Introduction to XMILE: An Open Standard for System Dynamics Modeling

Karim Chichakly
isee systems
Outline

• Review webinar series
• Advantages of System Dynamics
• Overview of XMILE
Climate Change

Your scenario is over the goal of 2.0°C

Annual greenhouse gas emissions

2000 2010 2020 2030 2040 2050
ReThink Health

ReThink Health - Anytown

Select Initiatives...

Risk

Care

Capacity

Cost

Trends

Definitions

Specs

Rankings

Assumptions

Sliders Set the Reach, Intensity, and Cost for Each Initiative*

Enable Healthier Behaviors

Reduce Crime

Reduce Environmental Hazards

Create Pathways to Advantage

Student

Family

0%  50%  100%  Start  2012  ▼

0%  50%  100%  Start  2012  ▼

0%  50%  100%  Start  2012  ▼

0%  50%  100%  Start  2012  ▼

For DisAdv Only

For Youth Only

For Working Age Only

For Seniors Only

For DisAdv Only

For DisAdv Only

* All choices will be retained for new scenarios, until reset

Fund Initiatives

Reset All

* All choices will be retained for new scenarios, until reset
Big Data and Retail
Energy Market Dynamics

**Wind Integration Services**
- Return
- Month of the Year
  - 1
  - 12
- Wind Capacity
  - 0
  - 12,200
  - 4,000
- GC Cap for Wind Integration
  - 2
  - 1,000
  - 2,000
- Wind Integration Rate
  - 5
  - 20
- Wind Geographic Diversity?
  - 0
  - 0
  - 1
- Wind Schedule Lag
  - 1
  - 2
- Inc. dec. sensitivity factor
  - 0.8
  - 1
  - 1.2

**GCAES Used for Wind Integration**
- run the pumps
- run generators

**Wind Generation & Scheduled Generation**

To illustrate: suppose the wind is integrated for every hour but one. You have integrated 167 out of 168 hours in the week - 99.4%.
Regional Planning
Online Analytics

Electoral Votes

- **Obama**: 201
- **Romney**: 180
- **Virtual Tie**: 157

Latino Portion of U.S. Electorate

- **Current Estimate**: 10%

Percent Voting GOP Among Latinos

- **Current Estimate**: 23%

Tip: Click on each state for state-specific estimates and data.

Last updated Dec 10, 2012. About data

Reset Values

Copy Data
What do these have in common?

→ System Dynamics!
Why System Dynamics (SD)?

- SD models ecosystems
  - interconnected systems
  - complex feedback

- structure determines behavior

- tertiary effects over long time horizons
Why System Dynamics?

SD models dynamics over time

GDP from Energy Sector (Alberta, Canada)

2000  2010  2020  2030
Why System Dynamics?

SD exposes implicit mental models and assumptions
- shared understanding
- reduces misunderstandings

My understanding

![Diagram](R)

Your understanding

![Diagram](B)
Why System Dynamics?

Safely test policies and validate outcomes

Create Pathways to Advantage

Student

0%  50%  100%  Start  2012

Latino Portion of U.S. Electorate

10%

Current Estimate

Sequestration from Afforestation

Global CO2/year

0  1  2  3  4  5

(D-1 index for low to high values)

0  0.5  1  0.30

Temperature Change Over Preindustrial

Degrees C

Obama  201

Romney  180

Virtual Tie  157

2000  2020  2040  2060  2080  2100

BAU  Current Run

Temperature change by 2100: 3.3 °C

isee systems  OASIS  IBM  forio  System Dynamics Society  VENTANA systems inc
XMILE

- An open standard for System Dynamics (SD)
- Being developed in OASIS
- XML representation of SD models
- Provides
  - Standard language
  - Means to extend language
  - Stock-flow diagram
  - Interactive components
Open Standards

• Enable integration and interoperability
• Open doors to new applications
• Promote innovation and competition
• Increase collaboration
• Legitimize the market
• Reduce risk to large corporate users
• Increase demand

→ Increase the market
XMILE Technical Benefits

• Sharing and archiving of models
• Re-use of common components
• Opens development of add-on tools
• Makes System Dynamics more accessible
• Integrates with Big Data
XMILE Technical Details
XMILE Technical Goals

• Core subset of functionality
• Stock-flow diagram not required
• Interactive components not required
• Advanced language features, e.g., arrays and submodels, not required
• Extensible in both representation and simulation behavior
• Small file size
• Human readable and editable
• Includes metadata – models can be indexed & searched
Standard language

• Stocks, Flows, Auxiliaries
• Graphical Functions
• Groups
• Units
• Builtin Functions
Optional Extensions

• Event triggers
• Macros
• Conveyors
• Queues
• Submodels
• Arrays
Sample Model

<model name="Hares">
  <variables>
    <stock name="Hares">
      <eqn>5E4</eqn>
      <inflow>hare_births</inflow>
      <outflow>hare_deaths</outflow>
    </stock>
    <flow name="hare_births">
      <eqn>Hares*hare_birth_fraction</eqn>
    </flow>
    <flow name="hare_deaths">
      <eqn>Lynx*hares_killed_per_lynx</eqn>
    </flow>
    <stock name="Lynx">
      <eqn>1250</eqn>
    </stock>
    <aux name="hare_birth_fraction">
      <eqn>1.25</eqn>
    </aux>
    <aux name="hare_density">
      <eqn>Hares/area</eqn>
    </aux>
    <aux name="area">
      <eqn>1E3</eqn>
    </aux>
    <aux name="hares_killed_per_lynx">
      <eqn>hare_density</eqn>
    </aux>
  </variables>
</model>
Display and Interaction

- Layout and styling of model
  - `<stock name="Hares" color="purple" x="285" y="81"/>

- Cascading styles

- Input and output objects
XMILE for System Dynamics

Non SD Developers → Non SD Developers

Integrated SD Applications → Integrated SD Applications

XMILE Model Libraries → XMILE Model Libraries

XMILE Model Components → XMILE Model Components

Users of SD Models → Users of SD Models

SD Demand → SD Demand

SD Modelers → SD Modelers

(R)
Timeline

- Working draft released: June 2013
- XMILE TC formed: June 2013
- First TC meeting: July 2013
- Early TC draft: January 2014
- Draft of XMILE 1.0: June 2014
- Review by SD community: July 2014
- Public review: August and September 2014
- XMILE standard adoption: October 2014
XMILE Technical Committee

XMILE overview webinar schedule:
• May 20: Simulation Capabilities
• June 3: Display and Interface
• June 24: Panel Discussion
• July 21-23: Delft Conference
  • Round table discussion and ballot

www.oasis-open.org/committees/xmile/
xmile.systemdynamics.org