Learning in MarketPlace:
Economic Objects to Think With and Talk About

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Abstract

In recent years, educators have recognized that simulation environments offer rich learning possibilities. For most people, however, there are two kinds of simulations—those with transparent models that are trivial and those with opaque models that are interesting. The big question in research on simulations and learning is how to help people to add a third kind—simulations with models that start simple and transparent but that develop in complexity in step with the user's ability to understand them.

One strategy for creating such simulations is to have people build them. For people who find programming accessible, systems such as StarLogo have demonstrated that having students construct simulations is a viable strategy for creating simulations of the third kind.

MarketPlace, an Internet-accessible environment for the play and discussion multiperson market simulation games, takes a different, albeit potentially synergistic approach. MarketPlace takes advantage of the presence of multiple humans to ease the representation of complex dynamical social situations. Much of the "model" is moved into the realm of human interaction and discussion. The complexity of the system that is being simulated increases in step with the sophistication of the participants.

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Contents

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This work is dedicated to my family—Dan, Margarete, Alex, Rima, Lina, Saribek and Richard. My interest in learning I got from their example. My interest in policy I got from all those endless political arguments around the dinner table.

Introduction

"For better or worse, simulation is no mere fad. Indeed, to think of simulation games as mere entertainment or even as teaching tools is to underestimate them. They represent a major addition to the intellectual repertoire that will increasingly shape how we communicate ideas and think through problems. The advent of this new medium has escaped the attention of cultural critics because it has come in the form of children's games. But the computer simulation game is an art form; when combined with three-dimensional graphics and sound, it is an extraordinarily powerful one. We shall be working and thinking in SimCity for a long time." (Starr, 1994)

In recent years, educators have recognized that simulation environments offer rich learning possibilities. Simulation environments support a critical strategy for understanding our rich and complex world—making evocative simplifications or models of aspects of that world. For most people, however, there are two kinds of simulations—those with transparent models that are trivial and those with opaque models that are interesting. Most high school students, for example, would probably see the behavior of an elastic ball in a box model that was presented to them as trivial and transparently connected to the rules. By contrast, the same students would likely have a hard time figuring out what the model generating the interesting behavior of the hit simulation toy SimCity was at all. The big question in research on simulations and learning is how to help people to add a third kind—simulations with models that start simple and transparent but that develop in complexity in step with the user's ability to understand them.

One strategy for creating such simulations is to have people build them. For people who find programming accessible, systems such as StarLogo (Resnick 1994), Logo (Papert 1980), and Stella (Richmond and Peterson 1992;

Mandinach and Cline 1994) have demonstrated that having students construct simulations is a viable strategy for creating simulations of the third kind.

MarketPlace, an Internet-accessible environment for the play and discussion of multiperson market simulation games, takes a different, albeit potentially synergistic approach. MarketPlace takes advantage of the presence of multiple humans to ease the representation of complex dynamical social situations. Much of the "model" is moved into the realm of human interaction and discussion. What the system is a simulation **of** changes as the understanding of the participants changes their behavior.

The formal rules themselves are quite simple and can be quickly explained. When human players are added to the mix, however, the resulting market behavior is quite complex. This behavior is presented in real time through an interface that helps users to track the state of the system and the actions of the other players.

To learn about the model, users need to make connections between the rules and what happens in the game. MarketPlace aids this effort by showing how particular surface behaviors connect to specific rules in the model.

MarketPlace thus provides a new way for people to explore ideas about market mechanisms. While market mechanisms underlie a wide variety of phenomena in the modern world, people tend to have great difficulty understanding the limitations and possibilities of market ideas. By embedding its multi-person simulations in a discussion environment,

MarketPlace helps users to think about markets in new ways.

Overview

This document is divided into several sections. The second section, "MarketPlace's Place," discusses the strategy behind the MarketPlace design. The third section, "The MarketPlace System," describes the MarketPlace program from the user's perspective. The next section, "Learning from the Design Experience," compares MarketPlace with several games that have similar goals, and talks about the tactics behind the MarketPlace design. "Learning from Using MarketPlace" recounts the experience of the pilot study and discusses economic ideas that MarketPlace can be used to illustrate. Finally, the "Future Directions" section points toward work yet to be done.

MarketPlace's Place

Constructionist Inspirations

It is easy enough to formulate simple catchy versions of the idea of constructionism; for example, thinking of it as "learning-by-making." One purpose of this introductory chapter is to orient the reader toward using the diversity in the volume to elaborate—to construct—a sense of constructionism much richer and more multifaceted, and very much deeper in its implications, than could be conveyed by any such formula.

My little play on the words construct and constructionism already hints at two of these multiple facets—one seemingly "serious" and one seemingly "playful." The serious facet will be familiar to psychologists as a tenet of the kindred, but less specific, family of psychological theories that call themselves constructivist. Constructionism—the N word as opposed to the V word—shares constructivism's connotation of learning as "building knowledge structures" irrespective of the circumstances of the learning. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe. And this in turn implies a ramified research program which is the real subject of this introduction and of the volume itself. But in saying all this I must be careful not to transgress the basic tenet shared by the V and the N forms: If one eschews pipeline models of transmitting knowledge in talking among ourselves as well as in theorizing about classrooms, then one must expect that I will not be able to *tell you* my idea of constructionism. Doing so is bound to trivialize it. Instead, I must confine myself to engage you in experiences (including verbal ones) liable to encourage your own personal construction of something in some sense like it. Only in this way will there be something rich enough in your mind to be worth talking about. But if I am being really serious about this, I have to ask (and this will quickly lead us into really deep psychological and epistemological waters) what reasons I have to suppose that you will be willing to do this and that if you did construct your own constructionism that it would have any resemblance to mine?

I find an interesting toe-hold for the problem in what I call the playful facet—the element of tease inherent in the idea that it would be particularly oxymoronic to convey the idea of constructionism through a definition since, after all, constructionism boils down to demanding everything be understood by being constructed. The joke is relevant to the problem, for the more we share the less improbable it is that our self-constructed constructions should converge. (Papert 1991b)

Keeping this in mind, let's look at some examples of environments where children build to understand. What could you learn by playing with these?

Evocative Objects: Logo, StarLogo, Stella
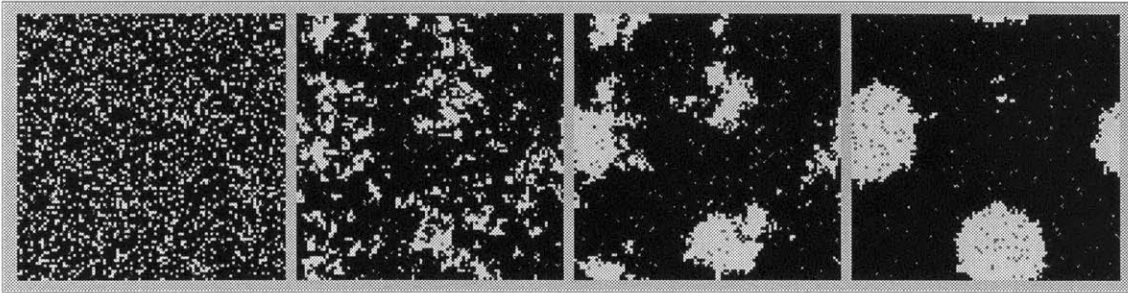
**StarLogo termites gathering wood chips into ever more concentrated piles**

StarLogo (Resnick, 1994) is a language based on the childrens' programming language Logo. Logo, which was based on the procedural language Lisp, adds a the idea of an object called a turtle that the user can command about the screen. StarLogo goes one step further, allowing the user to command thousands of turtles moving on a cellular-automata-like background of patches. StarLogo is useful for studying the emergent behavior produced by many entities following simple rules. Ant colonies, traffic jams, forest fires, and bird flocks are among the systems that have been explored using StarLogo.

Stella is a tool for doing systems dynamics modeling (Forrester, 1968). Systems dynamics models are based upon non-linear or linear differential equations. Feedback is central to many system dynamics models and supplies much of their ability to surprise their users. Stella is a natural tool for the creation of models that show aggregate behavior. The classic predator-prey population oscillation model is an example of the sort of dynamic Stella is often used to present.

Crystallizing Context: CSILE

Experts, for the most part, don't build their knowledge in a vacuum. Scientists publish, lawyers argue cases and go to lunch and engineers e-mail each other constantly. Why should students be mired in a model that doesn't include presentation? CSILE (for Computer Supported Intentional Learning Environment) builds upon the scientific model of publication. Students write notes (which can consist of various bits of media) and commentary on other students' notes. Notes can be put forth as candidates for publication which causes them to be submitted for review (by other students with a final clearance from the teacher.) Notes which survive review are marked as published and can be selectively searched against. While this process may seem mechanism-heavy, the creators of the system argue that the process is an important subject in itself.

Discussing Dynamics: MediaFusion
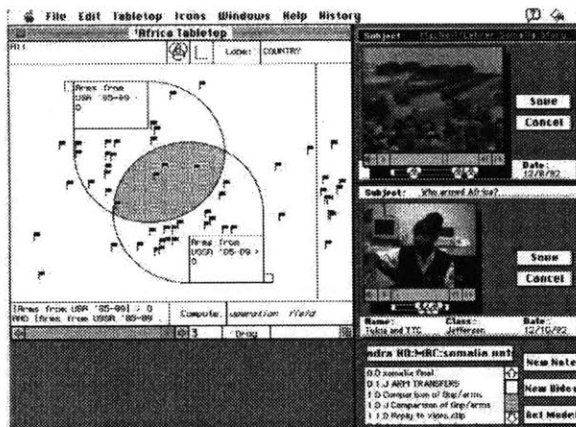
MediaFusion Screen

MediaFusion (Borovoy, Cooper, and Bellamy, 1993) is an application that allows video to be annotated for the purpose of supporting discussion on

some topic. Annotations can take the form of other pieces of video or documents from a chart-making application which can be manipulated in place.

MediaFusion is of interest because of the way it lets students refer to dynamic media. Through the simple mechanism of having annotations show up on the scroll bar, MediaFusion lets students comment of pieces on video. The combination of source video and annotations can then be watched and further annotated by other students. MediaFusion thus brings video out of the realm of things that are passively watched—making it part of a conversation between students.

The Market as an Organizing Principle

Around the world, countries are increasing their reliance on market mechanisms. Countries that once depended on central planning are in the throes of transition to market economies. Citizens in these countries have an obvious need to learn and understand the market. Even in countries such as the US, with its long history of market economics, the role of market mechanisms continues to expand. Whether the topic is health care, the National Information Infrastructure, or physical highways, market mechanisms are assumed to have a role to play. Market ideas also find uses beyond economics in areas such as evolution and ecology. Markets are studied as prime examples of adaptive systems.

People, however, find understanding market concepts difficult. Intelligently applying market mechanisms requires understanding of at least two

kinds—an understanding of how markets work and understanding of where they break down.

Computers have played a major role in changing the way economists themselves think about how markets work. Sophisticated formalisms supported by computer modeling tools such as Stella have enabled economists to move away from the equilibrium, perfect competition, ahistorical models of classical economics (Radzicki and Sterman 1994). Many of these changes, such as the recognition of the role of positive feedback, have occurred only recently (Arthur 1990; Krugman 1991).

More important for our purposes, computers make it possible for non-economists to create, manipulate and take apart markets. Constructionism (Papert 1991b) suggests that while everyone may participate in markets, those who "build" them are most likely to deeply understand them. StarLogo, for example, has been used to simulate decentralized adaptive systems like markets. By involving "real people" as part of the model, MarketPlace facilitates modeling aspects of market function that involve decision making.

Why Modeling and Simulation?

What do modeling and simulation offer for the learner? For the purposes of MarketPlace, the most important benefits are the following:

• Simulation models (microworlds) turn abstract descriptions of rules into concrete, manipulable manifestations of them (Papert, 1980).

- They provide a compelling context for inquiry into a content domain (Confrey, 1995).

- They serve as conversation pieces to focus discussions (Senge, 1990).

One way of defining an expert is someone who can mentally turn a compact formal description of some dynamic into a fully imagined experience of some phenomenon (with luck, the one implied by the formal description.) Simulations are concrete embodiments of this process. They take a set of formal rules and turn them into experiences. The hope is that by seeing the process, learners will come to be able to do it themselves or that the simulation will at least allow the learner to grasp some of the implications of the formal rules previously only accessible to the expert.

The reverse process is also important. Finding compact explanatory mechanisms that underlie a range of phenomena makes the world a more comprehensible place (diSessa,1988). Simulations can help users realize the diversity of the surface manifestations that a small set of rules can generate. (StarLogo is a good example of a toolkit for generating richly interesting behavior from small rule sets.)

Learners are more likely to go to the trouble of trying to make connections if they find the experience of working with the simulation rewarding. Computer simulations can present information in many forms, allowing learners to bring to bear varied learning styles to the problems presented. A well-designed simulation environment can exploit synergies between the various forms allowing each to perform tasks they are well suited for. For

example, rather than trying to present some phenomenon that changes in time via static media, a computer simulation can show it directly as it changes and then in static and dynamic retrospectives.

Finally, simulations can serve as focus points for communities of inquiry. They provide concrete instantiations of formal explanations that may be easier to appeal to than the formal explanations themselves. Senge gives the example of corporate decision makers who lack ways of representing their decision process and have to rely on telling others that their policy preferences simply feel right. Giving them modeling tools with which to represent their reasoning enables more substantive discussions of why they prefer what they do.

Glass Box Modeling

"When policymakers depend on simulations, they cede power to those who define the models. Washington is already Sim city." (Starr, 1994)

A simulation that displays its behavior, but not the model that produces that behavior, makes it difficult for a player to see connections between model and behavior. Will Wright has said that he learned far more building the popular game SimCity than anyone will ever learn playing it. Design is a particularly powerful learning experience because of the way that experience and reflection are interwoven. Black box simulations such as SimCity are the norm not because their creators don't want users to have a more constructive role, but because current design knowledge doesn't extend far enough to provide one. To escape the black-box problem, MarketPlace uses the tactic of

making its simulations multiplayer.

Through a few simple rules which can be explained to players within a few hours (by having them play with the system), MarketPlace supports exploration of classical market situations with perfect information, no externalities, and diminishing returns. However, MarketPlace also provides a place to explore markets functioning far from optimality—driven there by monopoly power, information gaps or positive feedback loops.

MarketPlace underwent a number of trials, with participants of varied backgrounds. As the players increased the sophistication with which they played, they enriched the way they thought about market phenomenon—and the variety of market phenomena demonstrated by the simulation.

It's especially important for simulations that purport to model social systems to be open to criticism. MarketPlace attempts to support players in their critical stance in two ways. Firstly, MarketPlace's transparency helps users feel "qualified" to criticize the system. The rules are simple enough that users can (and do) suggest alternatives. (Ideally, of course, they could then try out their alternate versions.) Secondly, players in MarketPlace provide almost all the agency demonstrated in the game.[1] There aren't hidden computer "players" making decisions for opaque reasons. Things happen because a real person does something—a decision that can be questioned.

Multiplayer Simulations—System Dynamics in a Social Context

How does making MarketPlace multiplayer make it possible to create

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[1] With the notable exception of MarketPlace's Law feature.

interesting social simulations with just a few simple rules? In short, the players fill in for the parts of the system that are more difficult to model formally. In the case of market simulations, it's natural to use them to fill in for people, firms, or institutions. For instance, adding humans makes it easy to have simulations featuring complex and idiosyncratic risk/reward tradeoffs without resorting to simple fixed heuristics or implementing complex models of behavior. The formally stated systems dynamics model (Forrester, 1968) can then be used to do what it does best—describe simple structures such as positive feedback loops. The humans perform the decision making and then ask each other "Why did you do that?"—valuable opportunities for reflection. Much of the model ends up being represented in the discussion that occurs during and after play. This informal representation lacks much of the theoretical power of a formal representation—but a formal model of the human decision making would be so complex that it would be inaccessible to the audience that MarketPlace is aimed at. A formal model that people don't understand is worse than no model at all.

This ability to get extra expressive mileage out of simple models has the potential to ease the user-programming problem in future versions of social simulation environments. It's simpler to design user-programming environments to enable the creation of simpler things. In MarketPlace it allows a simple, easily comprehended, formal model to generate a wide array of interesting market behaviors.

An example adapted from (Krugman 1991) demonstrates the economically interesting behavior that a combination of people and a simple formal structure can simulate that would otherwise require a complex formal

structure. Imagine that we have a number of players interested in building factories that produce machinery. Assume that factories that are adjacent to other factories are more productive as a function of the number of nearby factories. Assume that players know this and that they can place factories anywhere on the MarketPlace map (which starts out empty).

The players whose cluster of factories ends the biggest will be at a substantial advantage, while the value of the other players' initial investment will fall. A player who manages to convince other players that her site is likely to end up the big one might well make that a self-fulfilling prophecy. A site that has the most factories built on it the first turn might panic another player to either build production at that site or change to producing a different commodity. The players' models of the world come into play in a way that is very hard to make real in single-player environments. For example, if the players have recently been exposed to game theory, they might assume that all the other players are going to make this move and therefore all rush to the big site on the second turn.

Thus, a group of players playing both within and with the structure defined by a simple formal model can have experiences which capture the dynamics of debates about trade and subsidy, the influence of public perceptions and moods on the economy, and the very different effects of positive and negative feedback. Formal models describing the behavior of the human players would necessarily be large and therefore inaccessible to most people. The reasons for the decisions made by the human participants are at least potentially accessible and can lead to a wide array of discoveries about the above topics. These discoveries, however, only come through reflection about the

experiences gained in using the system.

A Context for Reflection

The most important learning tends to occur after the game playing is over (Lederman 1992), when participants construct understanding by reflecting on their experiences. This reflection may be an individual act, but as is pointed out in (Bereiter and Scardamalia 1993) reflection is often a social act or directed at a social purpose. Researchers may work late nights alone, but it's with an eye to publishing and speaking at conferences or having people read their theses.

Interesting gains have been made in the effort to apply the lessons from the field of computer supported cooperative work to the classroom (Scardamalia and Bereiter 1994). CSILE (Computer Supported Intentional Learning Environment), for instance, provides logistical support to reinvent the classroom along the lines of a research team. Students write down their observations, and participate in peer review of their fellow students' contributions.

MarketPlace takes a different approach. MarketPlace activities are games; they provide a focus for the discussions. The social dynamics of the game lead naturally into discussions of the economic phenomena that drive those dynamics. Producer and consumer, polluter and anti-pollution crusader, each role provides a valuable perspective from which to begin to look at the complex world of economics.

Aren't there disadvantages to casting simulations as competitive games? Doesn't the game form constrain exploration? Don't the needs of the game form often distort the expression of the model? Yes, but the same distortions and constraints that make games problematic destinations make them good introductions to a complicated domain.

The key in avoiding the pitfalls of constraint and distortion lies in seeing the game as part of a larger system of approaches for learning about markets. MarketPlace's job is to provide a compelling presentation of important market concepts. The discussions that happen around the system and the players ability to act upon their interest are critical adjuncts to this simulation environment. Players need to be able to enter fully into their roles and then pull back to understand their experiences in context.

A MUD with a Model

MUD's (Multi-User Dungeons) are Internet-accessible computer environments that allow players to take on a role in a text-based virtual world. MUD's present their world as a collection of connected "rooms" each of which may contain characters controlled by other player or simulated objects. Users manipulate the world and send messages by typing commands. MUD's are famous for their complex social dynamics and offer interesting examples of user-programming.

MarketPlace is intended to be the first in a series of social virtual worlds where simulations focus the social interaction around a theme. In the case of MarketPlace, the system support for social interaction is rudimentary (although still heavily used in actual games.)

The MarketPlace System

In MarketPlace, players colonize a distant world along with five to nine other players. They build factories, make food, energy or machinery, sell these commodities to each other and then use the commodities they've made or purchased to make more.

Scoring

Players score two ways. They score by having money and by having commodities. Each dollar is worth one point. Each unit of of a commodity is worth 5 points. Commodities, however, decay over time—so you can't simply sit on your pile.

Playing

MarketPlace is played in a series of turns. Each turn is broken into two phases—configuration and auction.

• Players develop plots of land by placing factories upon them. Their factories produce food, energy, or machinery units, consuming units of the other two commodities in doing so. (For example, a factory producing food eats up energy and machinery.)

• They buy and sell commodities at auctions.

Next turn they use their purchases to feed factories and produce more commodities.

The Flow of the Game

Develop Land
Reconfigure Factories

Produce Commodities

Buy and Sell
Commodities at
Auction

Use Commodities Bought at
Auction to Feed Factories

Use Demand Information
Gained at Auction to Shape
Factory Configuration
Decisions
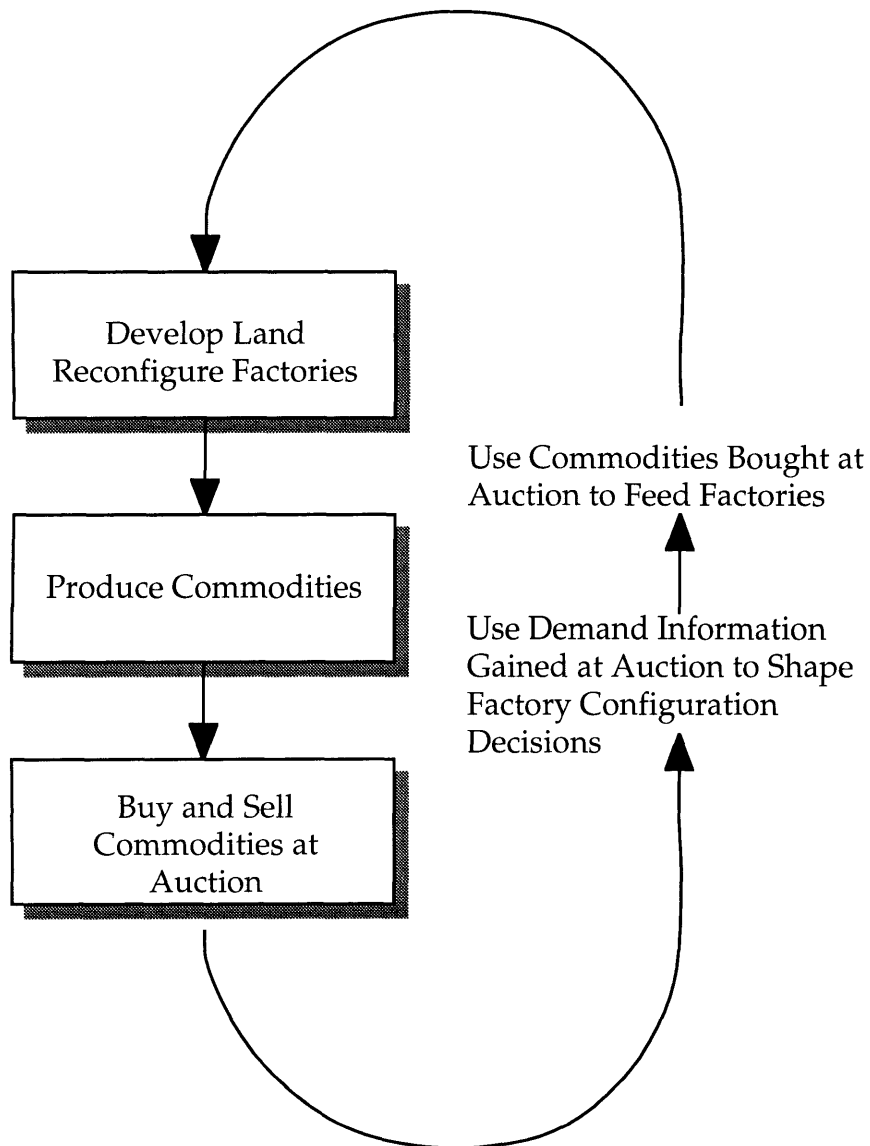
Ending MarketPlace

There is no particular turn at which a MarketPlace game is projected to end,
any more than there is a projected end to most real-world markets. Games
end when the time allotted for play elapses, the colony pollutes itself into
collapse or the system crashes. (One player complained that due to the

possibility of a crash, the game could end at any time. When I explained (tongue-in-cheek) that this helped stop people from taking advantage of the last turn, he exclaimed "Ah, so it **is** a feature.")

Architecture and Implementation

MarketPlace is implemented in two pieces: a client program which presents the MarketPlace world to players on their personal computers and a server program which acts as a point of coordination. Players view and manipulate the world through the client, which sends the resulting commands to the server. The server may then send update commands to the other clients to keep them in sync. For instance, when players build factories their moves are sent to all the client programs so other players can react to the moves. The clients may also forward undo messages that cancel previously sent moves. The server matches up the undo message with the move to be canceled and forwards an appropriate undo message to all of the clients.

Both the client and the server are implemented for the Macintosh upon a beta version of Smalltalk Agents, a flexible object-oriented language and development environment designed to support the rapid prototyping of applications.

The server and clients communicate via TCP/IP. Clients can thus be scattered across any TCP/IP compliant network, the most important example of which being the Internet. MarketPlace implements its own object streaming protocol on top of TCP/IP to facilitate the movement of structured data between the clients and the server.
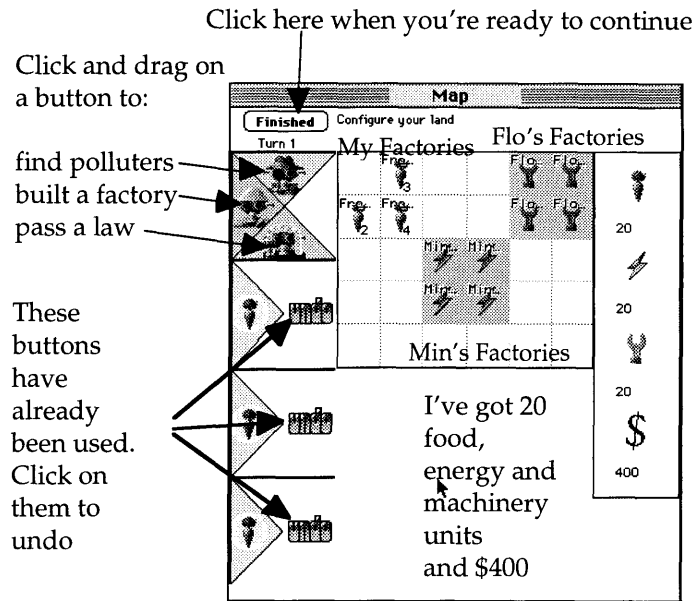
Using the Map

Arranging Your World

The MarketPlace map starts out empty. Players may make four moves during each configuration phase. For the first several turns there is one move you can make - build a factory or change a factory's type.

If there are empty plots of land available, you can pick one and build a new factory on it. You choose what kind (food, energy or machinery) of factory to build. You can also change the kind of existing factories.

The MarketPlace Map

Click here when you're ready to continue

Click and drag on a button to:

find polluters
built a factory
pass a law

These buttons have already been used. Click on them to undo

Map

Finished   Configure your land

Turn 1   My Factories   Flo's Factories

Min's Factories

I've got 20 food, energy and machinery units and $400

20
20
20
400

MarketPlace's world is a featureless rectangular area[2] scaled in size to the number of players. As players place factories, their choices differentiate the locations. The production bonus given to factories surrounded by like factories (see below), encourages clustering. One area becomes the place for food production and another the place for energy generation.

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[2] The area wraps; squares on the right side of the map are adjacent to squares on the left side.

Production Rules

Factory Consumption

Food
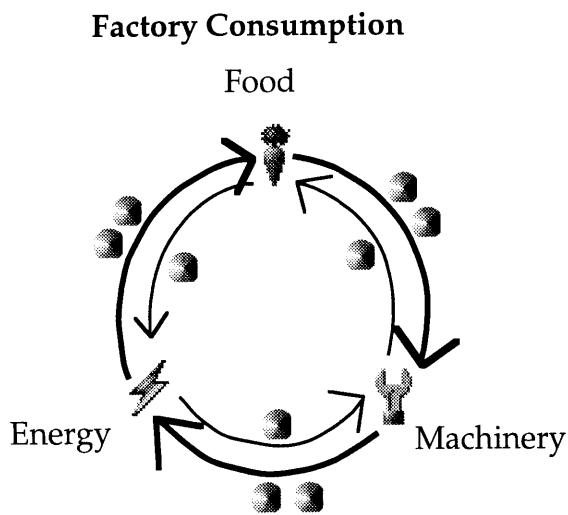
Energy   Machinery

How Much Did They Use?

A factory that makes one commodity requires the other two commodities as inputs. A food factory, for instance, requires two units of energy and one unit of machinery to produce some amount (depending on Economy of Scale, Clustering and land damage - see above) of food.

How Much Did the Factories Make?

How much a food (or energy or machinery) factory produces depends on only three things:

• How many other food factories the player has (Economy of Scale)
• How many food factories the given factory is surrounded by (Clustering)
• Whether the land the factory is on has been damaged by pollution

The economy of scale factor gives players an incentive to specialize. Someone who produces only food will be more efficient than someone who produces all three commodities. The clustering rule makes some land more valuable for producing some commodities than others.

The production rules are simple but have profound effects. Without bonuses for economies of scale and clustering, factories use up more commodities than they put out. To perform well, players must specialize in one or two commodities. The circular nature of consumption, however, means that someone who specializes must purchase large amounts of some other commodity from other players. To do well, therefore, the players must trade.

Readying For Auction
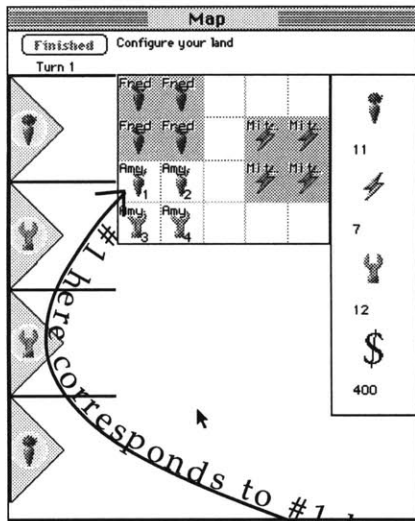
This shows our status going into the first auction round. We're planning to build four more food factories. We've got a surplus of 10 machinery, need 3 more energy units and 1 additional food unit. Accordingly, we're going to put out a bid to buy 1 food at 10, try to buy 3 energy at 10, and sell 10 machinery at 14.

Energy Consumed

Machinery Consumed

Factory ID

Food Produced This Turn

Production Sources Bar

Blue Economy of Scale Bonus
Red Adjacency Bonus
Green Basic Production

The Production Report display shows what the factories did this turn and help the players calculate what they will consume (and ought to therefore buy now in the auction) next turn. By showing why their factories produce as they do, the report helps to open up the model to the user.

Reading the Auction Screen

Sell offer

Price we're offering

Amount we want to **sell**

⟵s⟶

$13

28

Buy offer

Amount we want to **buy**

Price we're offering

3

$8

⟵b⟶

Boycotts - Don't want to buy or sell from/to someone? Clicking on their name cuts them out of your transactions

Auctions

Auction 2 of 4

Names of Players

Our Bids in This Column

Time Left in This Round

Set the number of food units we're buying/selling here

Drag your offers up and down to set the price

How much food/energy/machinery we bought or sold last auction

bought 12   bought 8

Buying and Selling at Auction

Auctions are where you try to buy what you need, and sell your extra commodities. The auction starts with the buy and sell offers you set up before the auction. You can also place new offers to buy and sell. When the clock runs out, everyone's offers are sent to the server, which determines which ones succeed. The highest buyer and lowest seller gets priority.

For example, imagine (see below)
Fred is offering to **sell** 28 machinery at 13,

Mitchel is offering to **buy** 3 machinery at 8,

And Amy is offering to **buy** 16 machinery at 14.

The server would sell 16 of Fred's food to Amy at 13 & 1/2 (halfway between the two prices)
and wouldn't sell any to Mitchel. Note that Mitchel could raise his price in the next auction round, or Fred could lower his and Mitchel would still get the food he wants.
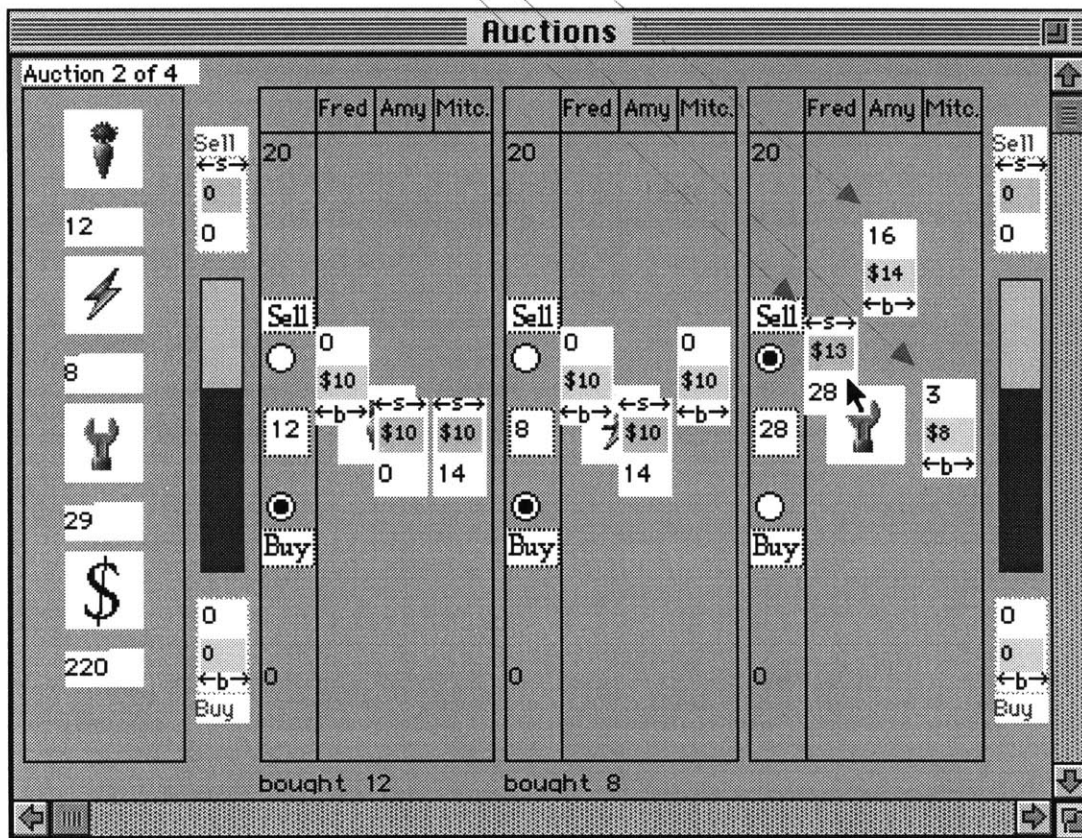
A More Detailed Example

What if the buyers offer to buy more than the sellers have? Is offering a low price always the best strategy? Here's a more complex example that answers the above questions. Remember:

The highest buyer and lowest seller gets priority.

For example, imagine
Fred is offering to **sell** 8 food at 10,
Rick is offering to **sell** 5 food at 12,
Amy is offering to **buy** 5 food at 14,
Mitchel is offering to **buy** 7 food at 13,
Michele is offering to **buy** 6 food at 12,
And Jack is offering to **buy** 4 food at 9 .

The server would sell 5 of Fred's food to Amy at 12 (halfway between the two prices)
would sell 3 (the rest) of Fred's food to Mitchel at 11 & 1/2
would sell 4 of Rick's food to Mitchel at 12 & 1/2
would sell 1 (the rest) of Rick's food to Michele at 12

Note that even though Michele offered a price that's meets both Rick's and Fred's offers, she will only get one unit of food. Note that even though Amy offers a higher price than Mitchel (14 vs. 13), she doesn't end up paying more—because she thus gets first dibs on Fred's cheaper food.

Laws and Boycotts

It's clearly better for the group playing the game as a whole if no one pollutes. Players can pursue both informal and formal agreements not to pollute.

The activity of pollution is invisible until players expend effort to uncover it. Players must spend part of their turn looking for pollution (thus foregoing an opportunity to do personally useful things) in order to detect which other players are polluting. Players who uncover pollution may then make it publicly known. They may try to convince other players not to buy the commodities produced by the offending player—to organize a boycott. Players may also make use of MarketPlace's Law facility.

Laws contain penalties for those caught polluting. Laws are enforced by the game with some level of effectiveness, in exchange for everyone being taxed. Taxes are paid in time, not money. Laws cost more than having the players look for pollution themselves, but give players some assurance that others are both not polluting and helping to police polluters.

A Market Externality: Pollution

Factory Pollution

After the 3rd turn, factories can be built which pollute. Only the owner can see that a factory pollutes, to everyone else it looks normal. Pollution causes land damage to randomly chosen plots of land anywhere on the map (which the polluting party may or may not own.) Over time, the damage caused by pollution is greater than the savings gained by it, but damage and savings may accrue to two different parties....

* Looking to see who is using dirty production processes

While the effects of pollution are visible to land owners, the sources of pollution are hidden until someone looks for them. Looking for pollution gives you a chance of catching polluters and creates a notarized report that you can forward as you see fit. The report omits any pollution you may be producing.

* Make a Law against pollution

Laws can be proposed by any player. Laws, if agreed to by a majority of the players, look for pollution and levy fines if polluters are caught. Once agreed to, Laws function automatically. Laws have a fixed cost of one move per player per turn, however, so they are very expensive.

Laws can also be repealed by a majority vote

Click this checkbox to create a polluting factory

Gray cross-hatching indicates pollution

You can see which of **your** factories pollute, but **other players'** polluting factories appear normal.

Note production drops in these heavily polluted plots

Make a Law against pollution

Click here to propose a new law

Propose Law

● **Make New Law**

Click here to propose a law that takes away the food, energy or machinery that a polluting factory makes.

What kind do you want?

Click here to propose a law that takes away some amount of money for every polluting factory it finds.

○ **Production Loss**   ● **Cash Pe**

Penalty per factory

10

Click here to set the **amount** of money it takes away for every polluting factory it finds.

○ **Repeal Old**

Click here to propose to **repeal** an existing law.

A list of existing laws will appear here. Click to **select** which law to propose to repeal.

Okay

Vote

Fred proposes that: Each polluting factory shall be fined its production Vote yes or no?

Yes   **No**

• Propose a Law by dropping a judge robot   on the map.

• Laws either fine the owners of factories caught polluting or confiscate the factories' production. In either case, the penalties are given to the other players.

• Laws only find about one out of four polluting factories.

• A majority of players must vote for the law before it goes into force.

• Laws have a fixed cost of one move per player per turn, however, so they are very expensive.

• You can use the judge robot to propose to repeal an existing law, too.

Learning from the Design Experience

How does MarketPlace fit into the universe of games with similar goals? What kinds of considerations underlay the design choices made in constructing MarketPlace? This section first discusses games that have goals similar to MarketPlace's.

Two Simple Trading Games

First, let's compare two games that are roughly about the same subject. They are both intended to teach players about how markets *clear*—how markets enable people who would benefit from trading find their match. One game, however, offers a much more interesting role to its players. This role allows the players a greater degree of agency, allowing them to display a richer set of market behaviors.

The Market Clearing Game (DeYoung, 1993) is closely patterned on experiments done by experimental economists. Laboratory experiments have to be carefully controlled, which practically means that subjects (and thus students) have to be tightly constrained. Imagine six students split into two three-person groups—one of buyers and one of sellers. The three sellers are told they can each buy one unit of a canonical good per auction for $10, $15 and $21, and the buyers are told they could resell one unit of the good per auction (somewhere else) for $14, $20 and $25 (see below). Buyers and sellers are brought together in an auction where sellers publicly post asking prices and buyers choose among them. After some period the auction is declared over. The auction is repeated several times.

Buyer	1	2	3	
can resell at	$14.00	$20.00	$25.00	
Seller	A	B	C	
can acquire at	$10.00	$15.00	$21.00	
sell/buy pairs	A -> 1	B -> 2	C -> 3	total gain
gain	$4.00	$5.00	$4.00	$13.00
max sell/buy pairs	A -> 2	B -> 3		
gain	$10.00	$10.00		$20.00

A Market Clearing Example

One way of looking at the above situation is that the prices represent the utility gained by each of the players by having one unit of the good. The question is then who should trade with whom in order to maximize the total value of the units of goods to everyone? In other words, if seller A sells a unit to buyer 3 for $20, seller A is $10 better off and buyer 3 is $5 better off - a total of $15 is gained. If, however, seller A sells a unit to buyer 1 for $12, the total gain is only $4. To maximize the total gain overall, it is clear (if you work out the cases) that seller A and B should sell to buyers 2 and 3, and that buyer 1 and seller C shouldn't trade (that creates the maximum total gain of $20.) The question is would a set of buyers and sellers trying to maximize their local return arrive at the same globally optimum answer?

The classroom experiment is intended to show that the answer is yes. A version of the above problem is run where there are eighteen buyers and sellers. Five rounds are run and in short order the optimum set of buyers and sellers start trading.

While this result is interesting, the impoverished social setting for the game limits the kinds of connections students can and ought to make between it

and the real world. This limitation is thrown into highlight when the Market Clearing Game is compared to another simple trading game.

The Market Exchange and Wealth Distribution Game (Bell 1993) is a seemingly simple game with surprisingly rich implications. Students trade M&M's. Like the Market Clearing Game above, students differ in the utility (here represented by game points) they derive from the M&M's. Instead of being assigned the utility value individually, they derive it from their present stock of candy. The third (and sixth and ninth and so on up to fifteenth) M&M in a group get its owner a point bonus. Thus if player 1 has two red and one green and player 2 has one red and two green they can both gain by swapping a green for a red M&M. No globally visible reflection of the total state is kept. Students thus have to ferret out advantageous trades and convince people to engage in them.

One additional feature is added. Students start with one of three initial stocks of candy reflecting their membership in one of three groups: poor, middle class or rich.

Students pursued the game at different levels of intensity. Players saw the importance of salesmanship in determining who got to trade. Students formed consortia to pool their candies increasing their opportunities for gain—seeing the interaction of non-market schemes for organization with market ones. Although the economic message in the two games is similar (markets can foster exchanges that move the system towards a total welfare maximum), the second game's openness to student modification makes it much more evocative.

Sell

What's the best role for the computer in an educational simulation game? There is a long-standing dream in the computers and education community of using computers as intelligent tutors. However, when such programs are used in conjunction with social simulations, there is a high price to pay. This price is demonstrated by Sell, a game developed at Northwestern University's Institute for the Learning Sciences (ILS). ILS has a project to create multi-player simulation games to teach various subjects. They've built a graphical interface on top of existing MUD technology. The first game they've created using the system is an economic simulation called Sell.

Players in Sell are operating retail stores in a simulated town. Players buy merchandise from suppliers and decide how to price and promote their wares.

For a multiplayer game, however, there is very little player to player interaction. For instance, players buy and sell from and to the computer, not each other. This design choice is forced by Sell's big selling point. Players in Sell have their interactions with the system processed by a program that is looking for incorrect moves. Students are then directed to videos of experts talking about the area in which the student made a mistake. Given that the ability of a computer program to understand human interaction is very limited, students have to be placed in a very constrained situation to allow the analysis program to function. Thus, human to human interaction, with its requisite complexity, is out.

MULE: The Starting Point

The game that most strongly influenced MarketPlace was MULE (Bunten, Bunten, Rushing, and Watson, 1983). Written for the 8-bit microcomputers of the early eighties, MULE was a design triumph but a commercial failure. MULE places four players in the role of settlers of a new planet. The game contains:

• resources in the form of plots of land that are developed by placing production units upon them,

• which units produce one of several commodities (food, energy, or ore) according to rules of diminishing returns. The commodities are sold to other players or a computer-played store at auctions,

• producing funds that players use to purchase more commodities and production units.

• The central store acts as buyer and seller of last resort—setting limit prices for the sale and purchase of commodities. It also acts as the sole manufacturer and seller of production units.

Players are given a limited amount of time per turn, which they must pay for with food. Moves in the basic game include installing production units on land plots and changing what production units produce. Non-energy production units require energy to function. Ore units are used by the central store to manufacture more production units. MULE is scored cooperatively and competitively. Players are granted points for the commodities, cash and

production units they own at the end of the game. If the colony as a whole scores higher than a threshold level, the top player is said to win. (If the colony is below the threshold they are collectively told off by the game—discouraging the top scoring player from boasting to anyone.)

Experiencing Markets and Market Failure in MULE

MULE demonstrates how a market can generate changes in resource allocation in response to changes in price. Underproduction of a commodity leads to a rise in the price offered at auction, which leads players to shift into producing that commodity.

Lemonade-Stand Capitalism

MULE thus models a classic simple economy—sometimes called lemonade-stand capitalism. Players start with equal market power, have perfect information about the products they purchase, and there are no side effects (externalities) of production or consumption.

Volatility and Monopoly

The MULE economy is volatile to only a limited degree. The small number of players ought act more like large firms than the large number of classical economic actors, any one of which is too weak to influence prices. Players may be able to corner the market in a commodity, driving the price up. However, players are limited by the actions of the central store and the limited elasticity of demand. Even given these limitations, one of the limiting factors on efficient market function can be found—monopoly.

MarketPlace, MULE and Markets

MULE, while a very playable game, has many shortcomings as a presentation of economic ideas. MarketPlace adds a number of features:
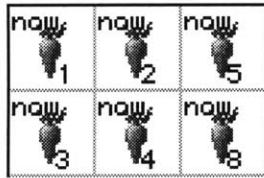
- greater incentives to trade and specialize

- greater risks of market failure

- a simplified, symmetric model of commodity use

- market externalities and methods of controlling them

- interface enhancements to make the model more apparent

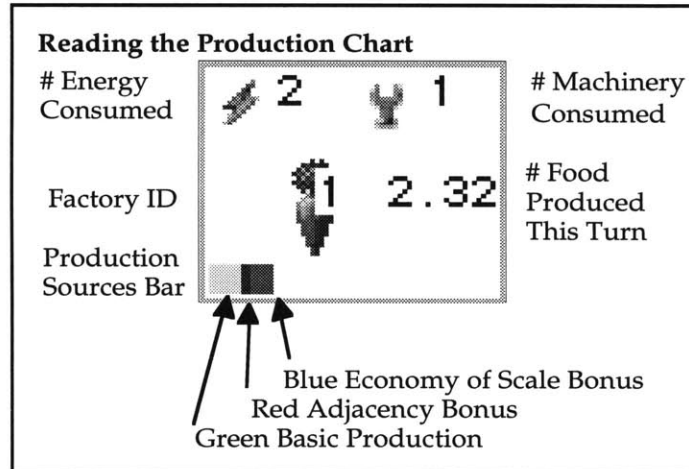Incentives for Specialization and Trade

In MULE it's possible to create a surplus even if you don't specialize. In MarketPlace, it's very difficult. MarketPlace factories use more commodities than they produce unless you either cluster them together or specialize. Let's examine this feature in a bit more detail.
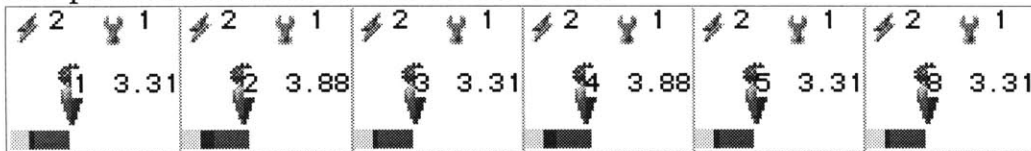
Take for example the following two cases:

Case 1—Six Clustered Food Plants

Reading the Production Chart

Energy Consumed

Machinery Consumed

Factory ID

Food Produced This Turn

Production Sources Bar

Blue Economy of Scale Bonus
Red Adjacency Bonus
Green Basic Production

Case 2—Three Food and Three Machinery

The production chart for case 1 looks like:

The six food plants take in 12 energy units and 6 machinery units and produce 21 food units—a net gain of 3 units.

The production chart for case 2 looks like:
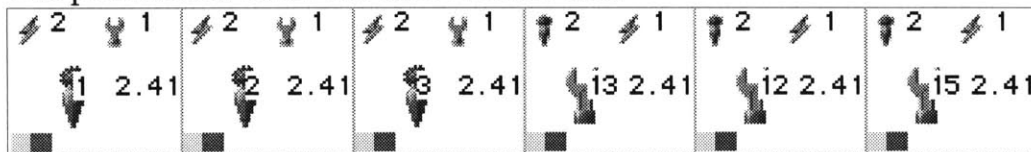
The six mixed plants take in 6 food units, 9 energy units and 3 machinery units and produce 14 mixed units—a net loss of 4 units.

Relying on Trade

The downside of specialization is an increased reliance on your suppliers. If you specialize in food, you need a large amount of energy. If too little energy

is produced, you may end up paying high prices for it. Of course, one reaction

to a shortage may well be to shift into producing the rare commodity.

(However, the player is likely to lose scale bonuses during the transition.)

Symmetric Commodities
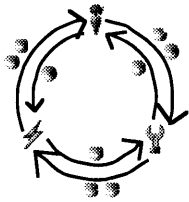
The commodities in MarketPlace are mirror images of each other. Each food

factory requires two energy and one machinery unit, each energy factory uses

two machinery and one food unit and so on. A unit of food is worth the same

number of points as a unit of energy or machinery. Nonetheless, the prices of

the different commodities soon diverge in auction. Too many players

specialize on one commodity, the food plants are placed together but the

energy plants aren't, one of the food suppliers refuses to lower her prices to

something buyers will accept. By having the commodities be similar the

source of the price divergence is much easier to see.

Illustrating Externalities: Pollution

After the third turn, players are given the option of producing their

commodities more cheaply by polluting their surroundings. Such pollution

causes the colony's future production to drop somewhat, so the total cost to

everyone of the pollution is greater than the savings. Unless players spend

moves to detect it, pollution is invisible—it makes its presence known only

through its effects.

MarketPlace's version of pollution is particularly problematic. Besides being invisible, it's also global in effect. The damage it causes is irreversible. I wanted to make sure it was seen as a problem, and in real games it almost always is.

An Interface that Shows the Model

The most complex part of the MarketPlace model is the production output calculation. The combination of bonuses from economy of scale and adjacency factors can be difficult for players to understand. MarketPlace addresses this difficulty by allowing users to see how and why their current configuration performs and allowing them to try many different configurations before committing to one of them. The interface elements that enable this process of trying out the model are the production report window, and the multiple undoable action buttons on the Map window. The user can try out various alternative arrangements for his factories, and understand why each of them performs as it does. After a few of these, most users have a pretty clear idea of how the production model works.

Learning from Using MarketPlace

"It is hard to imagine that a chemist can put herself in the place of a hydrogen molecule. A biologist who studies animal behavior is not likely to know what it feels like to be a duck. You are more fortunate. You are studying the behavior and interactions of people in economically interesting situations. And as one of these interacting economic agents, you will be able to experience the problems faced by such an agent first hand. We suspect that you will learn nearly as much about economic principles from your experience as a participant as you will from your analysis as an observer." (Bergstrom and Miller, 1995)

What can be learned by playing with and talking about MarketPlace? This section attempts an answer to this question in two ways. Firstly it asks "What sort of economic behaviors could possibly be observed in the game?" Secondly, it recounts anecdotal evidence of economic behaviors being reflected upon in an initial pilot study. Additionally, it mentions some of the interesting meta-issues concerning simulations in general that the game can be used to illustrate.

The initial pilot study was conducted with two groups. One consisted of high school students who were at MIT for summer school—this group played in two three-hour sessions. The second consisted of high school students from Dorchester, an inner-city district of Boston—this group played in three three-hour sessions. Each group was composed of seven or so people. Attendance at the sessions fluctuated between three and seven people. Sessions lasted three hours. Sessions began with a short (ten-minute) introduction to the system, after which players jumped into one or more practice games to get a feel for the dynamics of the model. These games were followed by a discussion of what had transposed during the game.

A Composite Picture of a Game

What happened during MarketPlace games? The following paints a composite picture of what went on in the games of the pilot study. The pilot study games were conducted in an electronic classroom at MIT. Earlier tests had shown that it was very important to have all the participants in the same room, especially during the critical introductory phase. Students could then jump directly into using the system, calling upon me or another player when they didn't understand something.

The interface to most of the system was easily grasped and used. During the practice game, students were quickly able to use the Map window buttons to build factories, the various status displays to see how their status compared to that of their fellow players, and the Message window to send messages. They would experiment with building various arrangements of factories—looking at the graphs in the Production Report window to see how each performed. Most students would quickly come to the conclusion that a clustered set of similar factories was the highest performing arrangement. However, that arrangement left them in the uncomfortable position of being completely dependent upon their suppliers for production inputs.

Some players had a difficult time buying and selling their commodities through the auction window. Auctions in MarketPlace are timed, and many students felt pressured by the speed of the auctions when they first started playing. Some students therefore decided to try to be at least somewhat self-sufficient, producing two or even three commodities.

We then started the "real" game. The first few turns were dominated by considerations of factory siting and configuration. Students jockeyed for position, generally trying to cluster their factories while avoiding collisions with other players. When two students claimed the same square, one of them (often the second player) would usually back off. Once, however, the number of empty squares dwindled, collisions became more frequent. Rather than make the usual four claims on four different plots, players sometimes used multiple moves to claim one particularly valuable contested square (increasing their chance of winning it.)

As the map filled up, players paid more attention to trying to produce the most valuable commodities. Players who specialized in a given commodity, of course, dominated production of it. They produced large surpluses of their commodity and often managed to sell it for more than they were paying for their production inputs. Given the cyclic nature of MarketPlace commodity production (to make one food you need two energy and one machinery, and so on), however, shortages in one commodity could spread to another.

With the inexperienced players of the pilot study, these shortages tended to spiral out of control. As players shifted production in pursuit of rare commodities their production fell since they could generally only shift half their factories per turn (and they sometimes miscalculated the inputs the new configuration would require.) The initial supply of commodities helped the colony make it through the first couple of turns, but by turn four things were usually falling apart. (These inexperienced players were often fixated on their relative scores, however, and often didn't notice that the colony as a whole was in trouble.)

The arrival of turn four in MarketPlace marks the arrival of polluting factories. Configuring your factories to pollute drops their input requirements by one third (you can produce food with just one energy and machinery unit) at the cost of damaging randomly selected plots. With the colony short of inputs, one or more players would usually reconfigure their factories to pollute. While they might experience an increase in production as a result, the increase was never enough to pull the colony back from the brink. As the session time scheduled for playing the game elapsed (or a client Mac crashed), it was obvious to everyone that the colony was in trouble. It was then time to discuss what had occurred.

Economic Behavior in MarketPlace

Supply and Demand

Where do prices come from? This question is one of the oldest and most fundamental ones in Economics. The classical view of price is that it directly reflects cost of production (Smith, 1776). If A costs twice as much to produce as B, A's price will be twice as high. Assume, for instance, that A's price was three times as high. The higher profitability of making A would draw producers toward A increasing its supply. This shift would push prices back towards a 2:1 ratio.

A modification to the above model is necessary to understand what goes on in MarketPlace. In MarketPlace the cost per unit of production changes with the quantity made. Additionally, it's important to realize that this analysis assumes that the production of these items can be increased and shrunk. The

price of a Honus Wagner baseball card reflects the fact that they aren't making any more of it (or perhaps him). For the MarketPlace world, however, this assumption is fine.

So how does this all work out in MarketPlace? With the relatively inexperienced players who've tried the game so far, the classical analysis modified to account for economies of scale works well. Players bid more for commodities that are in short supply during auctions to assure themselves of supplies. Players who specialize in a certain commodity can afford to undercut their less specialized competitors. Come the next turn, players tend to shift into production of the items which are in short supply.

You might expect to get an overshoot effect as too many players shift into production of the high-priced commodities. In tests, however, overshoots have been small. Since players in MarketPlace can see and react to the factory configuration decisions of the other players, players can see an over-reaction building and avoid it.

Trade

What is trade good for? Traditional accounts explain trade as allowing different countries to produce items upon their local advantages. However, as Krugman points out (Krugman, 1994), most trade is between ostensibly similar nations. One explanation is that nations develop specialties over time that become locked in, such as the United States' commercial airplane industry. MarketPlace's players similarly start out with identical resources. Soon they specialize in one commodity or another and cannot change all of

their factories in one turn. (Spreading a change to another commodity over two turns means losing the large part of the production bonuses for those turns.) They are similarly locked into their specializations.

You can only take advantage of the opportunities offered by economies of scale if you have a working system of trade. Games in which the auctions function poorly (for whatever reason), often show a decline in specialization as players try to become somewhat self-sufficient.

Players sometimes complain that the auction system is too impersonal. While you can specify who you wish to sell to, you specify it in a negative fashion by saying who you will not buy or sell from. Players want to be able to make player to player deals in a less impersonal fashion. Markets, however, are distinguished by their ability to foster trades between total strangers. The semi-anonymity of the MarketPlace system is a pale version of the level of disconnection present in most real markets. When you buy a manufactured product you are blocked from seeing a most of the history of its creation—who built it, who marketed it, who trucked it to you. That's the cost of the efficiency that allows the wide array of modern products. MarketPlace should support the more time-consuming person-to-person trades to make the contrast between the two ways visible.

Central Planning

What about central planning? A wide array of people have been seduced by the idea that the very real waste present in market economies could be made to go away by having things centrally directed. Players can see that it would be

most efficient in the MarketPlace economy if someone just assigned all the production roles. ("You make food over here, I'll make energy over there, ...") I've talked to players about this observation and discussed ways in which differences between the MarketPlace world and the real world might explain the observed poor performance of real-world central planning. The most convincing culprit seems to be the much higher number of products in the real world, and the overwhelming number of choices that have to be made about how to produce them. Players also worry about how they would divide up the benefits.

It is interesting that the MarketPlace toy economy seems to be a powerful argument against central planning. At first glance it seems that it should be quite the opposite. After all, the MarketPlace world could quite conceivably be planned. Because players can see that it only can be planned because it is very simple, it serves as a counter-example when they imagine scaling up the model (and the corresponding planning mechanism) to the level of the real world. This opportunity for insight owes much to the transparency of the MarketPlace formal model.

Market Externalities

The fact of costs that are not properly accounted for by markets is one thing. MarketPlace is designed to allow discussions of the subtleties of what makes different kinds of externalities more or less of a problem. Pollution, however, becomes an issue later in the game, and because of limited time it wasn't talked about much in the study games. One interesting issue that has been raised is whether it might be good for the colony as a whole to allow some

pollution in order to escape a production slump. (MarketPlace games where players are inefficient can spiral down into a severe shortage of production inputs, and polluting plants need fewer inputs.) This question in MarketPlace could open a useful perspective on real-world debates on the optimal level of pollution.

Playing Chicken

Land is a limited resource in MarketPlace. In the beginning, the MarketPlace board starts out empty. Players can claim up to four sites per turn for their own use. If two players attempt to claim the same square, either one or both of them will undo the move or the server will randomly assign the plot to one of them. In the beginning of the game when there is plenty of open land, players tend to avoid playing chicken over sites. They're avoiding the risk of wasting one of their four moves on an unsuccessful attempt to claim a plot. Even though the server gives no advantage to the first player to claim a square, there is a large psychological advantage to being first. Other players see your claim and tend to steer away.

Commodities, Monopolies and the Size of the Market

What do the game commodities of food, energy and machinery correspond to? What does it imply that players can trade units of food without knowing anything more about it than that it's food? A player attacked these questions by asking "What does 'food' in the game mean?" That gave a lead in for me to talk about the difference between generic items—where you can know what you're getting just by naming it, and unique items—where you have to look

at every item itself. I made an analogy between the simplification in the simulation (all kinds of food -> *food*) and the simplification made possible by having standardized items (all sorts of possible types wheat flour -> standard wheat flour). Commodities make the market simpler to use.

Is there a down side to that simplification? I expected a comment about a loss of diversity. However, one student then brought up the issue of monopoly. If only one company can take advantage of the cognitive simplification (when I am hungry—I can just buy "food"), then they can charge higher prices. This issue was a natural lead in to the second thing you need in order to have a real commodity—many suppliers.

In MarketPlace, with its small number of suppliers, the big difference is between markets for an item that have one supplier and markets that have more. Monopoly and oligopoly (a market dominated by a small number of companies) are well illustrated by this difference in pricing power.

Economic Geography

The MarketPlace map starts out completely featureless. Within a few turns, however, the adjacency bonuses quickly force the creation of districts—areas for food energy and machinery. This transformation of flat uniform terrritory into a set of "places" is a good demonstration of how history can determine the industries a region specializes in, even in the absence of local features that favor it.

Money

What is money? The strange quality of public debates about the gold standard points out the general confusion concerning what currency is for. The cash in MarketPlace is, in fact, anchored in that it has a value in points. However, versions of the system (up until the final one) were tested with no points given for anything. Players still were willing to trade with each other in the auctions. Players in the pilot study discussed the role of currency. They thought that if the point value of cash were taken away that people would probably still trade cash for commodities. (However, they didn't think anyone would sell anything if they knew the game were going to end that turn. Money is backed much by the expectation of being able to execute future trades.)

One of the obvious things to imagine adding to MarketPlace is a barter facility. Players often bring it up and it's a good opportunity to talk about the relative advantages and disadvantages of currency.

Players can easily imagine making a barter system work given the small number of commodities present in the MarketPlace world. However, when they are asked about a situation in which the number of commodities is much larger, they can extrapolate their MarketPlace based-model and see that barter would become very difficult.

The currency in MarketPlace is a bit deceptive as the agency that guarantees its validity is the game itself. None of the players has to worry about being slipped a bad bill. In real life it costs quite a bit for an institution (usually a government) to produce a legitimate currency.

Future Directions

The pilot studies of players using MarketPlace suggest that larger scale tests would be very interesting. There are a number of features which current experience suggests would be worth adding to MarketPlace. Finally, MarketPlace points the way to a much less episodic kind of game that would allow people to experiment with a wider array of market and social structures.

Better Empirical Studies

Due to practical considerations, the initial pilot study was shorter than would have been ideal. A longer study would have allowed students to spend more time with MarketPlace—letting them experiment more widely with some of the game's more complex features such as Laws and Pollution. A longer study would also give us the opportunity to track how students' ideas about markets change as they play.

To keep the games manageable, the groups were kept small. The MarketPlace design, however, can support groups of up to ten players in size. Larger groups of players allow the game to better demonstrate some kinds of economic behavior. A greater degree of competition between suppliers, for instance, might increase the pressure to pollute. The geographic differentiation of the game would become more complex.

Additional MarketPlace Features

Modeling the Model—Reflective Simulation Tools in MarketPlace

In the current version of MarketPlace, people talk and write about their ideas of what happened during the game and why. However, modeling tools would be useful for analyzing transcripts of games. It would therefore be interesting to include Stella-like or StarLogo-like modeling tools within the MarketPlace discussion system.

Repeat the Past

The current MarketPlace system does save a record of the progress of each game. However, the current tools for looking at these transcripts are quite primitive. Users ought to have a manipulable record of both what **is** happening and what **did** happen during a game that they could use while playing and in discussions about the system. The current system is weak in both areas.

Your Opponent's Voice

Most MarketPlace games currently happen in a single room containing many Macintosh client machines (although for logistical reasons the server machine is often far away.) These games tend to have high levels of excitement with the players shouting out suggestions to each other. MarketPlace games that are played between physically separated players tend to be less high-spirited. To preserve the intensity of MarketPlace games played between far flung groups of people, the system needs to support voice

communication between the players.

A MMUD (Market MUD)

MarketPlace is designed to support a group of players who wish to come together for a few hours and play a game. The original design proposed to allow the players to modify the games. The goal was to allow users to trace the effects of changes in the underlying model on the behavior of the players. For example, changing the production functions so that players could break even without specializing would presumably remove much of the incentive to trade.

However, if each game takes several hours to play it doesn't take long to see that designers aren't going to be able to try out too many alternatives. If you want to offer design experiences some other model is required.

One possible answer is to structure the environment so that games last months instead of days, but their models slowly evolve as they are played. People would play in it somewhat in the way they do in MUDs—multi-user textual virtual realities. Imagine a version of MarketPlace where the elements of the game were broken down further. Rather than a fixed set of players, factories, commodities, currency, auctions and pollution there would be:

• a world of objects that can be crafted so that they are more valuable (where the crafting of objects may have undesirable side effects)

• other players which come and go over many months

- a discussion system

- a spreadsheet-like model analysis program

- a scripting system that allowed the creation of new facilities

Players could then build up commodities, auctions, currency and so on for themselves. The world would differentiate as people grouped themselves. Different parts of the world could choose different kinds of governing arrangements. Comparisons might be made about the benefits and drawbacks of the various approaches. Disputes between groups might break out into attempts to "subtract value" from the opposing group's territory. All of these events could provide fodder to discussions about politics and economics.

Reader Biographies

Mitchell Kapor
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Mitchell Kapor is co-founder of the Electronic Frontier Foundation, a public interest organization working in the area of telecommunications public policy. He is the founder of Lotus Development Corporation and the designer of Lotus 1-2-3. He is currently teaching courses at MIT's Media Lab.

Edward A. Parson
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Edward A. Parson is Assistant Professor of Public Policy at the John F. Kennedy School of Government of Harvard University. His research concerns include environmental policy and negotiations. Particular recent interests include the development of international institutions to manage multilateral environmental problems; the analysis of multi-party negotiations; and the use of formal modeling in international policy-making processes. Parson has developed a series of simulated environmental negotiation exercises as policy research tools, adaptations of which are now widely used for executive training, and as experiential learning devices in schools and colleges to teach negotiation, group decision-making, and conflict resolution. His Doctorate is in Public Policy from Harvard, his prior degrees in Physics from the University of Toronto and in Management Science from the University of British Columbia.

Parson has worked and consulted for the Office of Technology Assessment of the US Congress, the Office of Science and Technology Policy, the United Nations, and the Privy Council Office of Canada. In other lives he spent four years as a professional musician, and two organizing grassroots environmental groups.

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