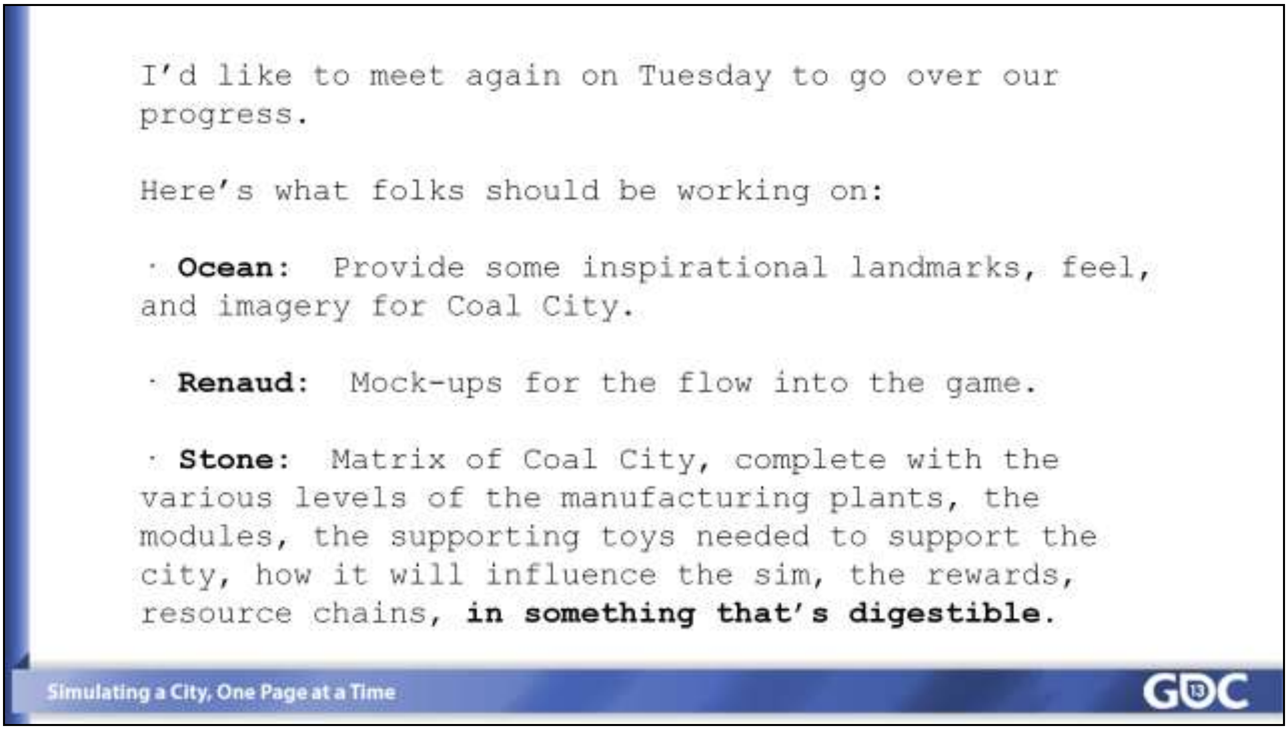
Here is the initial rough sketch that shows several different resources in the game and how they would flow through a supply chain.

Previous versions of SimCity don’t have systems like this, so we were making it up as we went along. We didn’t want to make Sim Coal Miner or Sim Fuel Refinery so we had to be careful not to go overboard. Ultimately, we were more concerned with how harvesting and manufacturing would affect the character of the surrounding city.



Illustrator Supply Chain

After we were comfortable with the basic whiteboard concepts I cleaned it up using Adobe Illustrator. This shows the basics of the supply chain system: there are a few jobs for the wealthy, lots of jobs for the poor, and each step of the way you can sell or convert the resources into higher priced goods. The farther up the chain you go the more money you can make.



I'd like to meet again on Tuesday to go over our progress.

Here's what folks should be working on:

· **Ocean:** Provide some inspirational landmarks, feel, and imagery for Coal City.

· **Renaud:** Mock-ups for the flow into the game.

· **Stone:** Matrix of Coal City, complete with the various levels of the manufacturing plants, the modules, the supporting toys needed to support the city, how it will influence the sim, the rewards, resource chains, **in something that's digestible.**

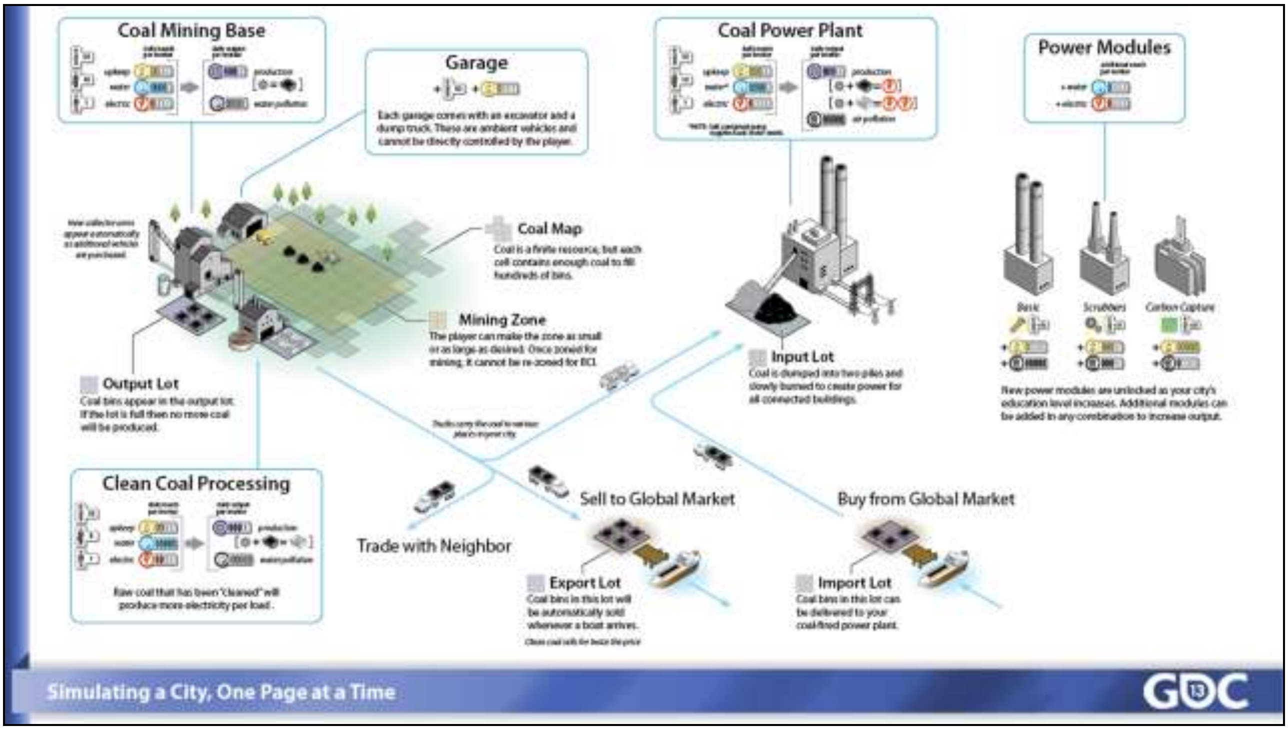
Simulating a City, One Page at a Time

Producer Email

Around this time I realized that I had gotten myself into a bind. By now everyone on the team just took it for granted that I could turn any design into an easy to understand one-page document.

Here's a real example from an email message that my Producer sent out. (Bold text is mine for emphasis.) "Something that's digestable" means "one-page design".

My first reaction was to reply with "No way can I do all of that in one-page!", but then I reminded myself that if I really wanted to push it as far as possible then I should at least try before declaring defeat. After spending some time on it I was happy to discover…



Coal Mining Base

Garage

Each garage comes with an excavator and a dump truck. These are ambient vehicles and cannot be directly controlled by the player.

New collector arms appear automatically as additional vehicle are purchased

Coal Map

Coal is a finite resource, but each cell contains enough coal to fill hundreds of bins.

Mining Zone

The player can make the zone as small or as large as desired. Once zoned for mining, it cannot be re-zoned for RCI.

Output Lot

Coal bins appear in the output lot. If the lot is full then no more coal will be produced.

Trucks carry the coal to various plants in your city

Clean Coal Processing

Raw coal that has been "cleaned" will produce more electricity per load.

Coal Power Plant

Input Lot

Coal is dumped into two piles and slowly burned to create power for all connected buildings.

Power Modules

New power modules are unlocked as your city's education level increases. Additional modules can be added in any combination to increase output.

Trade with Neighbor

Sell to Global Market

Buy from Global Market

Export Lot

Coal bins in this lot will be automatically sold whenever a boat arrives.

Clean coal sells for twice the price

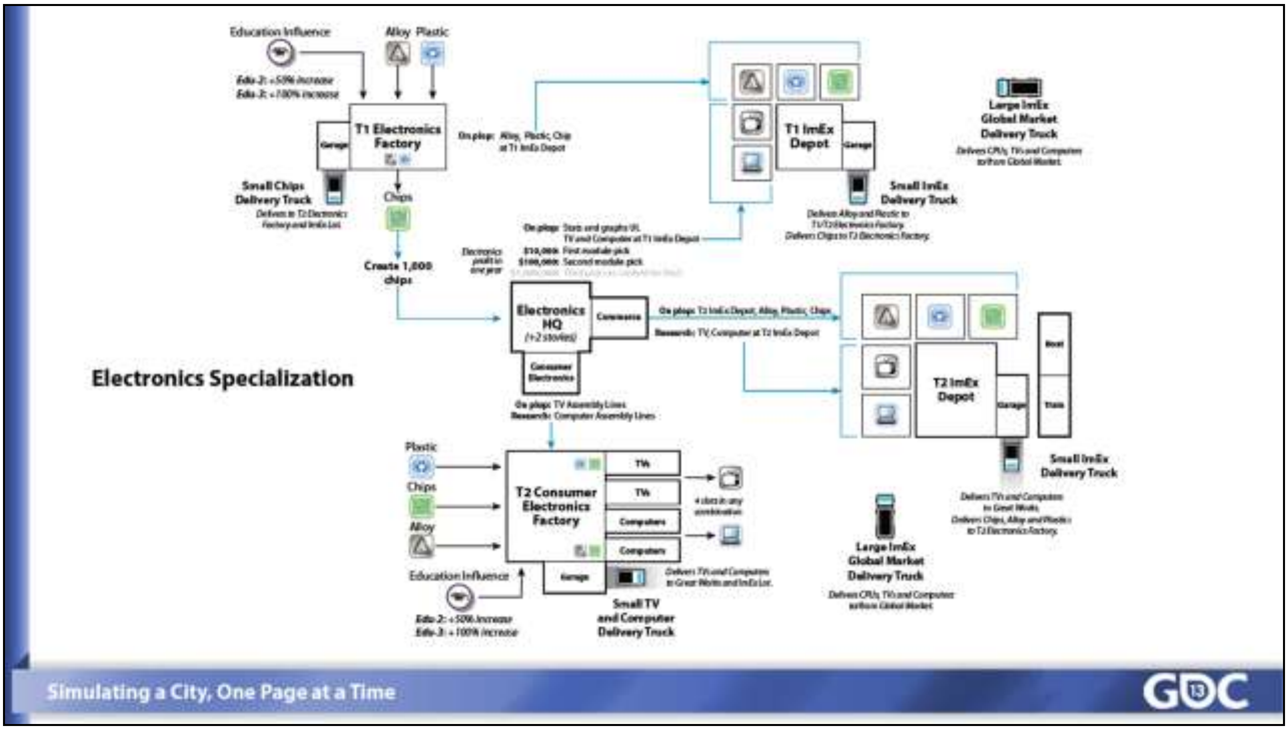
Import Lot

Coal bins in this lot can be delivered to your coal-fired power plant.

Simulating a City, One Page at a Time

Coal System

…that it could be done. The moral of the story is to always do what your producer wants without question. (After all, he's the one that eventually approves bonus checks!)



Electronics Specialization

Education Influence
Edu-2: +50% increase
Edu-3: +100% increase
Alloy
Plastic
T1 Electronics Factory
Garage
On plop: Alloy, Plastic, Chip at T1 ImEx Depot
Small Chips Delivery Truck
Delivers to T2 Electronics Factory and ImEx Lot
Chips
Create 1,000 chips
On plop: Stats and graphs UI.
TV and Computer at T1 ImEx Depot
Electronics profit in one year
$10,000: First module pick
$100,000: Second module pick
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Delivers Chips to T2 Electronics Factory.
Large ImEx Global Market Delivery Truck
Delivers CPUs, TVs and Computers to/from Global Market.
Electronics HQ
(+2 stories)
Commerce
Consumer Electronics
On plop: T2 ImEx Depot, Alloy, Plastic, Chips
Research: TV, Computer at T2 ImEx Depot
On plop: TV Assembly Lines
Research: Computer Assembly Lines
T2 ImEx Depot
Garage
Boat
Train
Small ImEx Delivery Truck
Delivers TVs and Computers to Great Works.
Delivers Chips, Alloy and Plastics to T2 Electronics Factory.
Plastic
Chips
Alloy
T2 Consumer Electronics Factory
TVs
TVs
Computers
Computers
4 slots in any combination
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Simulating a City, One Page at a Time

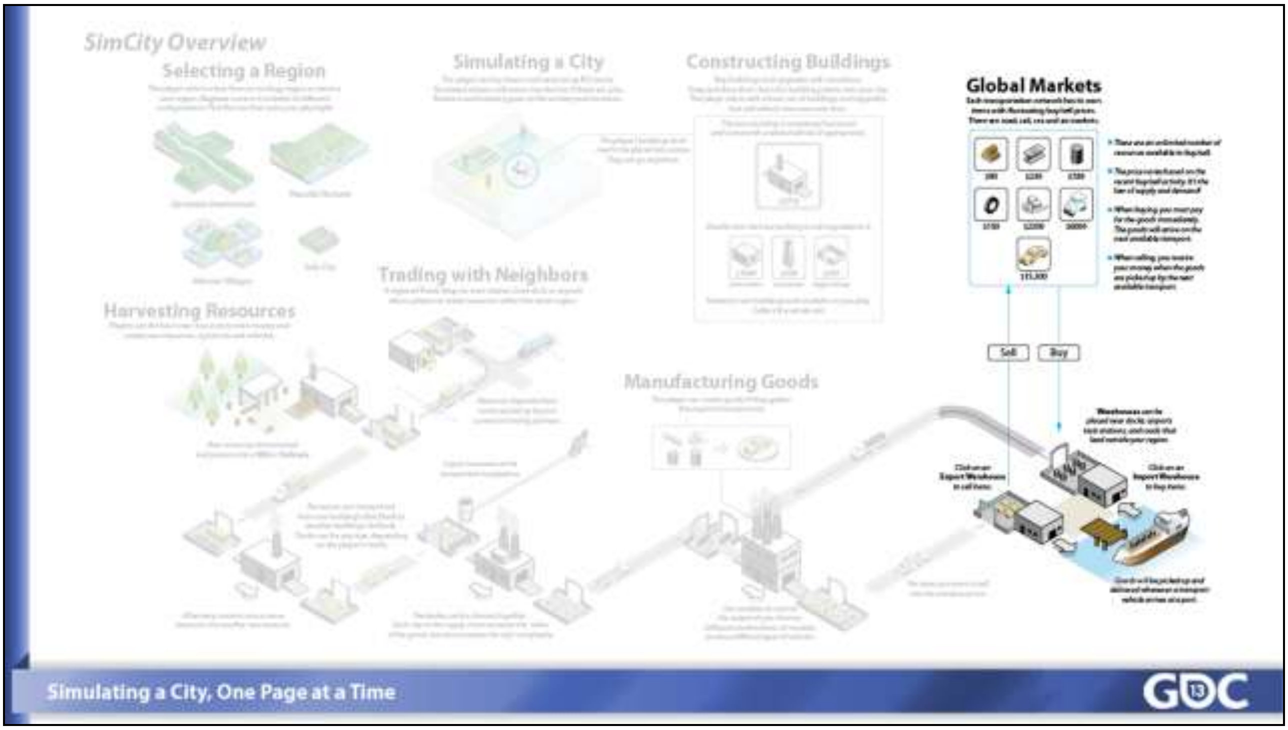
GDC 13

Electronics Specialization

As we got closer to shipping the game, my diagrams got simpler because I didn't have as much time to make them attractive. At first I felt guilty that I couldn't turn every drawing into a miniature cityscape with isometric buildings, but realized that at this point in development it didn't really matter.

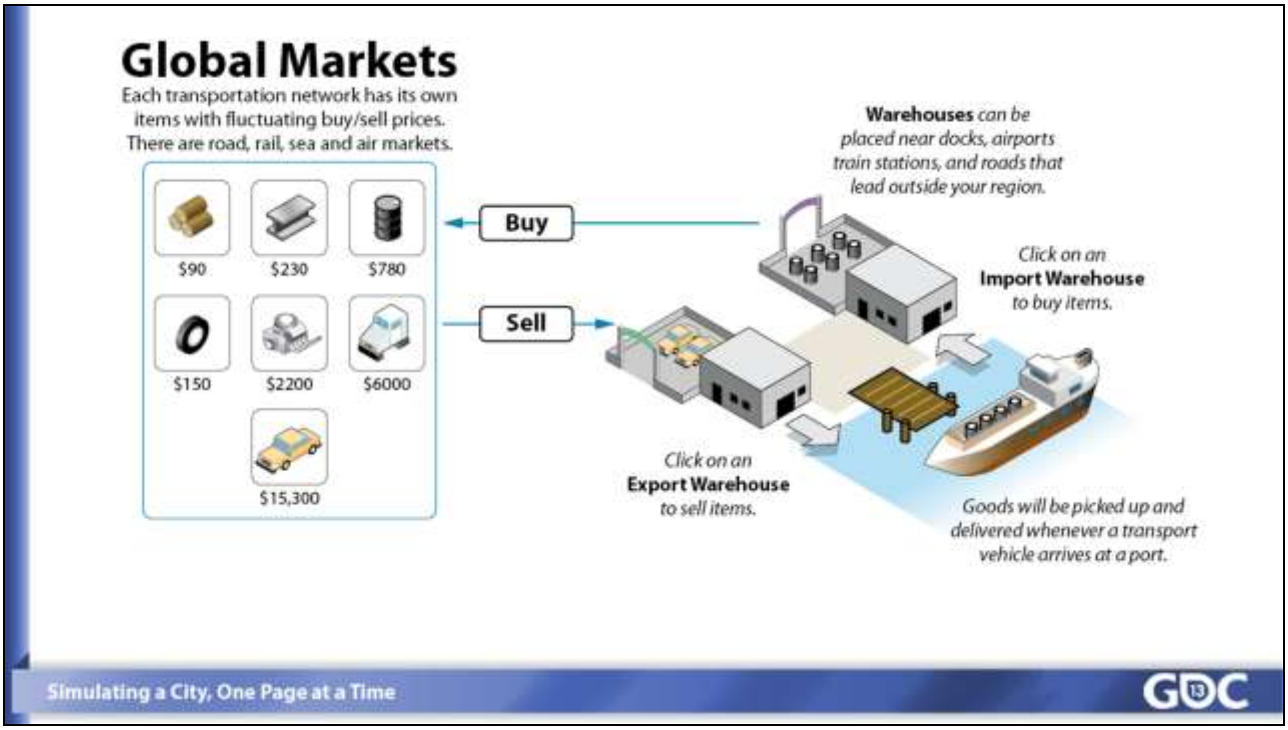
The team already had a shared vision in their heads. And now the game was functional we could just refer to it instead of a piece of paper. Also, by now I was usually working closely with one or two people who only needed the details.

Drawings like these rarely got hung on the walls for everyone to see; they just ended up on the desk of the person implementing the feature.


SimCity Overview
Selecting a Region
Simulating a City
Constructing Buildings
Trading with Neighbors
Harvesting Resources
Manufacturing Goods
Global Markets
Each transportation network has its own items with fluctuating buy/sell prices. There are road, rail, sea and air markets.
There are an unlimited number of resources available to buy/sell.
The price varies based on the recent buy/sell activity. It's the law of supply and demand!
When buying you must pay for the goods immediately. The goods will arrive on the next available transport.
When selling, you receive your money when the goods are picked up by the next available transport.
Sell
Buy
Warehouses can be placed near docks, airports, train stations, and roads that lead outside your region.
Click on an Export Warehouse to sell items.
Click on an Import Warehouse to buy items.
Goods will be picked up and delivered whenever a transport vehicle arrives at a port.
Simulating a City, One Page at a Time
GDC 13

Global Markets

The last feature I want to talk about is the Global Markets.



Global Markets

Each transportation network has its own items with fluctuating buy/sell prices. There are road, rail, sea and air markets.

Warehouses *can be placed near docks, airports train stations, and roads that lead outside your region.*

Click on an **Import Warehouse** *to buy items.*

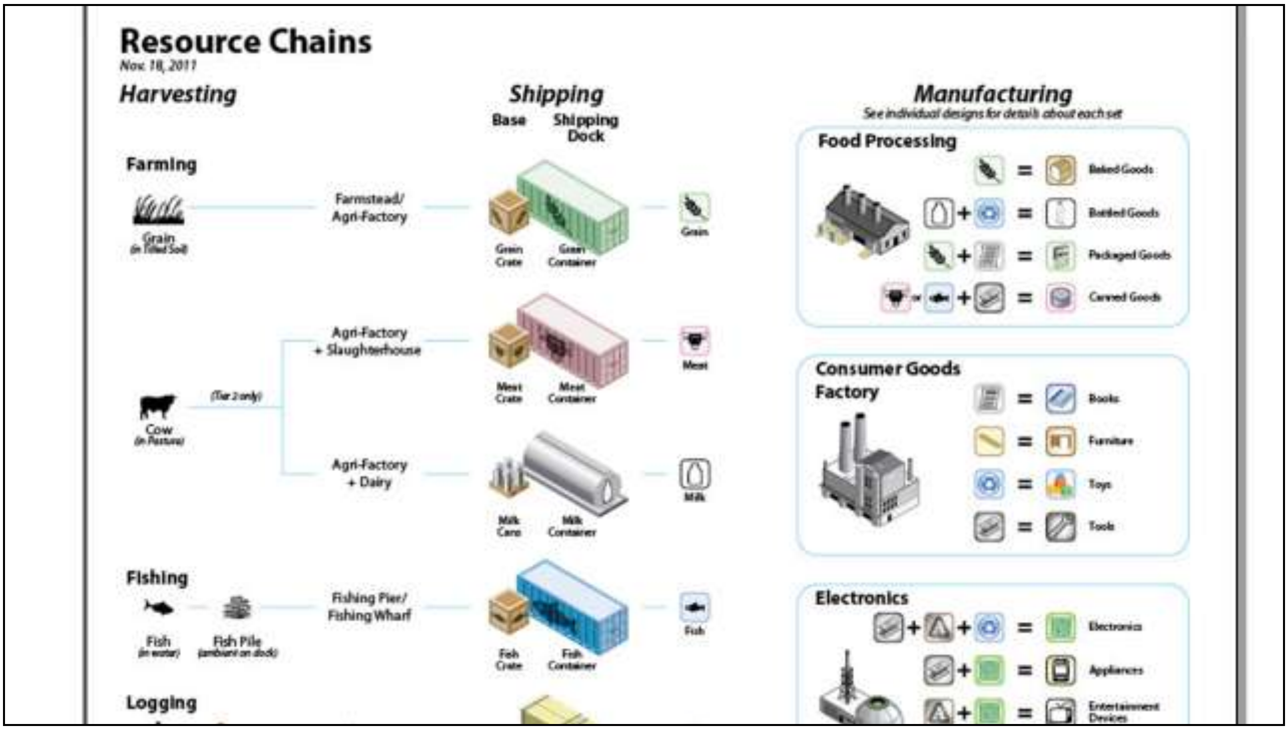
Click on an **Export Warehouse** *to sell items.*

Goods will be picked up and delivered whenever a transport vehicle arrives at a port.

Simulating a City, One Page at a Time

Global Markets

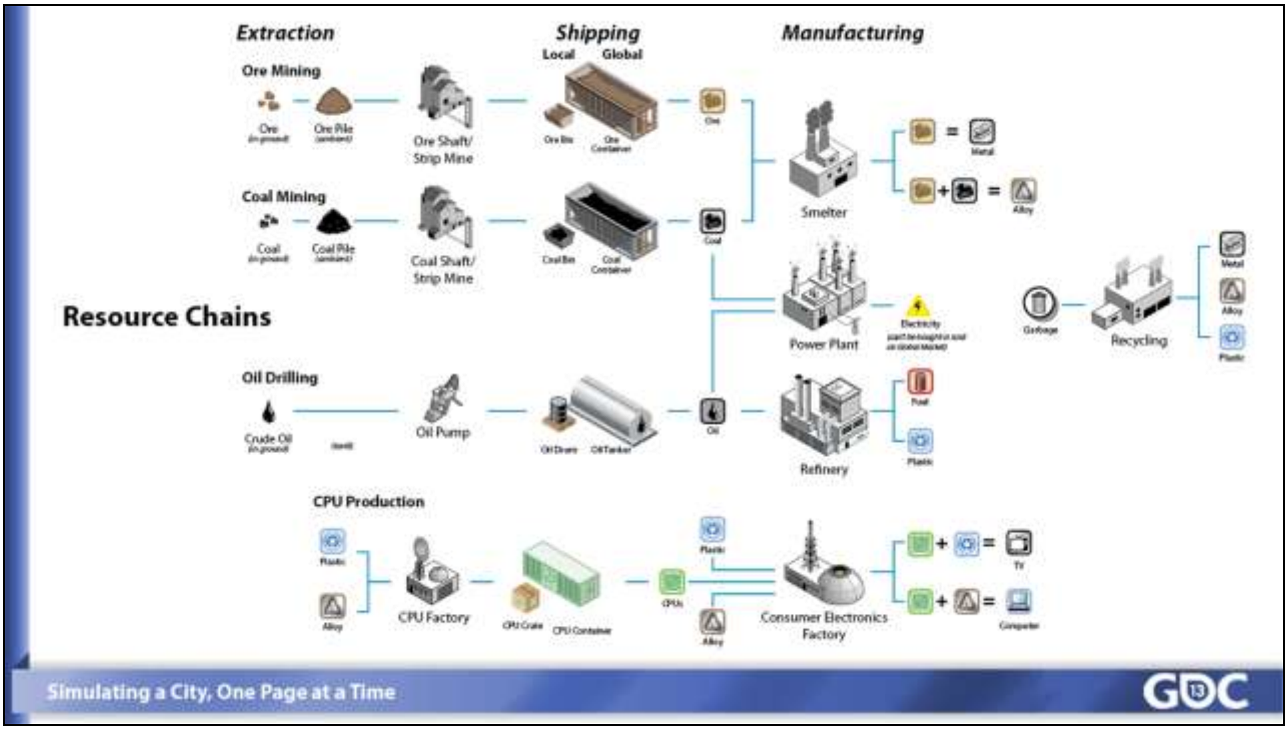
This was another new feature that allowed players to buy and sell resources. We knew we didn’t want a World of Warcraft style auction house, but we also wanted to make the prices fluctuate over time based on actual player activity.



Resource Chains

Here is the original list of resources and recipes. We didn't end up shipping with all of these, but early on it was helpful to see all the potential types on one page. This diagram also showed the mode of transport, which is important for SimCity because all resources sit in supply lots until they can be shipped to their destinations.

Overall, it is much easier for a single designer to make long lists than it is to get the programming, art, UI, and audio teams to coordinate to get those assets into the game. In preproduction I tend to purposefully overshoot so that when the inevitable cuts happen I can pick from the best.



Resource Chains

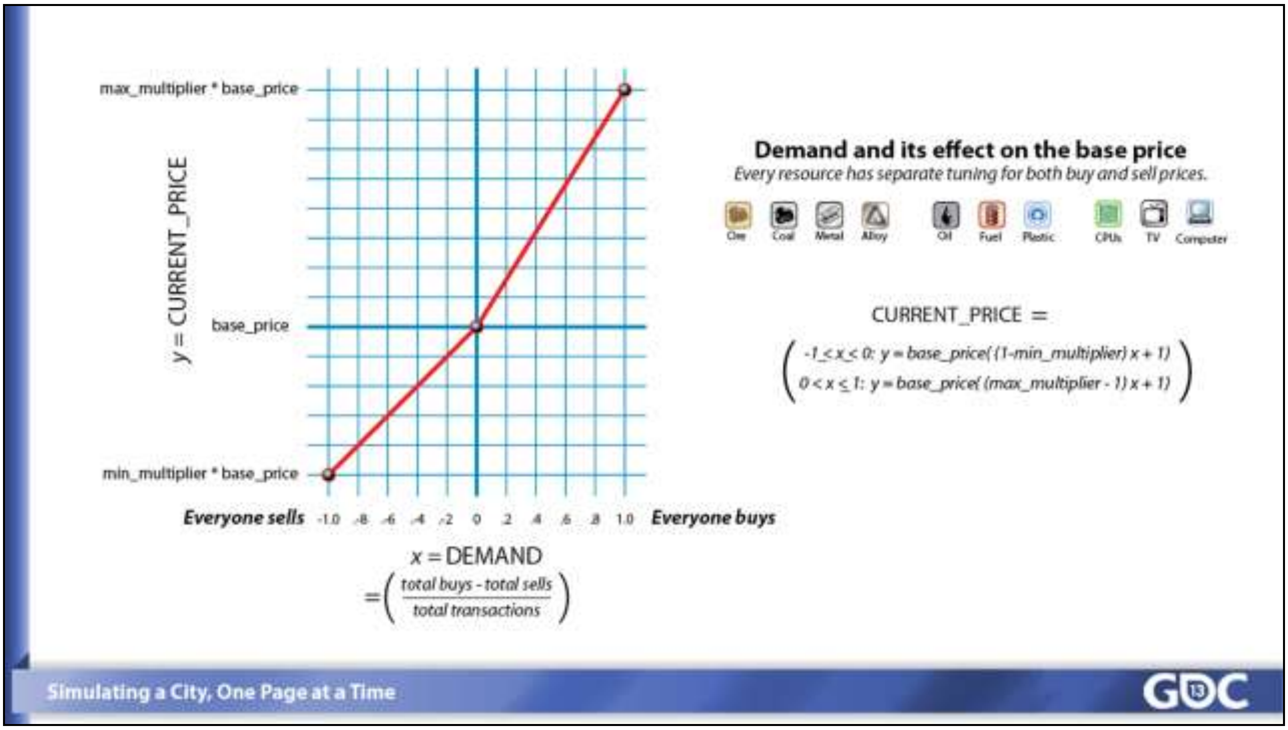
Simulating a City, One Page at a Time

Scoped Resource Chains

After scoping we ended up with just 10 resources, but it was easy to make the cuts because we could just look at the previous diagram to determine which one were critical.

Looking at the design documents during a scoping process makes the decisions much more tangible. I strongly recommend printing out your documents and bringing them to meetings to help make sure everyone around the table is sharing the same image in their heads. Everyone can see exactly what‘s going on as you draw big X’s through your drawings. (I recommend using a red Sharpie.)

Compare that process to one where you are simply deleting lines from an Excel file. In the former case you are still able to perceive the design as a whole. In the latter case each cut happens in a relative vacuum.



x = DEMAND

$$= \left(\frac{\textit{total buys - total sells}}{\textit{total transactions}} \right)$$

Demand and its effect on the base price

Every resource has separate tuning for both buy and sell prices.

CURRENT_PRICE =

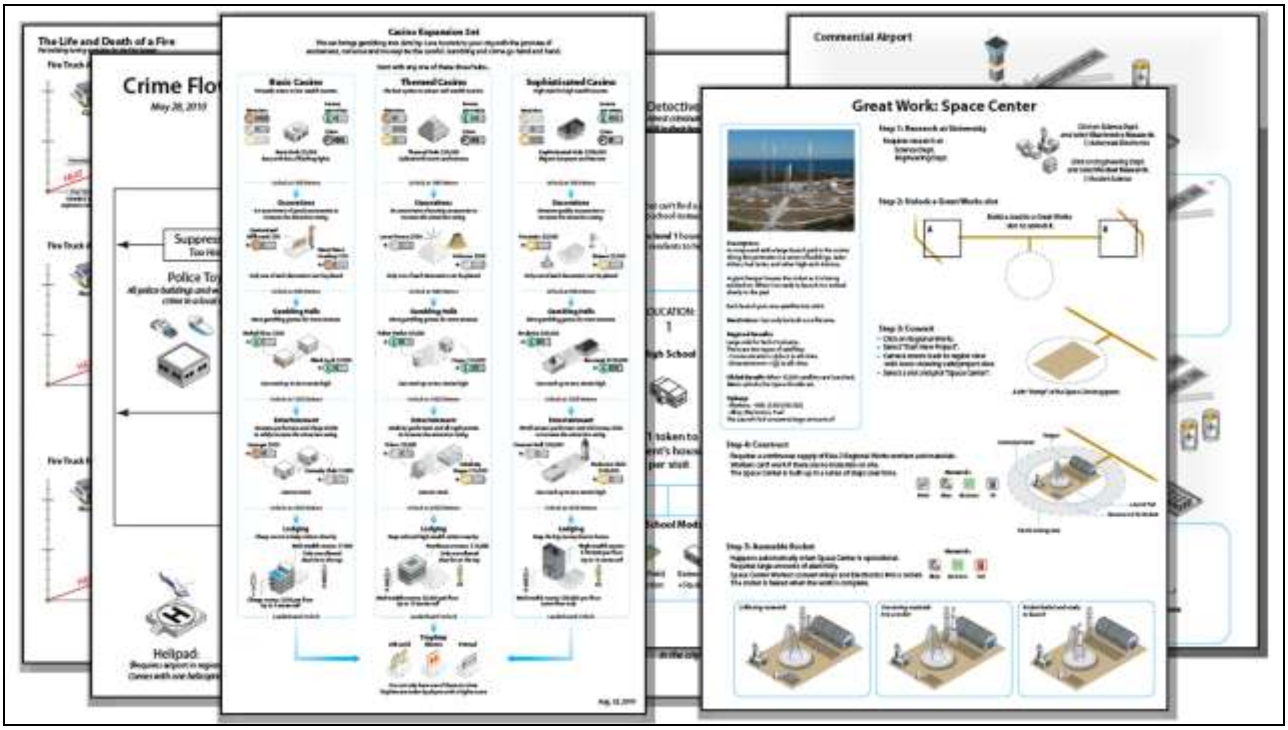
$$\left(\begin{array}{l} -1 \leq x \leq 0\text{: } y = \text{base\_price((1-min\_multiplier) } x + 1) \\ 0 < x \leq 1\text{: } y = \text{base\_price((max\_multiplier - 1) } x + 1) \end{array} \right)$$

Simulating a City, One Page at a Time

Demand Graph

This chart is kind of trivial but I wanted to show it because it ended up being very useful. The way the global market works is based on a simple formula (to the right). Basically, selling a resource causes the price to drop and purchasing a resource causes the price to rise. It’s a simple supply and demand idea, but I quickly learned that it was impossible for most of the team (especially artists and producers) to understand the formula. (Actually, most of them don’t even want to try.)

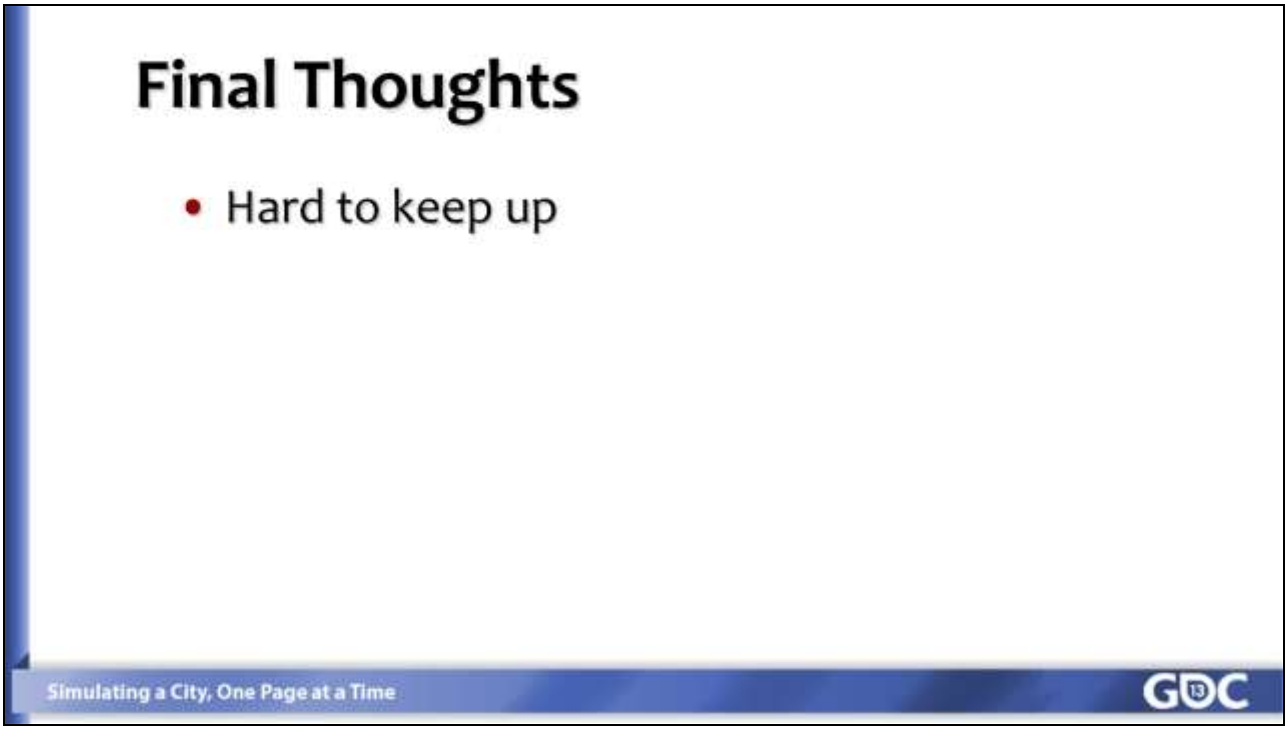
It only took me a few minutes to draw this simple line graph, but it turns out that I used this chart over and over to explain to people how the market worked. It did help make the concept much clearer to everyone on the team. Visuals, however simple, are always going to resonate more than formulas.



Miscellaneous

There were over 100 documents like these created for SimCity. There are many systems I don’t have time to talk about: fire spread, drawing curving roads, crime flow, education influence, airports, casinos, and great works like the space center.

I printed out many of them and have brought them along with me today. Feel free to come up to the stage and check them out after the talk.



Final Thoughts

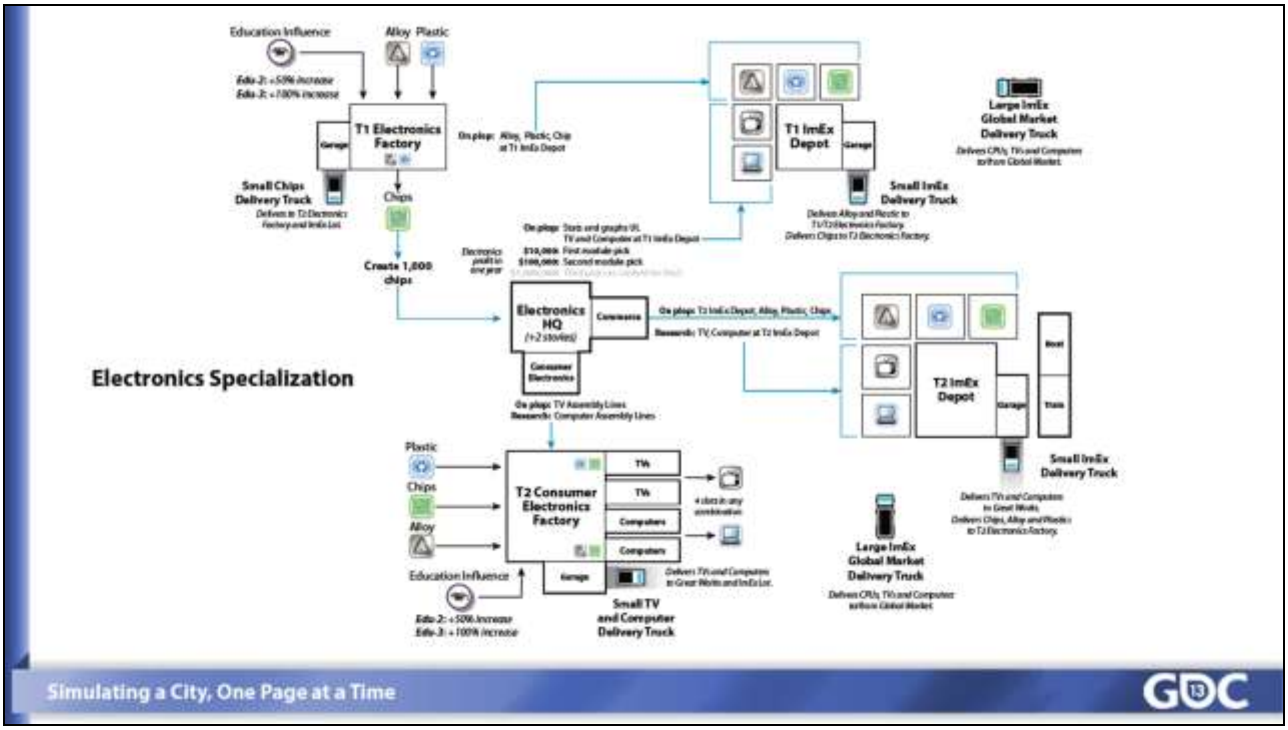
- Hard to keep up

Simulating a City, One Page at a Time

Final Thoughts

When I started this project I didn’t think that I would be able to push the concept of one-page designs as far as I did. Was the effort worth it?

First of all, it was hard to keep up. The quality of the diagrams deteriorated a lot when we hit alpha. Most of the core design work was done at that point, but when a new design was needed, or an existing design was modified, I resorted to scribbling on the printout and had a difficult time getting the Illustrator versions updated.



Electronics Specialization

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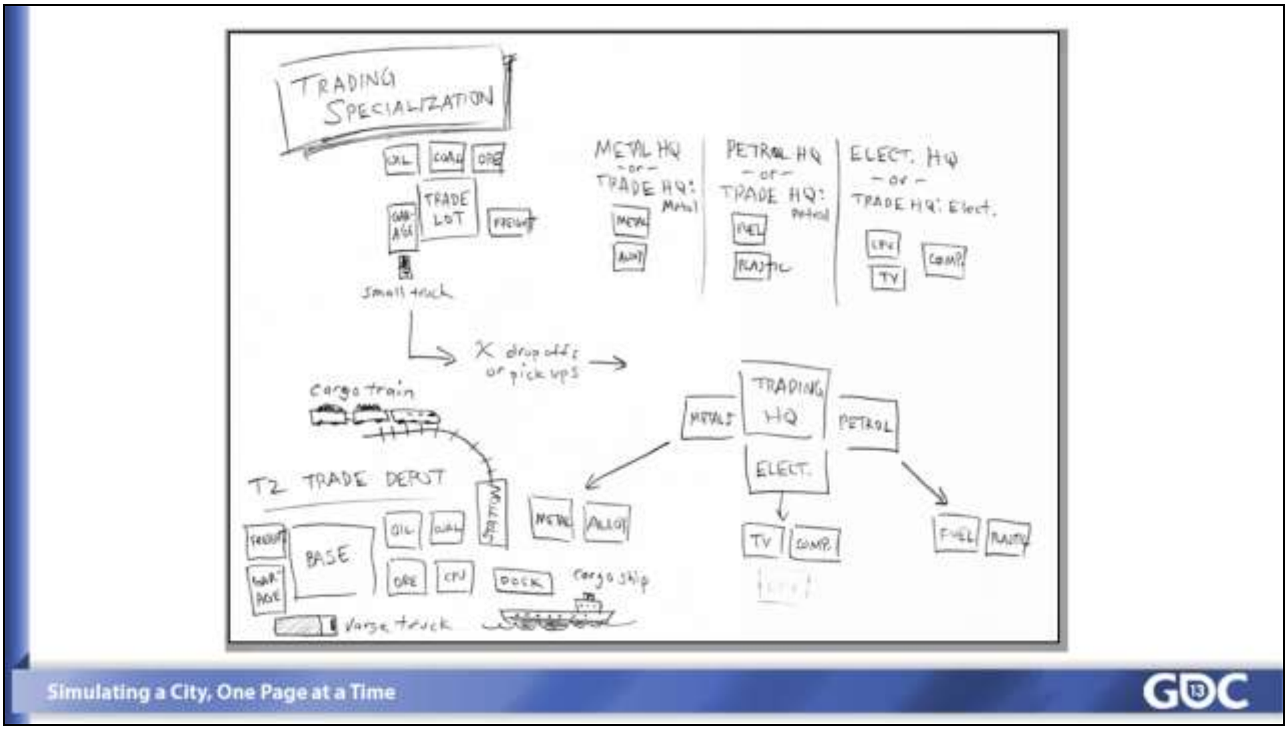
Simulating a City, One Page at a Time

GDC

Electronics Specialization

I showed you this design earlier and mentioned it was crude in comparison to the diagrams with isometric buildings. But later on the drawings didn't even look this good…



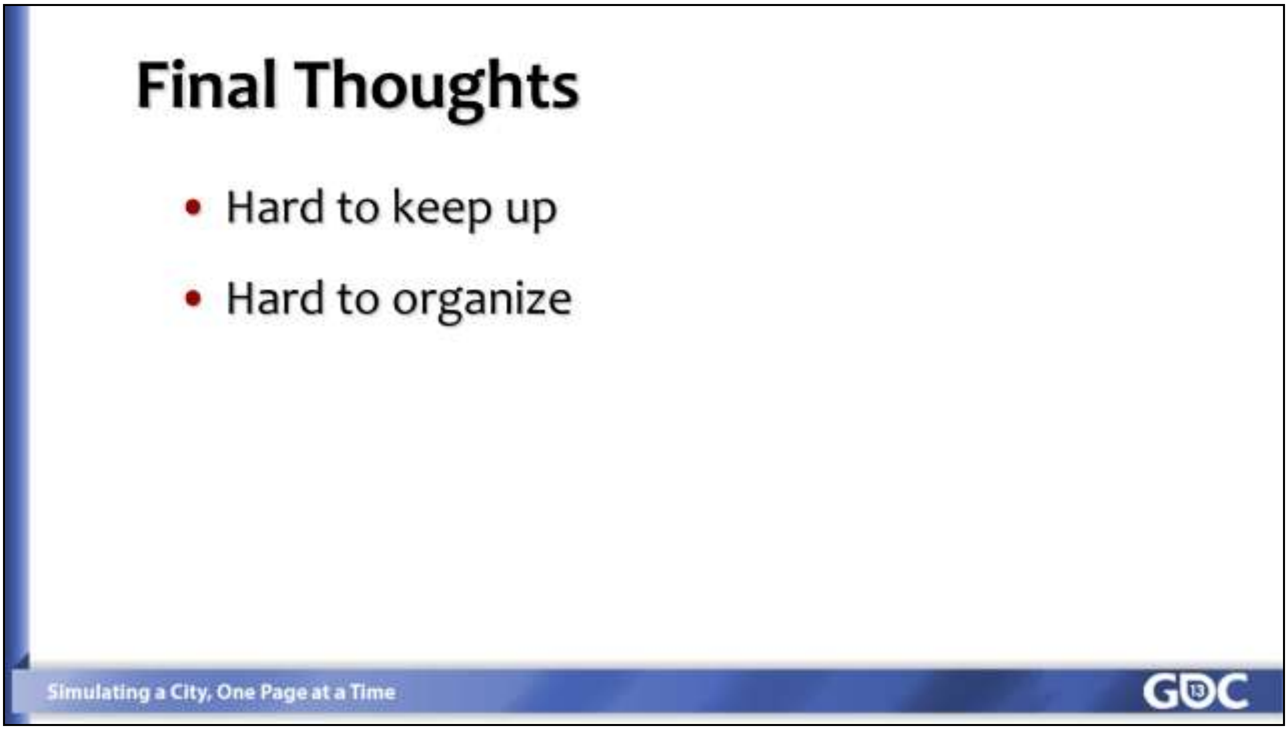
Simulating a City, One Page at a Time

GDC

Trading Specialization

Near the end of the project some of the documents started looking like this. I hoped that I would have spare time to clean up these sketches, but I never got around to it. Fortunately, no one seemed to mind (or notice, since everyone on the team was scrambling and distracted by that time).

It's an obvious statement, but I recommend doing as much as possible in preproduction. Build up a library of icons and clipart that you can quickly reuse so you aren't always starting from scratch. And don't get hung up with the surface. As long as the core idea is sound then the design will still be of use.



Final Thoughts

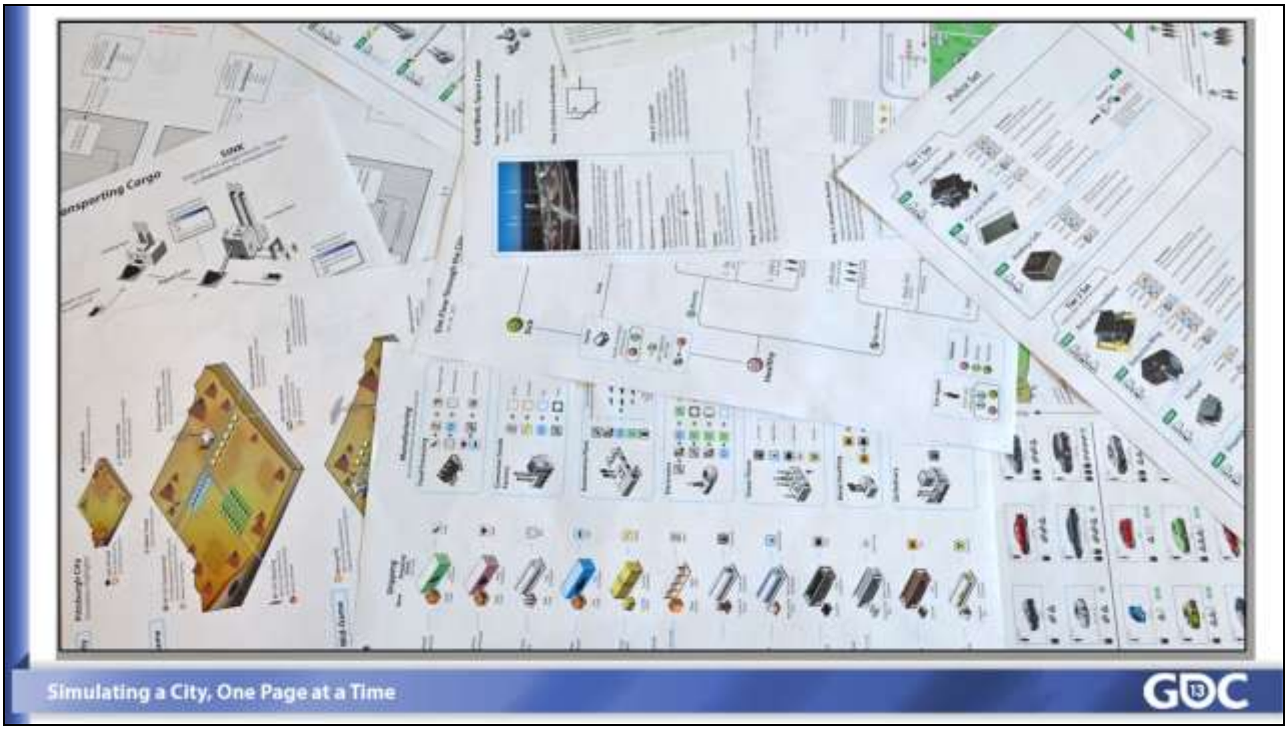
- Hard to keep up
- Hard to organize

Simulating a City, One Page at a Time

GDC 13

Final Thoughts

I made so many of these one-page designs that it was hard to keep them organized.

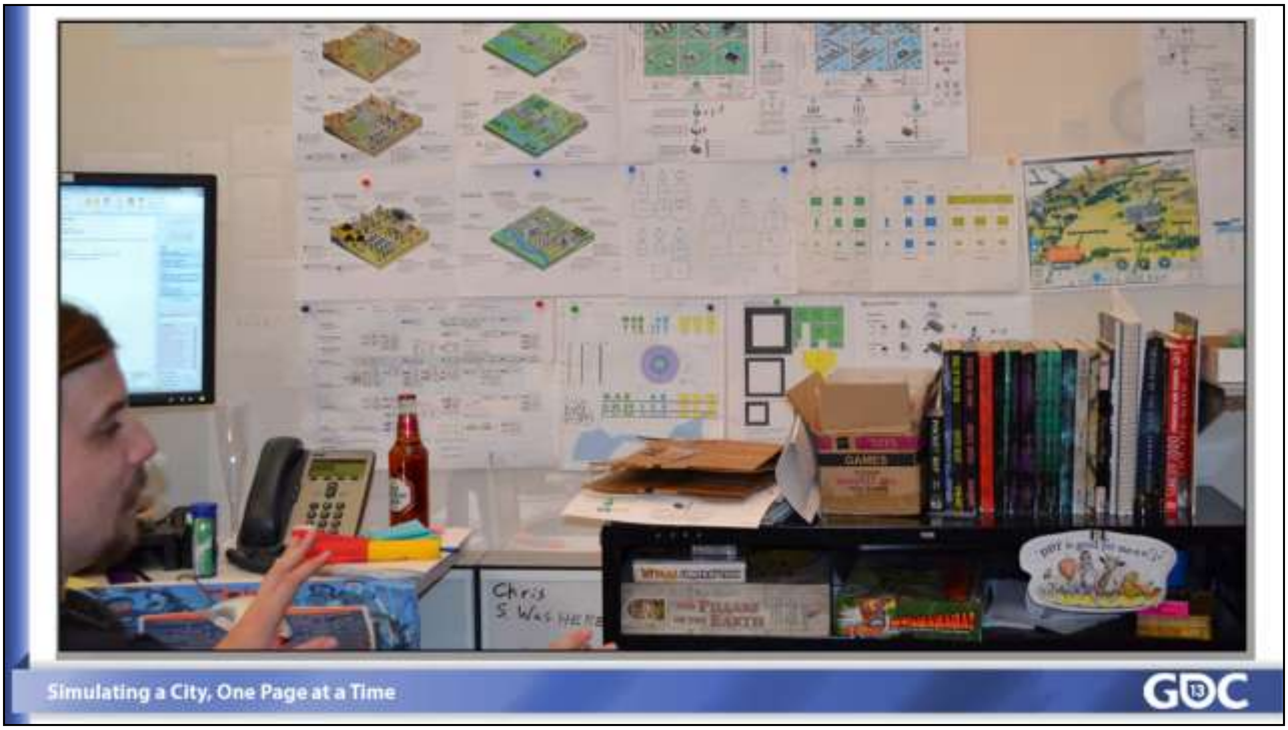


Simulating a City, One Page at a Time

GDC 13

My Desk

They were all piled up on my desk and I would have to dig through the stack to find the one I wanted. Often it was faster for me to load it up into Illustrator and print a new copy then it was for me to find the most recent version.



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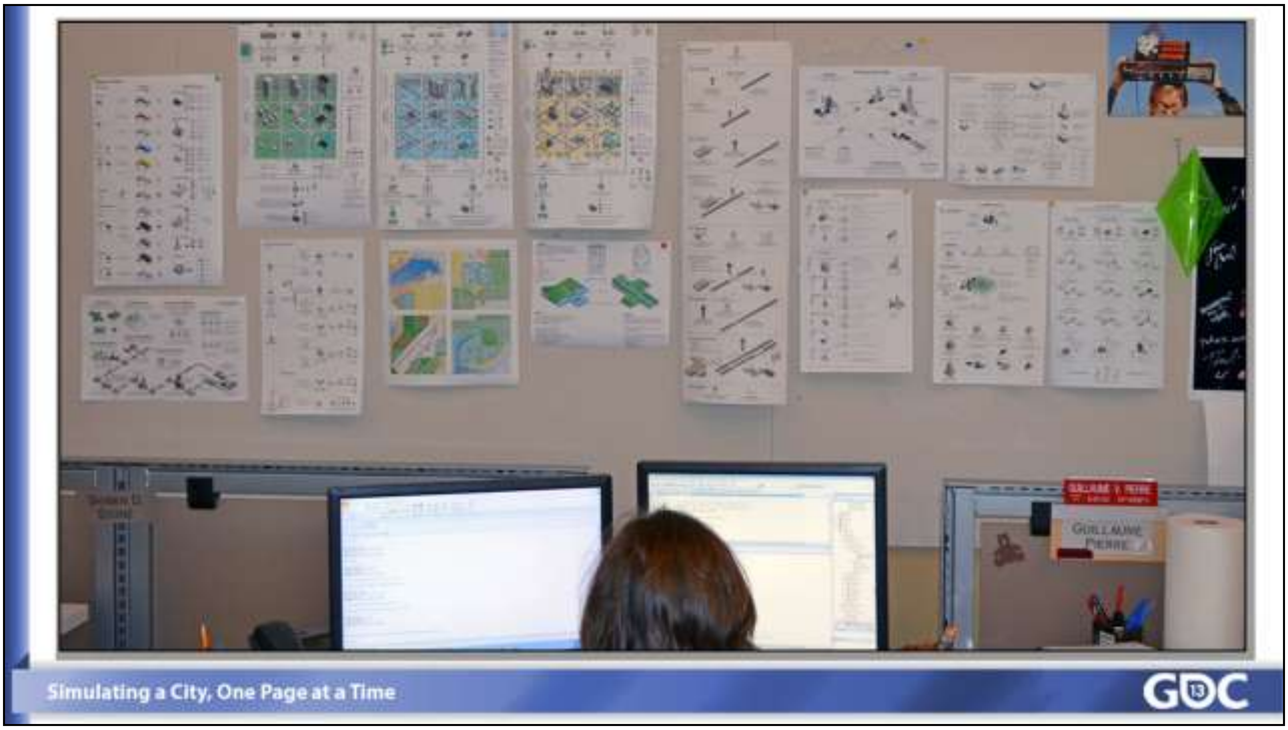
GDC

One-Wall Design Docs

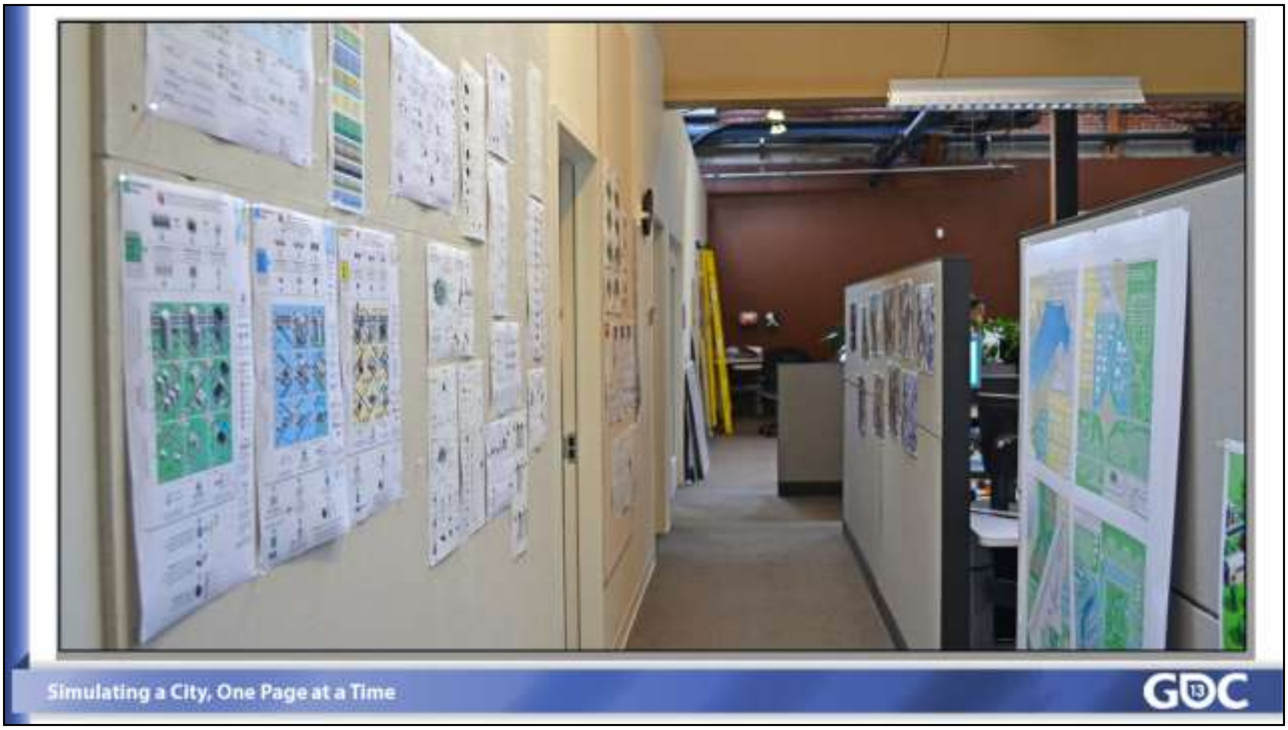
It makes a lot of sense to hang them up on the wall where you can find a particular design easily. Essentially, at this point I was no longer making one-page designs, but what I started calling “one-wall” designs. (This is Chris Schmidt’s wall. He was in charge of tuning and needed to refer to these designs often.)



Simulating a City, One Page at a Time

One-Wall Design Docs

Eventually the designs started spreading throughout the entire design area until we ran out of wall space. (This is Ross Treyz’s wall. He was also responsible for tuning.)

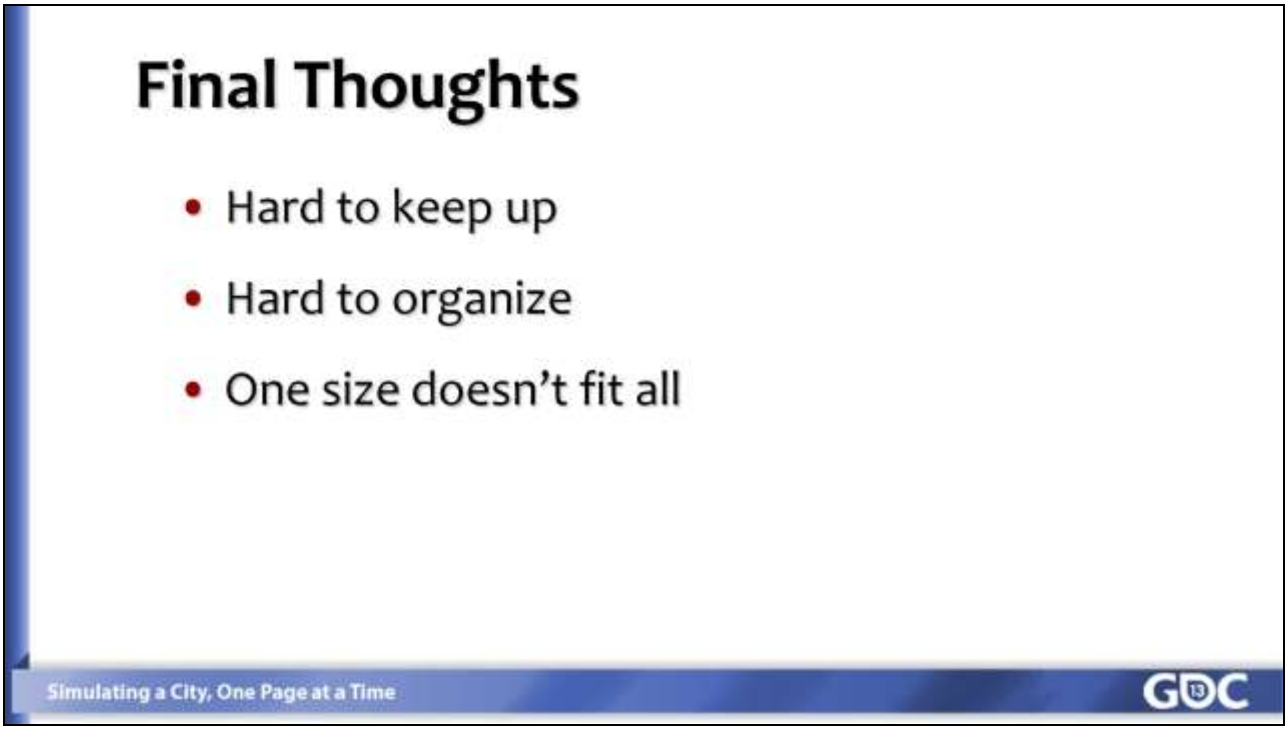


Simulating a City, One Page at a Time

One-Hall Design Docs

Eventually I ended up taking over a main hallway. I call these “one-hall” designs.

I don’t have a picture of it, but for a while I filled up the walls of an entire conference room. I called it the “Design Gallery”. I would walk members of the press and new employees around the room talking about the game in a manner similar to the one I just used in this talk.



Final Thoughts

- Hard to keep up
- Hard to organize
- One size doesn't fit all

Simulating a City, One Page at a Time

GDC

Final Thoughts

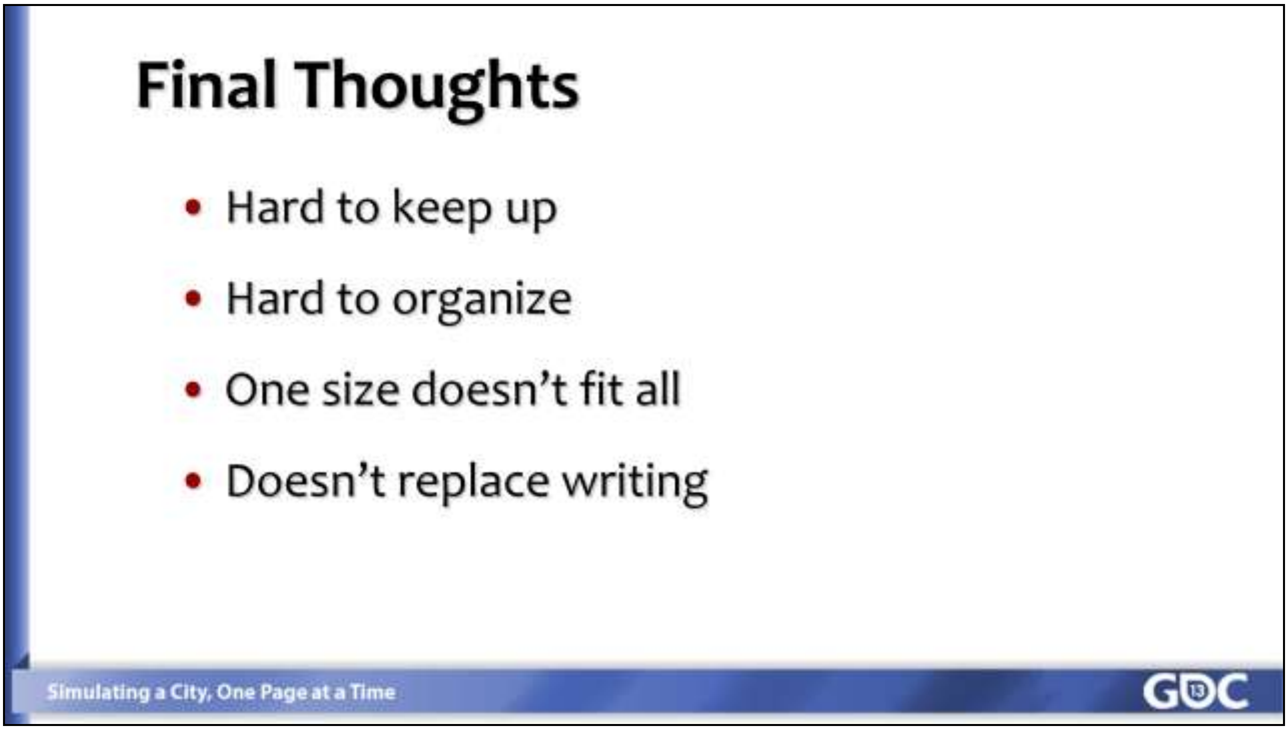
Every document doesn't need to be suited to everyone on the team. Think carefully about the intended audience. An exec is going to prefer high-level concepts while a programmer will need the details.

And taking this idea more literally, don't think that every design you make has to be printed out on as a giant poster and hung up in a main hallway.

Simulating a City, One Page at a Time

Timing Chart

Here’s an example of a timing chart that is the size of a playing card. I referred to it frequently when I needed to convert game time into real time. It was so handy that I made several and handed them out to the tuners, animators, and effects artists. Technically, this isn’t a design document, but it is a way of communicating helpful information to the team, which is part of a designer’s job.



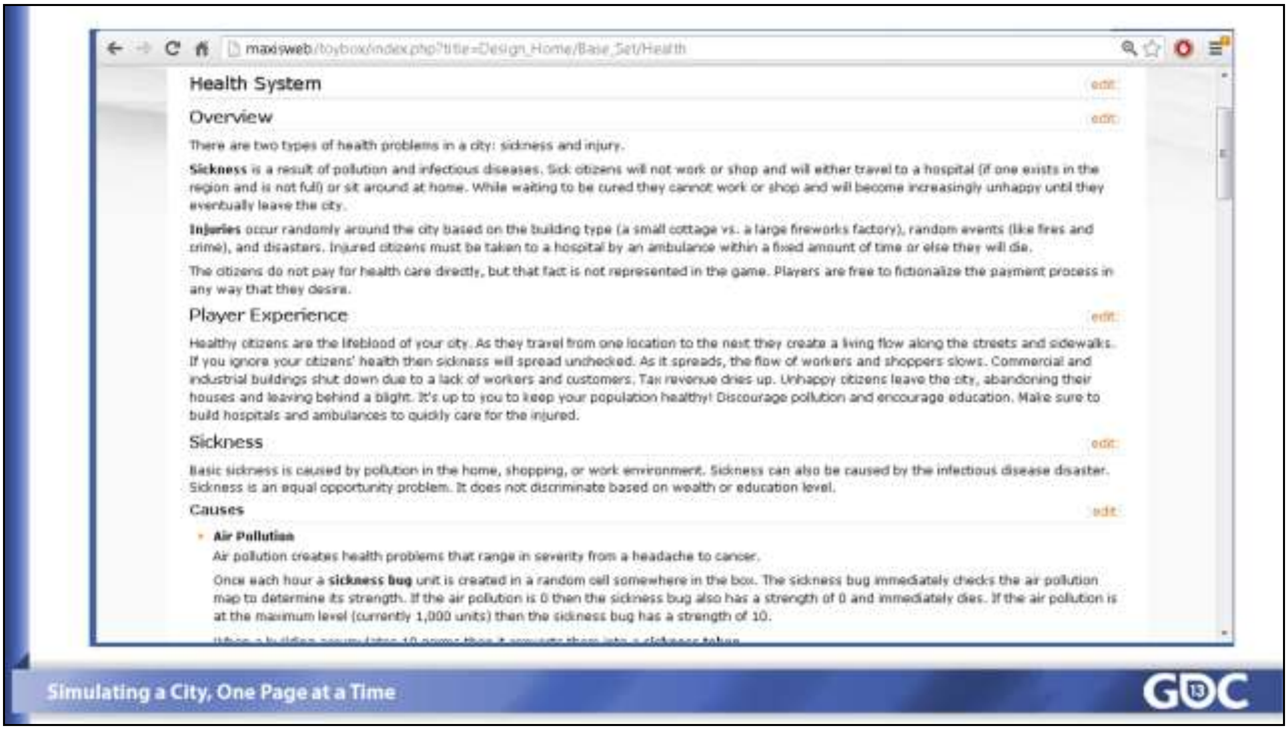
Final Thoughts

- Hard to keep up
- Hard to organize
- One size doesn’t fit all
- Doesn’t replace writing

Simulating a City, One Page at a Time

Final Thoughts

I don’t want you going away from this talk thinking that one-page documents can replace writing. I still used the wiki daily. In many cases, writing can be much faster and precise than an illustration. The problem isn’t the writing—which I find incredibly important part of the design process—but the reading. It is difficult to get people to read a long page filled with text.


maxisweb/toybox/index.php?title=Design_Home/Base_Set/Health
edit
Simulating a City, One Page at a Time
GDC 13

Health System

Overview

There are two types of health problems in a city: sickness and injury.

Sickness is a result of pollution and infectious diseases. Sick citizens will not work or shop and will either travel to a hospital (if one exists in the region and is not full) or sit around at home. While waiting to be cured they cannot work or shop and will become increasingly unhappy until they eventually leave the city.

Injuries occur randomly around the city based on the building type (a small cottage vs. a large fireworks factory), random events (like fires and crime), and disasters. Injured citizens must be taken to a hospital by an ambulance within a fixed amount of time or else they will die.

The citizens do not pay for health care directly, but that fact is not represented in the game. Players are free to fictionalize the payment process in any way that they desire.

Player Experience

Healthy citizens are the lifeblood of your city. As they travel from one location to the next they create a living flow along the streets and sidewalks. If you ignore your citizens' health then sickness will spread unchecked. As it spreads, the flow of workers and shoppers slows. Commercial and industrial buildings shut down due to a lack of workers and customers. Tax revenue dries up. Unhappy citizens leave the city, abandoning their houses and leaving behind a blight. It's up to you to keep your population healthy! Discourage pollution and encourage education. Make sure to build hospitals and ambulances to quickly care for the injured.

Sickness

Basic sickness is caused by pollution in the home, shopping, or work environment. Sickness can also be caused by the infectious disease disaster. Sickness is an equal opportunity problem. It does not discriminate based on wealth or education level.

Causes

- **Air Pollution**

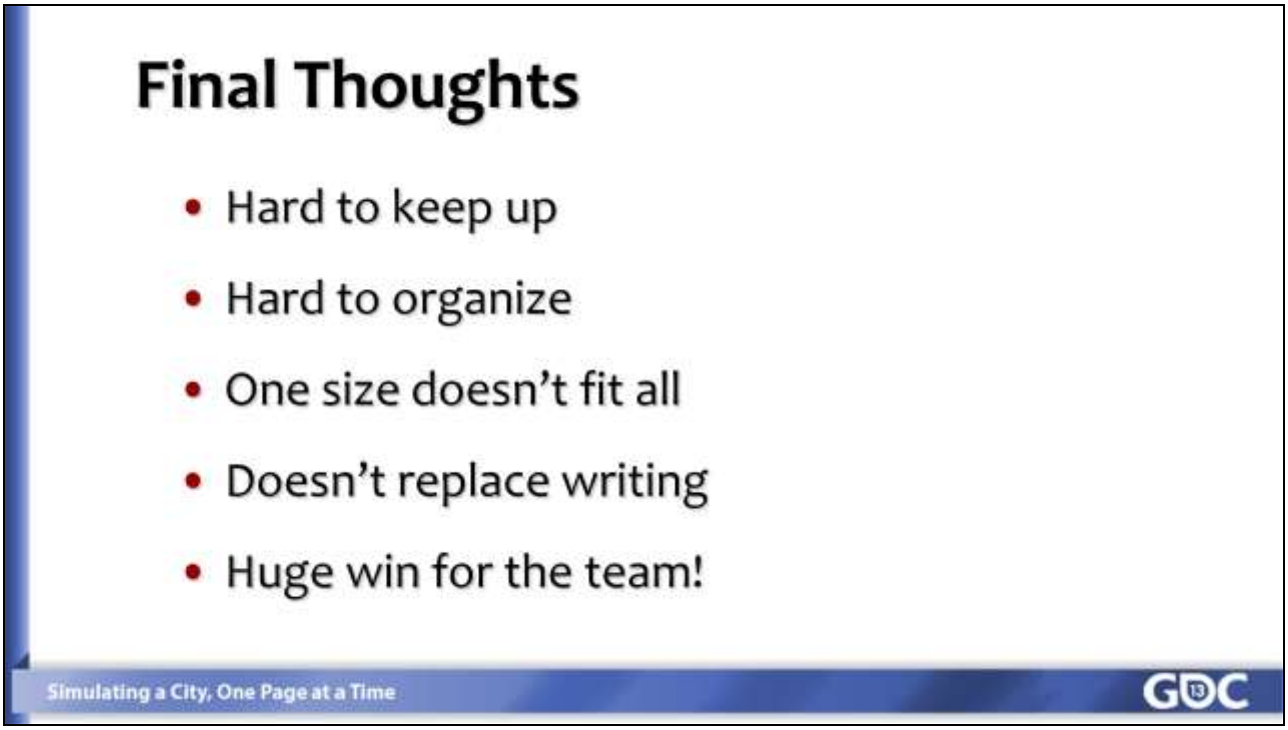
  Air pollution creates health problems that range in severity from a headache to cancer.

  Once each hour a **sickness bug** unit is created in a random cell somewhere in the box. The sickness bug immediately checks the air pollution map to determine its strength. If the air pollution is 0 then the sickness bug also has a strength of 0 and immediately dies. If the air pollution is at the maximum level (currently 1,000 units) then the sickness bug has a strength of 10.

Wiki Page

I usually start off with a wiki page and write down all the important parts in an outline form. Once I have a good understanding of the concepts then I'll convert it into a one-page design that is more suitable for public consumption.

The process is not one-way. The illustration informs the text just as often as the text informs the illustration.



Final Thoughts

- Hard to keep up
- Hard to organize
- One size doesn't fit all
- Doesn't replace writing
- Huge win for the team!

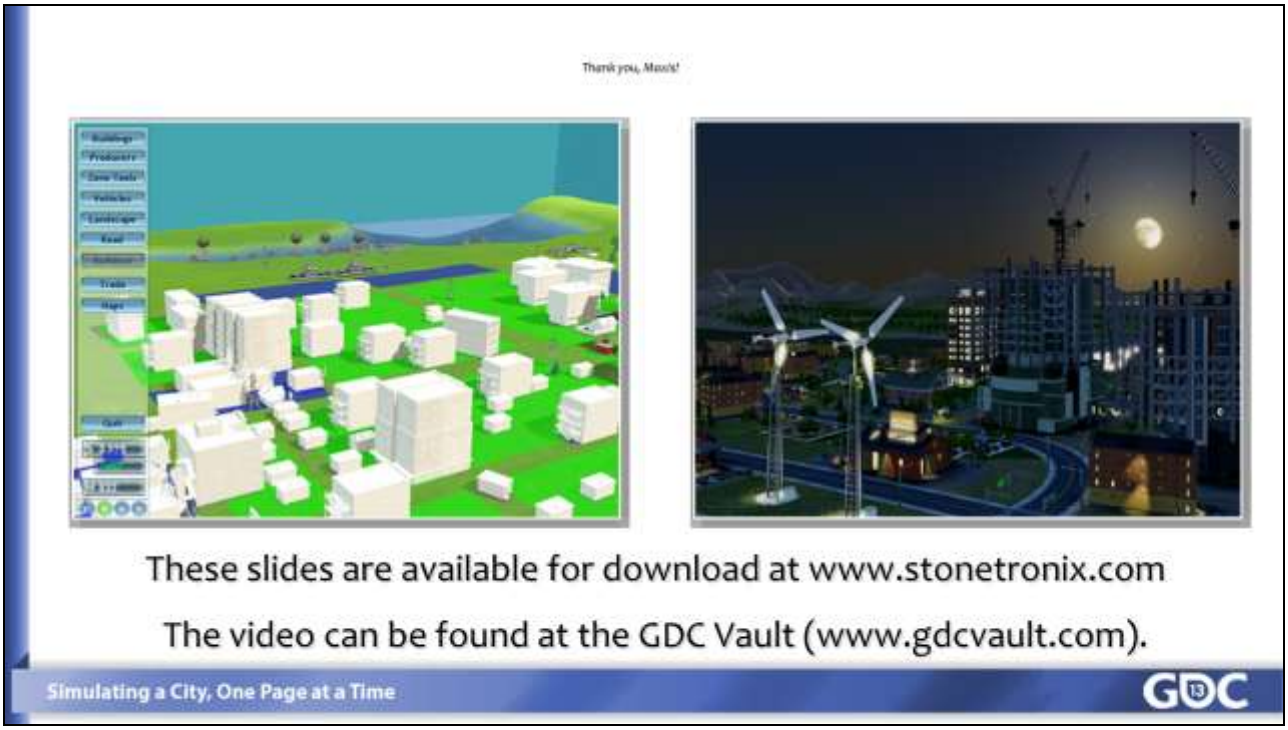
Simulating a City, One Page at a Time

Final Thoughts

So is all the effort worth it? Yes! The act of creating a one-page design forces you to thoroughly understand the design. And once a design is easy to understand then the dev team members (and ultimately, your players) benefit greatly.

Consider that this presentation was about an hour long and you now know, at least at a surface level, all the main features of SimCity. Most of our new hires received a similar lecture from me.

Compare that to an alternative process: the Lead Designer tells a new employee, “Sit down and read this wiki. When you are finished let me know if you have any questions.”



Thank you, Maxis!

These slides are available for download at www.stonetronix.com

The video can be found at the GDC Vault (www.gdcvault.com).

Simulating a City, One Page at a Time

Thank You

Even though I've been showing you my design work, I want to make sure that none of you go away from the talk thinking that I made SimCity. This was a huge team effort by hundreds of people. As a designer, most of my work is done when I can test the systems in a whitebox version of the game (similar to the early prototype you see on the left). Taking it to its final look and feel takes many talented artists, engineers, animators, audio and sound technicians, and an army of testers.

[Q and A, if time remains]