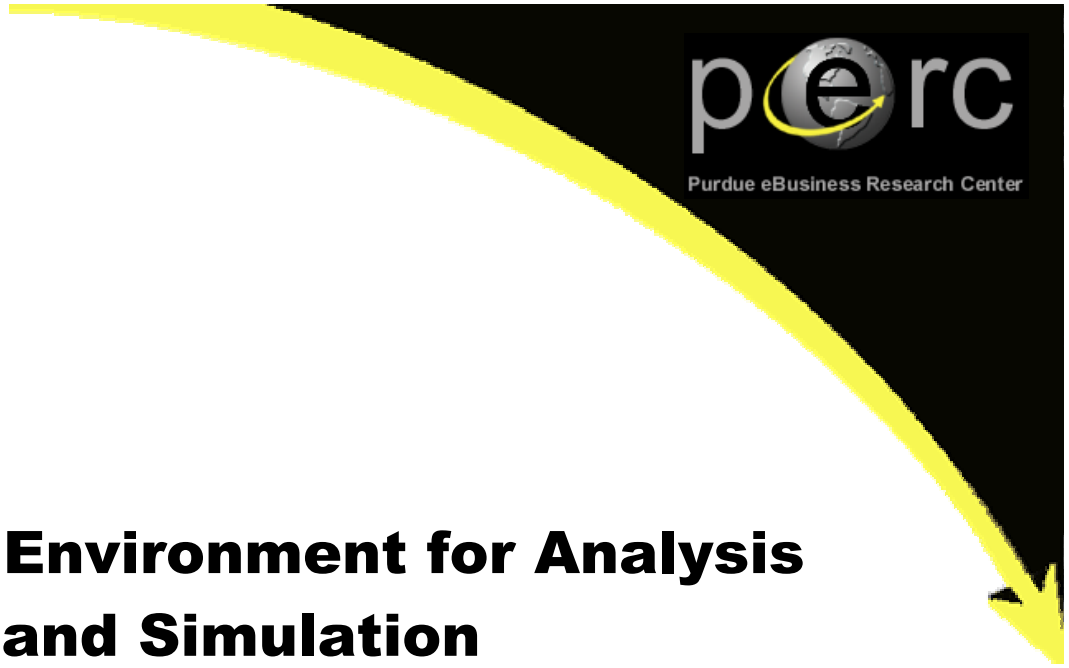

Synthetic Environment for Analysis and Simulation

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Introduction

Peering through the clouds

As a marketing manager of a major brand in a global automotive company named *CarKing,* it's a white-knuckle ride to create your latest multi-million dollar ad campaign. The ideal target market is identified and a value proposition to deliver to that market is created. With millions of dollars in the balance, what would you give to peer through the clouds of uncertainty obscuring your market and see how your ad campaign will be received?

This desire is common among business managers everywhere, a desire to have a clearer picture of how the market will react to action taken by business. Those firms with the clearest picture of market reaction attain success, while those with consistently cloudy vision lose customers and ultimately perish.

Business simulations are created with the intent of simulating markets, allowing firms to observe the results of their decisions in synthetic environments as opposed to real environments where experience can be an expensive teacher. Such environments can help decision makers attain a clearer picture of how markets will react to decisions, testing decisions that in turn will generate higher revenues.

SEAS

Synthetic Economies for Analysis and Simulation (SEAS) is at the forefront of business simulation, helping companies to see markets clearly and make informed decisions. SEAS is a result of over eight years of research and development at Purdue University's Krannert Graduate School of Management. SEAS seamlessly incorporates all aspects of managerial decision-making to provide a complete and integrated view of economies, industries, and organizations.

SEAS is a simulated environment that models all aspects of the economy, including the government, competition, public and foreign policy, and other international economies. SEAS is able to model this environment accurately through the use of intelligent software "agents". Agents are distinct entities such as types of customers and suppliers, citizens, channels, and competitors. Agents can be used to model any group of people whose actions are important to the organizations outcome.

The agents' behaviors are defined by actual data that demonstrates how the agents have acted in the past. SEAS incorporates genetic algorithms that allow the agents to react and learn from its own actions as well as actions by other agents. It is through the combination of the continual actions and reactions of all the agents that produces a very real and life-like environment that allows an organization to test different strategies and analyze the outcomes of executing those strategies - all in a simulated environment.

Utilizing SEAS removes a great deal of uncertainty with regard to key decisions and strategic direction faced by every organization. It allows the organization to play out several scenarios and analyze the outcomes, on many different levels. This analysis then aids the organization immensely in deciding what strategic direction and decisions to implement.

Using SEAS to optimize decision-making

To better understand how SEAS can be used to benefit firm decision-making, it's important to understand:

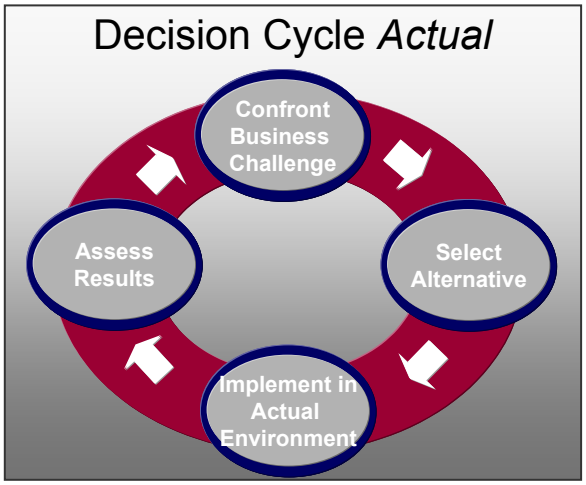
- The cycle of decision making in *actual* environments
- The cycle of decision making in *synthetic* environments
- What constitutes an *actual* environment
- What constitutes a *synthetic* environment

The Decision Cycle in an actual environment

Today's firms run a cycle of decision-making consisting of four parts (Figure 1):

- Confront Business challenge
- Select Alternative
- Implement Alternative in *Actual* Environment
- Assess Results

Figure 1



The four steps of the Decision Cycle in an actual environment can be demonstrated using our fictional firm, *CarKing* from the opening paragraph.

Confront Business Challenge
For *CarKing*, the challenge to this firm is to create a marketing campaign that will generate enough incremental sales to produce a campaign ROI of 30%.

Select Alternative
CarKing is weighing two alternatives to entice customers into purchasing a new vehicle: offer a $500 factory rebate to entice purchase, or a $50 gift certificate to participate in a test drive. (*CarKing* believes that customers participating in test drives have a higher propensity to buy over those that do not). Despite uncertainty, the firm must make a decision as to which alternative will be chosen. *CarKing* opts to offer the $500 factory rebate and moves forward with the campaign.

Implement in *Actual* Environment
CarKing contracts with a fulfillment house to mail out the $500 factory rebates to the customers identified as part of the target market.

Assess Results
CarKing's decision to implement the rebate generates a *negative* ROI; in retrospect, the marketing manager feels the $50 test drive incentive may have been a better play, but now lacks the resources for a second campaign.

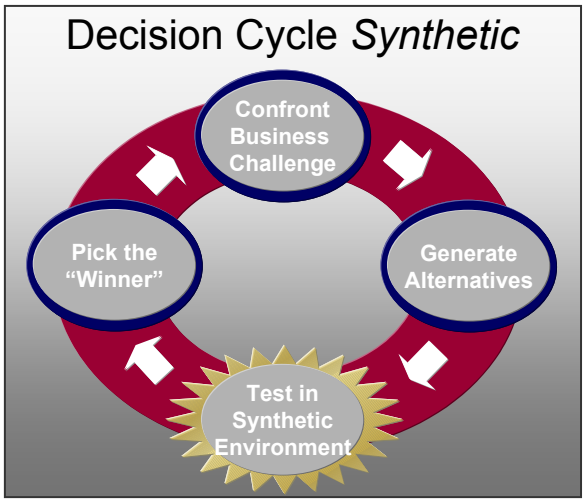
The Decision Cycle in a synthetic environment

As seen above, decisions in actual environments can feel like an all or nothing proposition, as they do not allow for a "do over" of a failed decision. Alternatively, the synthetic environment allows each alternative to be tested before being implemented in an actual environment.

Here are the four steps in the Decision Cycle in a synthetic environment (Figure 2):

- Confront Business Challenge
- Generate Alternatives
- Test Alternative in *Synthetic* Environment
- Pick the "Winner"

Figure 2



Building on the previous example, *CarKing* uses a synthetic environment as part of its Decision Cycle.

Confront Business Challenge
Again, the firm must generate marketing campaign with 30% ROI.

Generate Alternatives
Offer a factory rebate of $500 or $50 test drive incentive.

Test Alternative in *Synthetic* Environment
CarKing opts to offer the $500 factory rebate and moves forward with the campaign.

Pick the "Winner"
The results of *CarKing's* decision to implement the $500 rebate generates a *negative* ROI causing the marketing manager opts to return to the testing phase and implement the $50 test drive incentive. The $50 test drive incentive campaign results in enough incremental sales to generate a 28% ROI. The manager chooses to go with the test drive incentive for the *actual* campaign.

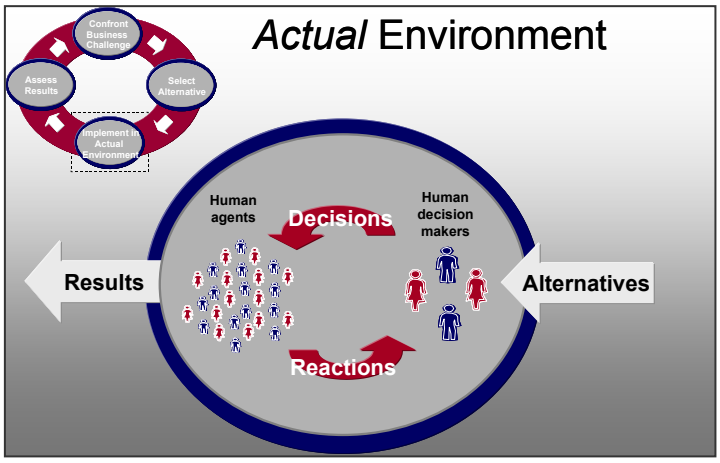
Defining actual and synthetic environments

Our example of *CarKing*'s Decision Cycle requires a deeper look into the composition of the actual and synthetic environments used in the examples, and the outcomes produced in each scenario.

The composition of an *actual* environment

To gain a better understanding of what makes up an implementation in an *actual* environment, we peel off the cover and take a closer look at its contents (Figure 3).

Figure 3



From right to left, the *actual* environment consists of the following:

- The *alternatives* that the firm is faced with
- The *human decision makers* who weigh the alternatives
- The *decisions* that are taken
- The *human agents* who constitute the market
- The *reactions* of the human agents to decisions
- The *results* of those reactions

The *human decision makers* have qualities that are unique. Like our *CarKing* marketing manager, these individuals assess the market both quantitatively and qualitatively and make an educated

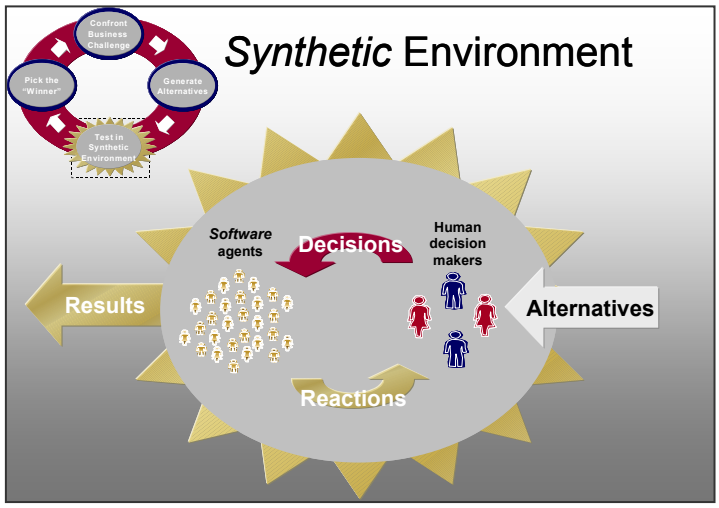
decision based upon research, experience, and "gut feeling." Many times, decisions made by human agents are unpredictable, much like trying to out guess the strategy of a competitor.

The *human agents* who, in aggregate, constitute the market are somewhat simpler. These individuals, thousands or millions of them, will react to the decisions of the *decision makers*. When their decisions are analyzed, trends are revealed that make guessing behavior somewhat predictable.

The composition of a *synthetic* environment

Now, to better understand the *synthetic* environment, we peel off the cover and take a closer look at its contents (Figure 4).

Figure 4



From right to left, the *synthetic* environment consists of the following:

- The *alternatives* that the firm is faced with
- The *human decision makers* who weigh the alternatives
- The *decisions* that are taken
- The ***software*** *agents* who constitute the market
- The *reactions* of the *software agents* to decisions
- The *results* of those reactions

In the synthetic environment, the *human decision makers* will be the same as in the *actual environment*; the difficult to predict "gut feeling", strategizing, and experience will all be captured in the decisions that are made these individuals.

Conversely, *software agents* now replace the *human agents* who constituted the market in the *actual* environment. Because the decisions of *human agents* are more predictable, the *software agents* can be programmed with simple rules to mimic *human agent* behavior. As opposed to other simulation environments that are static, software agents can be millions in number with programmed with adapting rules to make the market a living, breathing entity.

Features of SEAS

(not sure where this fits in the paper)

SEAS is so powerful and accurate because of the breadth and depth of it's environment. The technology is able to accurately simulate any environment because it takes into account all the critical features that is face by every organization.

Technical features

- It is a web-based distributed computing environment that is robust and fault tolerant.
- It employs a state-of-the-art networking, collaboration, data-warehousing and knowledge management technologies.
- It employs genetic algorithms that allow for re-configurable systems. One can customize its framework and the rules of interaction (such as organizational behavior rules, trading rules, regulatory constraints, and foreign policy) to the users exact needs using a high-level interface, and dynamically alter them during a simulation exercise.

Economic features

- It can model the global economy as a collection of inter-linked national economies, and each national economy can be governed independently.
- It can model a large number of configurable and inter-linked goods and services, labor, asset and foreign exchange markets.
- Its production and demand processes can be extremely complex and can be plugged in seamlessly.
- It can incorporate all the essential features of the government, including the legislative, executive and judicial branches.
- It can incorporate external and environmental variables pertaining to technical change, growth or societal shifts.

Management features

- It supports a full complement of management functionalities such as strategy, production, marketing, finance, and human resources. In addition, one can configure SEAS to model any firm, in any industry, in any economy at any level of detail.
- It can incorporate quantitative relationships as well as qualitative relationships, which are calibrated using actual data and can be updated in real time as new data emerges either in the real world or in the simulation.

Organizational features

- It records participants' every action and communication.
- It can accommodate large numbers of human and artificial agents playing in the same setting.
- It provides high level decision making and analytical tools to every participant
- It allows teams to collaborate internally by sharing the various decision-making functions across several different entities.
- It has a highly evolved visualization and decision support system that allows the human players to rapidly assimilate and use the large quantity of real time information generated during the actual simulation.