Boxed Economy Simulation Platform for Agent-Based Economic and Social Modeling

Takashi Iba and Yoshiyasu Takefuji
Graduate School of Media and Governance, Keio University, Japan
(iba@sfc.keio.ac.jp)

Open and look inside the black box, and you can find another world …

Social Simulation Building for …

Scientific Analysis
To understand or predict social phenomena
Social Simulation Building for …

Learning the Sense of World Building
to empower to build societies and organizations

Interpersonal Communication
to share the image of dynamic social systems
Social Simulation Building for …

- Interpersonal Communication
  to share the image of dynamic social systems
- Learning the Sense of World Building
  to empower to build societies and organizations
- Scientific Analysis
  to understand or predict social phenomena

What are problems ahead?

- We need the well-defined primitive terms and framework to describe the society by agent-based approach.
- It is necessary to support to implement the simulation for the simulation builder who has a little (or, no) skill of the computer programming.
- We need a system to share the parts of simulation models among two or more simulation builders.

A Simulation Platform to help Building Block Approach
Agenda

1. Brief Overview of Our Results
2. Boxed Economy Simulation Platform
3. Boxed Economy Foundation Model
4. The Road Ahead
Brief Overview of Our Results

Introduction Video (short version)

The original version and another video will be appeared at demo session!

Agenda

1. Brief Overview of Our Results
2. Boxed Economy Simulation Platform
3. Boxed Economy Foundation Model
4. The Road Ahead
Boxed Economy Simulation Platform (BESP)

- An integrated environment to make, execute, and analyze the agent-based social simulations.
  - Implemented in Java language.
  - The source code and detail specification are opened to the public.

Architecture Overview of BESP

- BESP is designed to realize an extensible software application with component-based architecture.
- The user can obtain the simulation model and environment which suit the needs, only if he/she sets necessary components into the platform.
### Plug-in Presentation Components

A presentation component is a software component for the user interface to operate and to visualize the simulation, and the output into the file.

1. Drop the presentation component (.class or .jar) into a “plugin” folder
2. Restart BESP

---

### Plug-in Model Components

The model component is a software component that implements the model which the user wants to simulate.

1. Drop the model component (.class or .jar) into a “plugin” folder
2. Select and set the property with BESP Model Composer.
Building the Model Components on BESP Model Composer

Agents Components
(Individuals and SocialGroups)

Building the Model Components on BESP Model Composer

Relation Components
Building the Model Components
on BESP Model Composer

Goods Components

Information Components
Building the Model Components of Behavior

Behavior Component is defined as a state machine, which is a system that changes the state when the event is received.

BESP Model Component Builder is developed by extending from "argouML" which is the open source software for modeling in UML.

Pre-defined templates for BESP Model Component Builder

To build the actions of Behavior Component, select **Action template**
- CreateGoods
- CreateRelation
- DestroyGoods
- KeepChannel
- PutGoodsIntoManager
- PutInformationIntoManager
- TakeGoodsFromManager
- TakeInformationFromManager
- SendGoods
- SendBackGoodsToLastSender
- SendGoodsToKeptChannelSender
- SendInformationContents
- SendBackInformationContentsToLastSender
- SendInformationContentsToKeptChannelSender

or write a custom code

Guard template
- IsChannelInfoEqualsBehaviorInfo
- IsChannelSignalFromReciever

For example, using JBuilder, which you can download freely from the web site.
Building the Behavior Components

Behavior Component

BESP Model Component Builder

BESP Model Component Builder generates the java program code, just by making the state chart diagram and setting the model with a graphical user interface.

Once You Build the Components,

you can use and set them without dealing with their source code!
Agenda

1. Brief Overview of Our Results
2. Boxed Economy Simulation Platform
3. Boxed Economy Foundation Model
4. The Road Ahead

More details are described in T. Iba, et. al., "Boxed Economy Foundation Model", The AAAI-02 Workshop on Multi-Agent Modeling and Simulation of Economic Systems, Canada, July, 2002
Components based on Boxed Economy Foundation Model


BESP and Boxed Economy Foundation Model

Box Operating System (BOS)

Java VM
Boxed Economy Foundation Model provides the design of the software architecture of social simulation for sharing and reusing the model components among the simulation builders, so that it will accelerate the P2P sharing of the models and components. It keeps the components on track by defining the rule for designing the components developed in the future.

**Agenda**

1. Brief Overview of Our Results
2. Boxed Economy Simulation Platform
3. Boxed Economy Foundation Model
4. The Road Ahead
Boxed Economy Project is a student research group!

Keio University, Japan
Graduate School of Media and Governance
Faculty of Environmental Information
Fund-Supported partly by Fujita Institute of Future Management Research, Japan

Project Leader
Takashi Iba
He is a Ph.D Candidate on Graduate School of Media and Governance at Keio University. His research interests are social simulation methodology and complex systems.

Advisors
Dr. Yoshiyasu Takefuji
He is tenured professor on faculty of environmental information at Keio University. His research interests focus on neural computing and hyperspectral computing.

Dr. Heizo Takenaka
He was tenured professor on faculty of Policy Management at Keio University. Today, He is Minister of State for Economic and Fiscal Policy, and Minister of State for IT Policy, Cabinet Office since 2001.

Project Members
Yoshihide Chubachi
Ken Kato
Kotaro Asaka
Yoshiaki Matsuzawa
Junichiro Tanaka
Ryunosuke Tsuchiya
Kanichii Kamishita
Yuu Yamada
Hanami Morikubo
You Nagami
Makaharu Hirakane

Preparation and Launch of Boxed Economy Project


- Studies market simulations (Takashi Iba’s Master thesis)
  - Winner-Take-All phenomena in Format Competition of Video Cassette Recorder (VHS vs. Beta)
  - Bubble and crashed at Stock Market
  - Wrote the book “Introduction to Complex Systems” (in Japanese)

- Started the project called “In-The-Box” project to build a basis for sharing the simulation.
- Started the working group to make an agent-based simulation of entire economy.
- As a result, we came to realize that the economy is too complex to build from scratch.
- Reaffirmed importance of component and framework.

- Started new project called Boxed Economy Project.
- Designed the Initial version of Boxed Economy Foundation Model.
  - Analyzed and Designed by Object-Oriented approach.
Research & Development of Boxed Economy Project

**Sep. 2000 - Dec. 2000**
- Improved the initial version of Boxed Economy Foundation Model.
- Prototyping of Boxed Economy Simulation Platform
  - Building Component by Java Beans
  - Implementing the improved initial version of BEFM

- Developed the initial version of Boxed Economy Simulation Platform
  - Applying Design Patterns
  - Introducing Rational Unified Process (RUP)
  - Use case driven development
  - Introducing Extreme Programming (XP)
    - pair programming
    - unit test

**Aug. 2001 - Dec. 2001**
- Refactoring the initial version.
- Developed Boxed Economy Simulation Platform (ver.1.0b)
  - Model Composer
  - Model Component Builder
  - Some Presentation Components
  - Applying Design Patterns, RUP, and XP

The Road Ahead, Boxed Economy Project

**Jul. 2002 -**
- Refactoring and Improving BESP and BEFM, then releasing version 1.
- Remaking “BESP Model Component Builder” as more user-friendly presentation component.
- Preparing some more presentation component to visualize, analyze, control, and report to database.
- Especially, Implementing the presentation component to support for managing large number of experiments.
- Translating the documents and comment at source into English
- Making the on-line materials to understand how to use.
- Simulating some sample models on BESP
- Exploring Design Patterns originally for Agent-based Social Modeling with BEFM

Takashi Iba and Yoshiyasu Takefuji at CASOS2002
Welcome!

- If you are getting interested in our projects and software, Please E-mail to
  - lba@sfc.keio.ac.jp or
  - box-designers@crew.sfc.keio.ac.jp
  (We would like to know how many people are interested in them!)
- I will make a demonstration at demo session at CASOS. (but there are few sample models now :-p)

"Boxed Economy Simulation Platform for Agent-Based Economic and Social Modeling"
Takashi Iba and Yoshiyasu Takefuji