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AMCIS 1997 Proceedings

Americas Conference on Information Systems (AMCIS)

8-15-1997

Simulating Electronic Commerce: A Game Environment Utilizing Software and Human Agents

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Abstract

Electronic Commerce [EC] is still in the developmental stages. Neither the technological nor the cultural constructs have solidified. The result is that there is no way of predicting what applications of EC will prosper [Kala-96]. We propose a simulation environment, that incorporates software agents and human agents in a game format to create a quasi-natural setting, for evaluating aspects of electronic commerce.

Introduction

The Internet has existed for over 30 years, in one form or another, and had not captured very much attention in the public press nor garnered much interest in private industry until quite recently. Since the first version of Mosaic appeared in 1993 [Zako-96] the number of hosts On the Internet has increased by tenfold or more and the number of networks has multiplied by 20. The World Wide Web, the use of the internet to transmit HTML documents, is now the largest user of the Internet by far, having outdistanced FTP in march 1995. With this proliferation of Browsers and the capabilities they bring both the media and industry have increasingly looked to the Internet as the market of the future. Most analysts and market development researchers assume that the Internet will support markets similar to those presently employed. The question that we seek to answer is what affect will the Internet have on commerce. i.e. what economic factors may change. To accomplish this we will simulate a variety of situations to determine the affected factors.

Simulations require the encoding of a multitude of constraints and assumptions about the situation to be simulated, even in the simplest of simulations. In using simulations we look to examine a range of possibilities [Law-91]. The greater that range the more difficult the simulation. Electronic Commerce (EC) is not a simple situation nor does it have a narrow range of possibilities to be investigated [Kala-96]. Thus a normal simulation of EC would either require a massive simulation effort or the results would be of limited use. We propose a simulation environment that incorporates software agents and human agents in a game format, which we term simugame, to create a quasi-natural setting for evaluating aspects of electronic commerce. Our simugame is titled Game Environment Simulated Electronic Commerce (GESEC).

A game provides some set of rules for play. These rules and any structures associated with the game, such as a game board, provide part of the environment. The remainder of the environment is supplied by the participants based upon their beliefs, knowledge, abilities, and motivation. Agents can be used in a simulation to model participants, however, because of the lack of information about EC participants this would limit the accuracy of the response of the simulation to changing technological factors. We intend to use the game structure, where people participate, to make use of their abilities, motivation, and reasoning to simulate the very same attributes of the real world but in a controlled manner.

Economics is based upon several fundamental assumptions. We can summarize these by saying that entities, either individuals or organizations, seek to maximize the satisfaction of their goals (Bowd-86). While there are competing theories to explain economic behavior and organization (Will-85, Barn-86) many of them rely on similar basic assumptions. To simplify this explanation we will concentrate on

classical economic theory. It is commonly assumed that the main goal of a business organization is profits and thus a business organization seeks to maximize profits. Individuals are assumed to seek to maximize the value of the goods and services that they consume where value is a personal measurement This is of course an over simplification of economic theory.

There are many factors that complicate the theory ranging from substitution to legal to social to moral issues. If, however, we start with our basic rule then we can examine how the physical attributes of commerce relate to the theory and we will then have a basis for examining the changes in the physical attributes of commerce that may occur due to the Internet and estimate their effect on the economic theory. Thus we will start GESEC in a physical mode where we allow interactions based upon historically used methods. After benchmarking at this stage we will integrate various aspects of EC and its supporting structure. Once we have established a working environment we will then alter a range of specific aspects of the simugame-game over a number of iterations. In this manner we will be able to observe the effects of the differing environments on the outcome. From this data we then expect, over time, to establish relationships between the various attributes of EC and outcomes.

Our goals for the initial research is to first validate the accuracy of the simugame concept based upon the non-electronic commerce benchmark. Following that we will extend it to several simple EC environments and determine our future goals based upon these initial findings.

The Simulation

It is our intention to implement a research tool that happens to be entertaining to a subsection of the population. It is not, however, our goal to compete with the gameware now being sold. We don't expect to have either the graphics nor the audio of those games. We will have a tool that, like a chess board, is rather plain in appearance but which is complex and pleasing in its play. One reason for calling this a "game" is to recruit participants. Students like to play games. They do this willingly. They have to be forced to participate in experiments.

GESEC will be composed of individual agents, software and human, organized into various organizations and markets. These organizations and markets will have several levels of complexity, simulating the complexity of the real world. The software agents will provide the structure and control of the simulation while the human agents provide the decision making and drive. Thus any one instance of the game might differ from any other instance in its members, constraints, abilities, and measures of success. While this makes individual sessions inappropriate for knowledge gathering it does allow for the distillation of knowledge about EC from the observations of several sessions.

The following table [Table 1] lists the basic types of objects that will be used in the simugame. Sessions will differ based upon the methods, constraints, and attributes actually instantiated.

Object	Type	Purpose
Organization	Object	A basic structure for providing the constraints, methods and attributes of interaction between objects.
Unit	Organization	Provides an environment in which the roles and interaction of objects takes place. Is comprised of simple objects such as individual agents. A unit typically has a single purpose.
Team	Organization	An environment comprised of units and possibly individual agents. It provides the constraints and methods needed to combined units into more complicated organizations that may have multiple goals.
Group	Organization	A hierarchy of organizational levels that provided the constraints and methods for an increasingly complex organizations. The number of levels

		is open and is defined at the initiation of any simugame session.
Market	Group	A specialized group that provides the means to control the commerce between market members
Agent	Object	A basic structure that provides the constraints, methods, and attributes for actions and responses.
Interface	Agent	To provide a means of communication between the object and its associated objects and a human agent
Memory	Agent	The means of storing information for an organization
Communication	Agent	Provides the inter and intra organizational communications methods.
Analysis	Agent	The tools to analyze problems
Process	Agent	Simulates some process, or sub-process. There may be several of these organized to simulate more complex processes.
Control	Agent	The scheduling and decision making processes for a given organization. This deals with the software aspects of the organization.
Assistant	Agent	Automates much of the human agent interaction. May be enabled to simulate human action in the fully automated simulation.
Item	Object	A basic structure that provides the constraints, methods, and attributes for the description and utilization of simulated physical or conceptual items such as goods services and money.

Table 1

Architecture

The goal of the participants in an iteration of GESEC is to win the game. The definition of winning, like many of the other characteristics of GESEC, is variable. As in real life the measure of success can vary from entity to entity. The human agents, or their simulation, are not necessarily competing against each other but rather against failure. This competition drives the simulation as the actions taken by the human agents are the precipitating events for changes in the simugame state.

We have designed the simugame in an object-oriented manner. Each entity is an object within its own environment which may also exist within the environment of a higher level object and so on. A human entity forms the core of some organization that incorporates, in addition, a number of software entities. Each entity has its own environmental structure which determines its purpose, abilities, and possible actions. The structure of the organization object determines the interactions between its component agents (internal) and its interaction with other organizations (external). We control the initial state of the simugame by the determination of the attributes of the various objects and their overall structure. The environment is established by the constraints, rules, methods, attributes, and measures given at the start of the simugame.

In its simplest form teams of agents would compete with each other in a market where they would seek to maximize their value based upon transaction between them and other members of the environment. This could consist of two competitors trying two different approaches to sales. The responses to their actions would be generated by the environment, i.e. there wouldn't have to be a multitude of participants to respond. In a more complex form sufficient participants would be generated to simulate more complex interaction.

There are several modes in which a simugame may be played. The two major divisions are automated and interactive. The automated mode is the simplest mode as it is a simulation where there is a starting set of parameters and some stopping point. There would be no human interaction. Events are controlled by the

reactions of different organizations (environments) to changes in other organizations. The interactive mode involves human interaction and as such must compensate for the differences between human and machine. Humans may participate in any of four different modes, see Table 2.

Continuous	The human participants must respond throughput the life of the game. The speed of the game has to be slowed to allow for their participation. This allows for the fullest range of interaction but can result in fatigue and the slowing of the speed means that the game takes longer to run through a session.
Batch	The game is divided into cycles during which the game is played as if it were continuous. These would be regular cycles such as daily or semi-daily. This allows the players to allocate time to the game and to evaluate their decisions better which fits with actual situations. This could lead to very extended game sessions.
Compressed	The game is run on a faster cycle and the human decision that are made lag the actual flow. This represents the real world situation where decision are made based upon old data. If the compression, however, is too fast then erroneous results may result.
Compressed batch.	This combines the batch and compressed modes concepts. So each batch represents a longer time but the separation into batches allows the participants to evaluate the situation better.

Table 2

Expectations

We will run the game numerous times, substituting repetition for control (Cook-79), and collect the results along with the initial variables. From this data we expect to be able to determine some underlying relationships about EC. It is our expectation that we will observe a high level of success in those organizations that are based largely upon information exchange, an ideal product for EC. It is also our expectation that heavy industry will be less successful in its use of the net simply as a by product of the extend to which it can use all of the channels. This though points to the heart of our research, i.e. that beyond the obvious what factors limit or contribute to the success of an EC endeavor.

In the short run we will be working with a simple game and general factors. As we improve the design of GESEC we will be able to incorporate a finer resolution of factors.

References

Provided upon request from John P. Baron