

Discrete simulation examples



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Overview

- Types of discrete-event simulation software:
 - general purpose drag-and-drop
 - programming libraries
- Case 1: Airport logistic simulation
- Case 2: Supply chain simulation
- Case 3: Transport simulation
- Conclusions and outlook

Types of Simulation Software

General-purpose:

- Arena
- Simio
- Simul8
- Plant Simulation
- Enterprise Dynamics
- Extend
- Anylogic
- ...

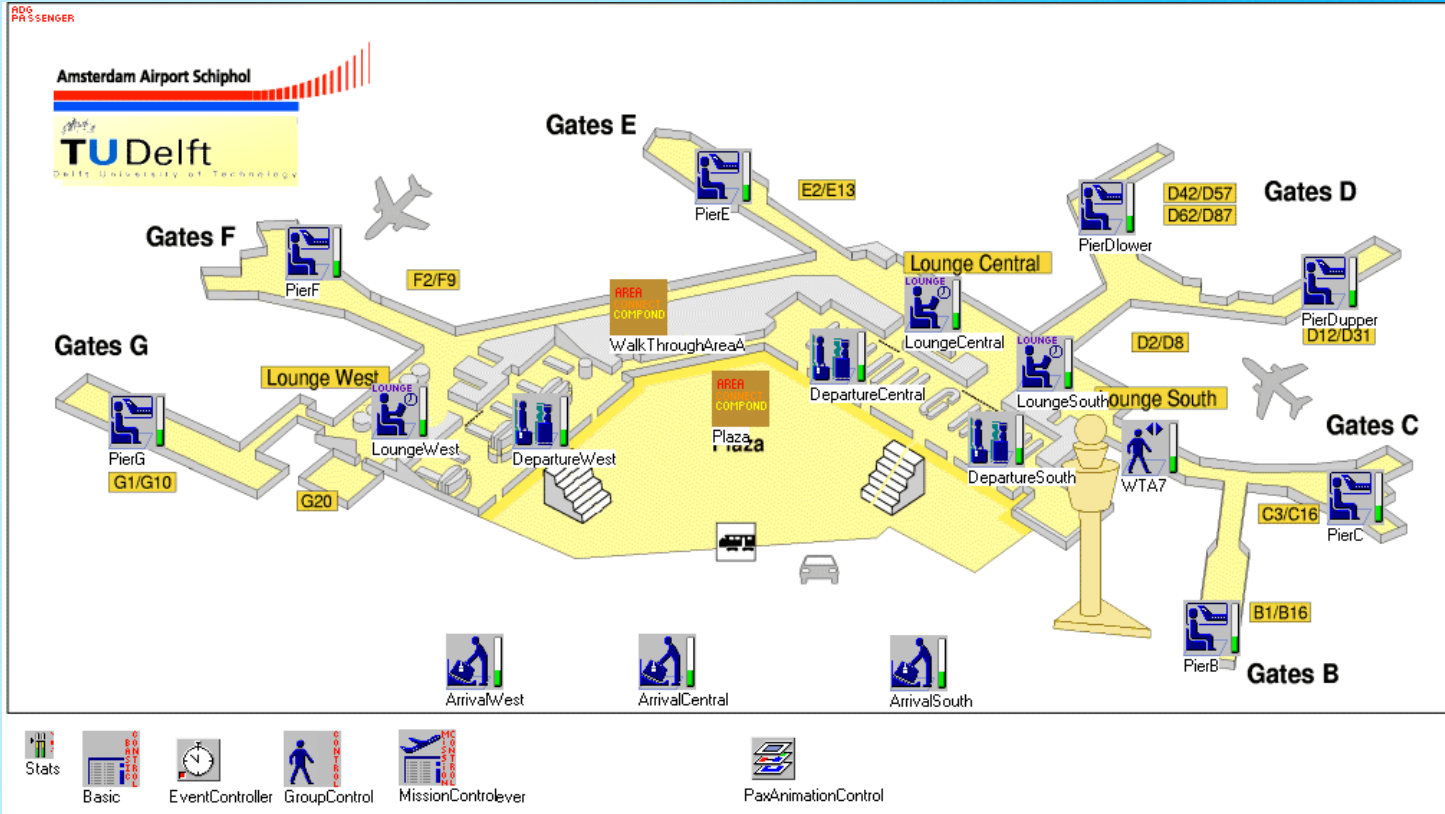
Developments:

- hierarchy
- libraries
- 3D animation
- input/output
- optimization
- extensions
- multi-formalism
- ...

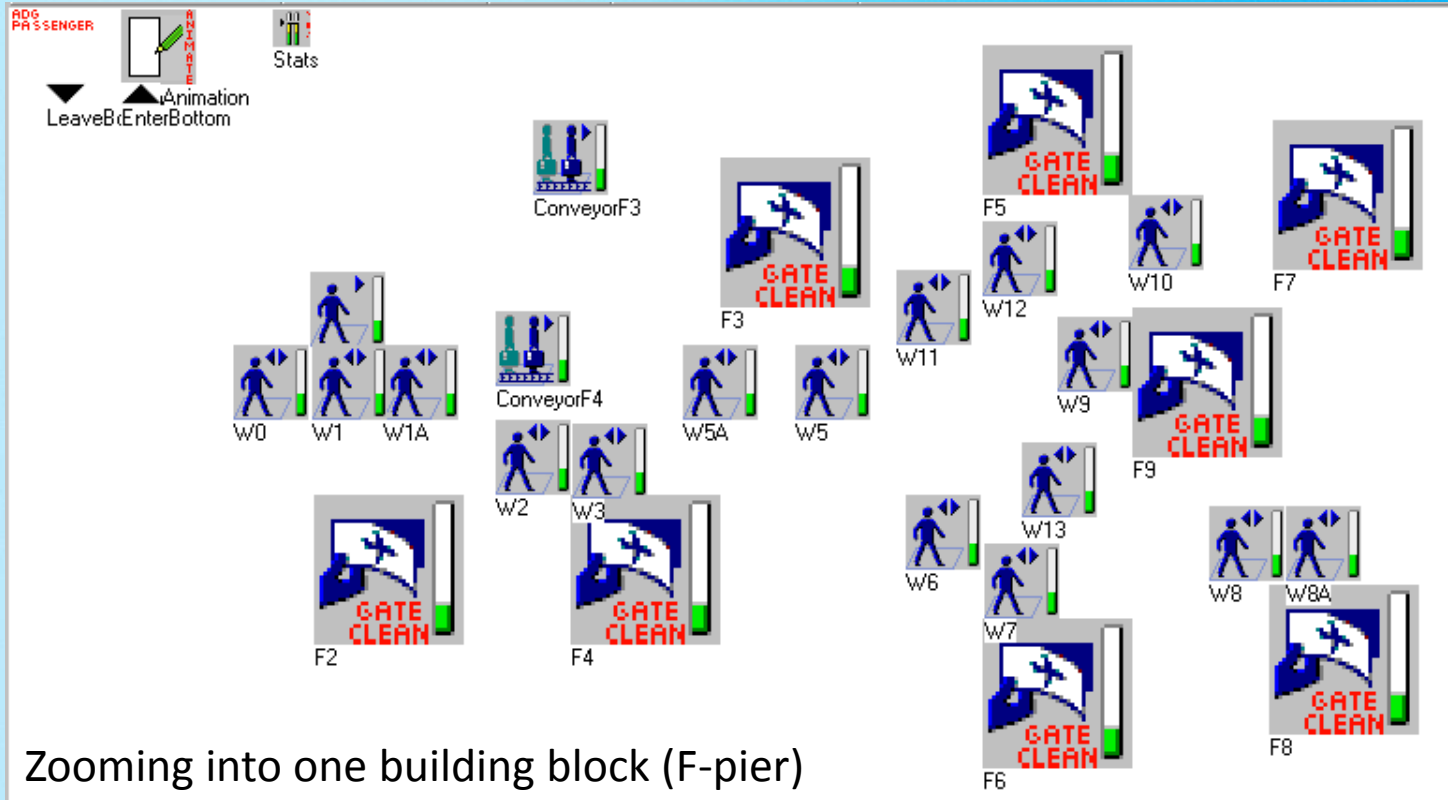
Example case: Airport logistics

- Observations:
 - one-shot models for each type of problem
 - long time to develop each model
 - model coding is quite complex
- Challenge: how to conceptualize and use building blocks
 - existing languages, formalizing concepts
 - new languages and concepts
- Question: can generic problems at airports be tackled in a generic way?
- Goal: one set of simulation libraries for airport logistics, design, and development

Example case: Airport logistics

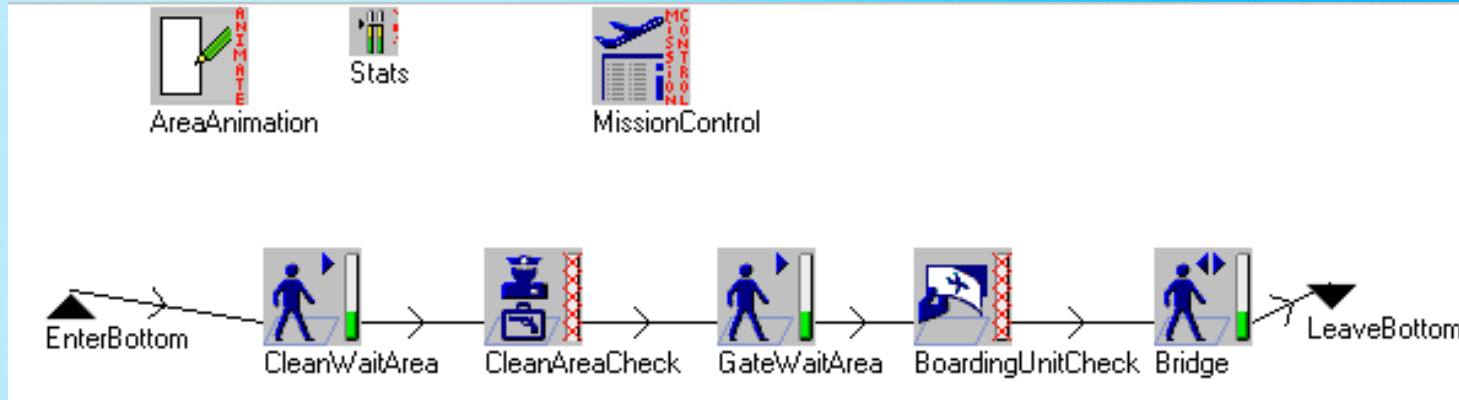


Example case: Airport logistics



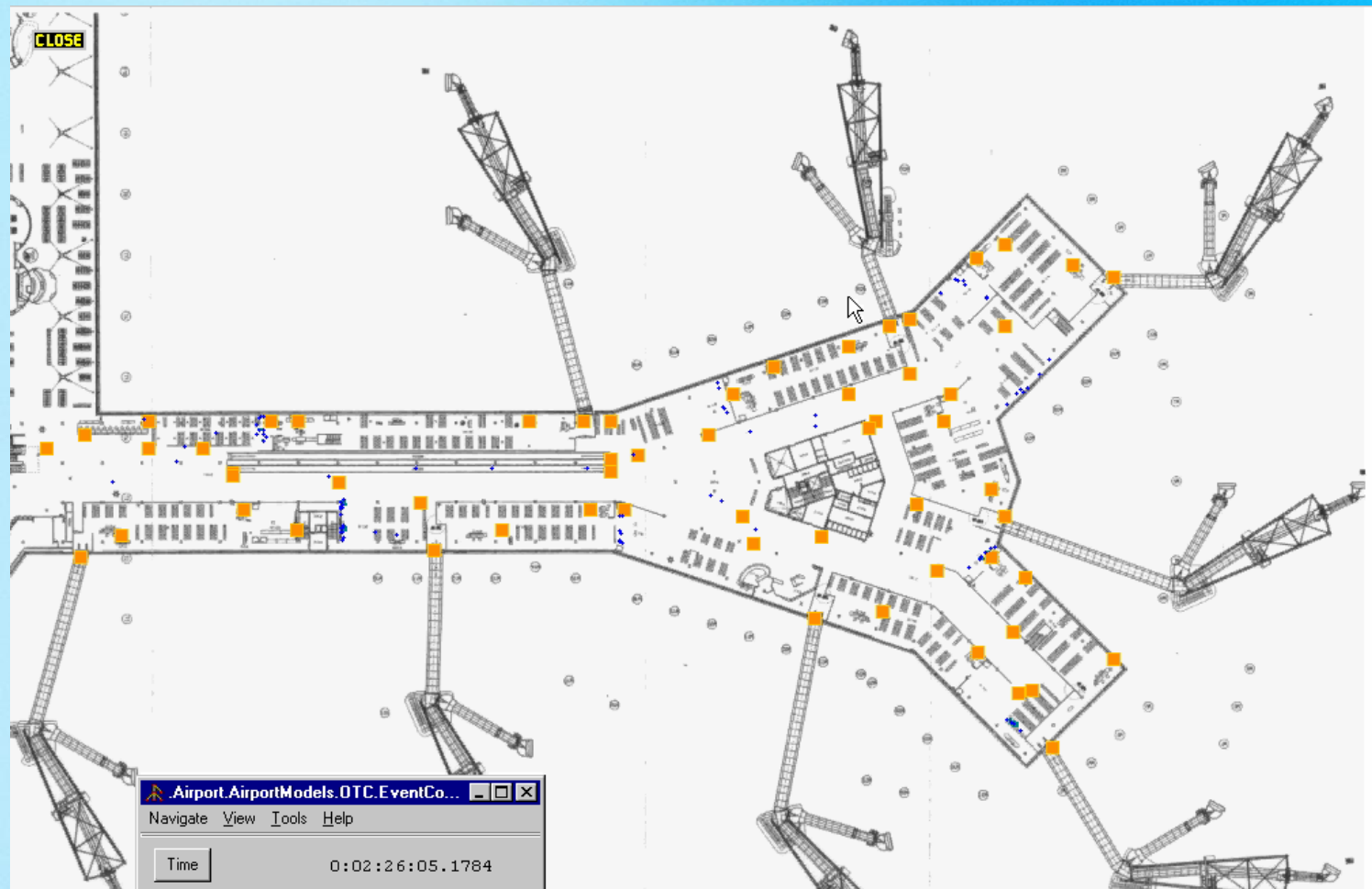
Zooming into one building block (F-pier)

Example case: Airport logistics



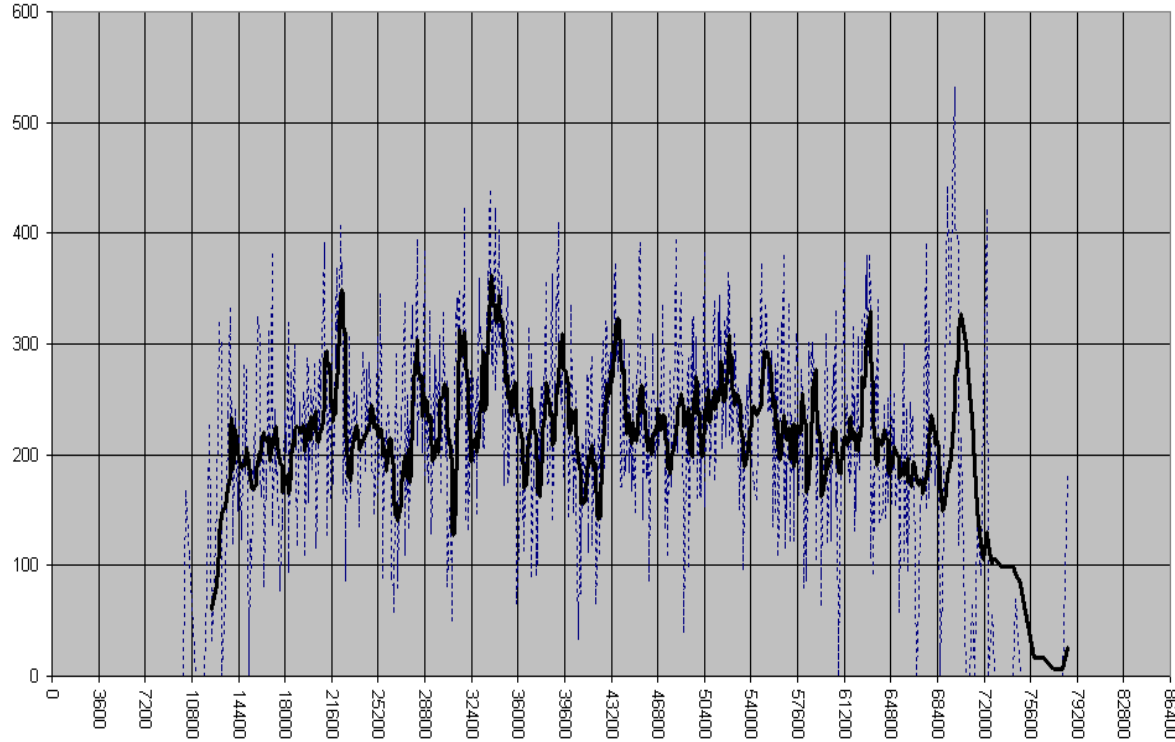
Zooming in further (building block gate F5)

- wait area
- security check
- clean wait area
- boarding control
- bridge



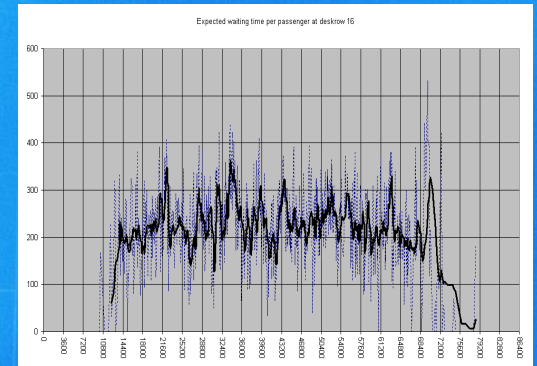
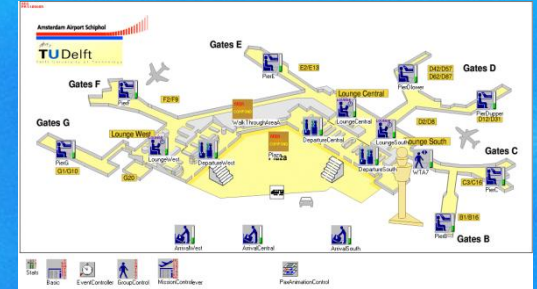
Example case: Airport logistics

Expected waiting time per passenger at deskrow 16



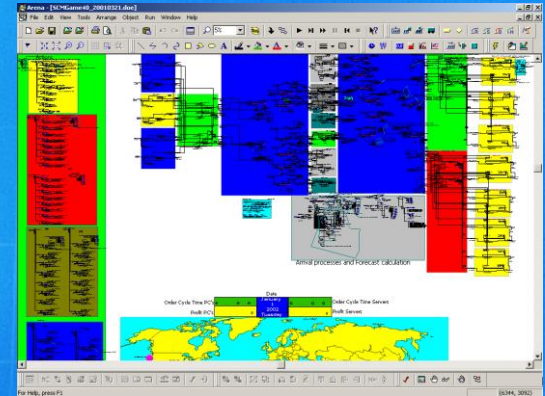
Example case: Airport logistics

- Conclusions
 - one library for passenger terminal logistics at airports
 - infrastructure can be modeled quickly
 - hierarchy helps to reuse earlier efforts
 - models are still complex – a lot of the behavior is hidden
 - more focus on input, output, scenarios needed
 - extensible library is possible

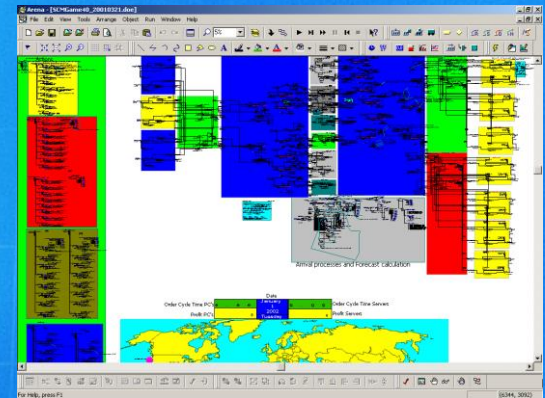
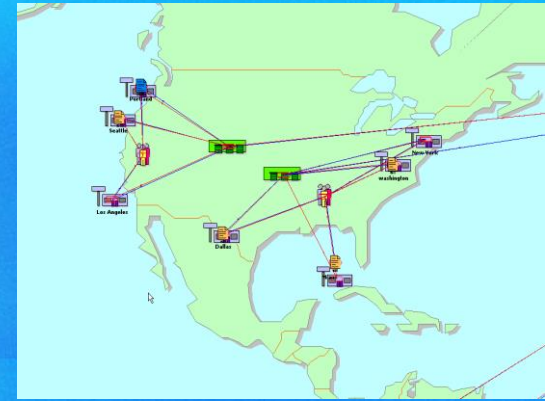
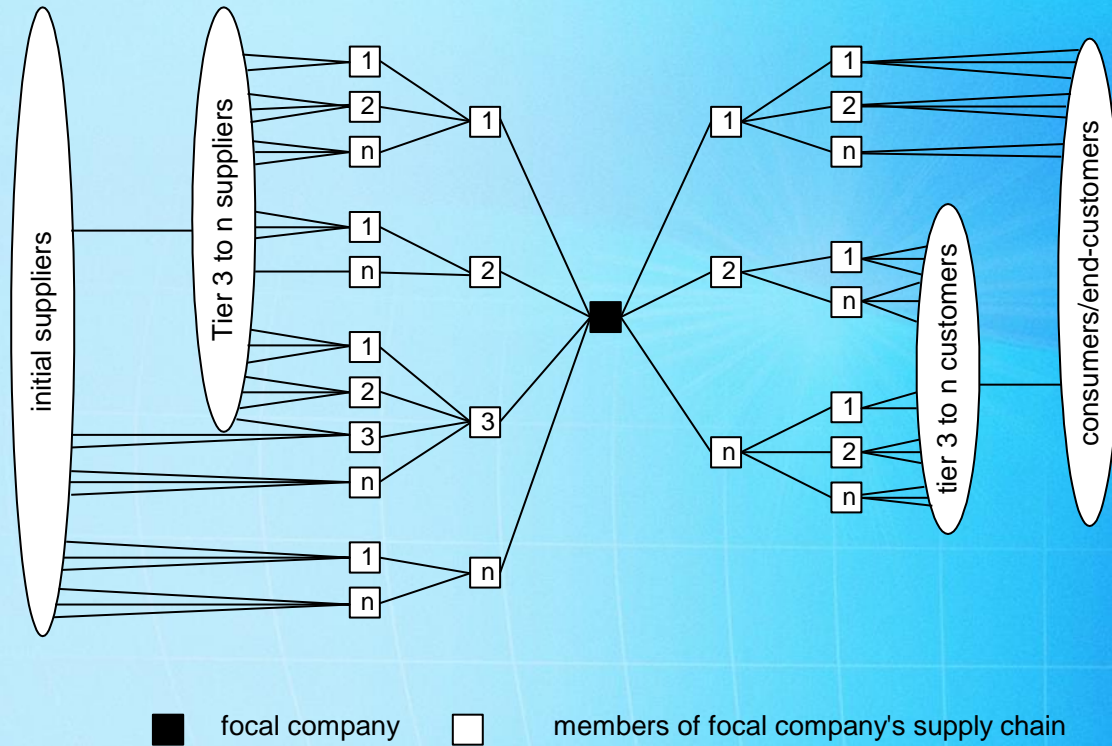


Example case: Supply chain

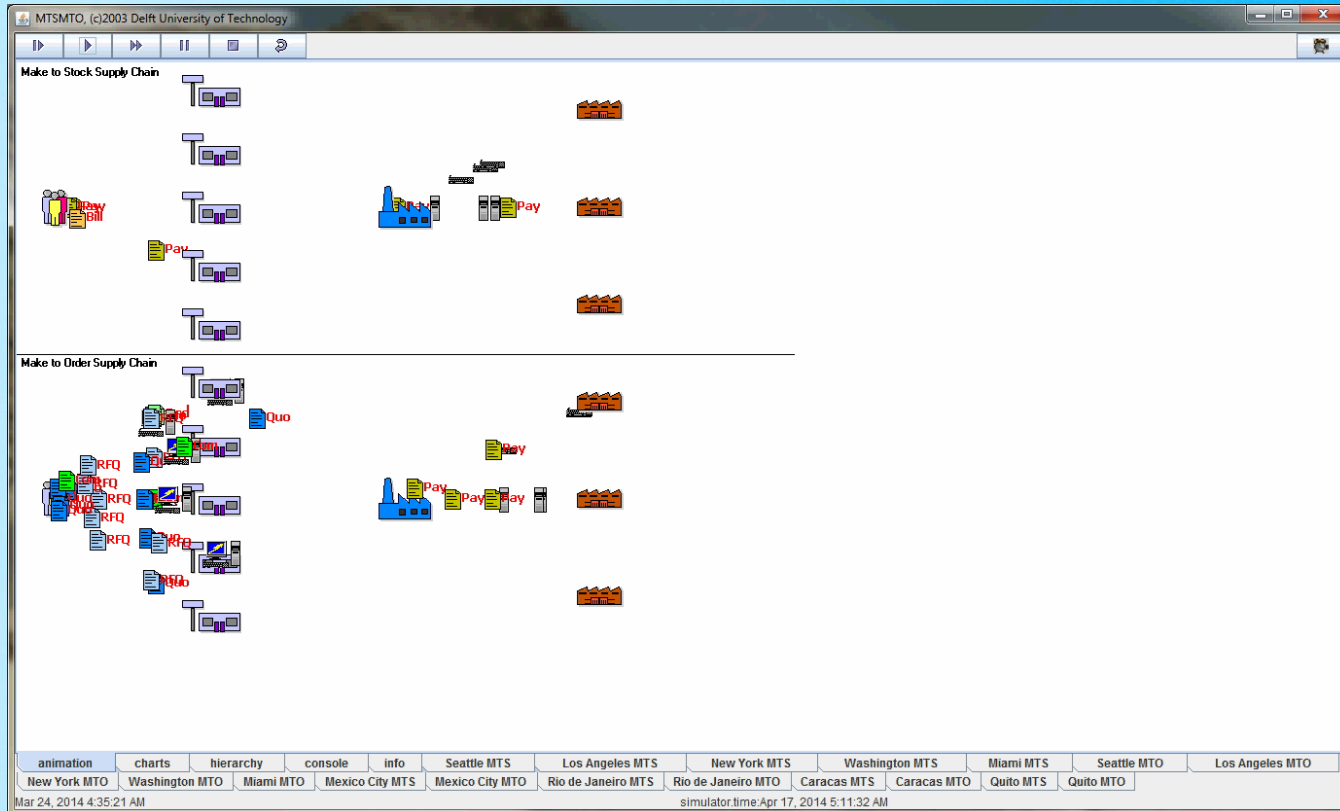
- Observations:
 - many changes in world-wide supply chains
 - time is an important factor
 - business relations are complex
- Challenge: how to create models for multiple scenarios that provide insight
 - compare alternatives
 - output is key
- Question: how can we parameterize models for multiple scenarios
- Goal: a flexible set of simulation models for demonstration and teaching



Example case: Supply chain



Example case: Supply chain



Extended to supply chain gaming

Distributor Game: PARQUI

News Messages Statistics

purchase

messages	Desktop	Laptop	Linux	MMedia
submit & view RFQs	0	0	0	0
place orders	15	21	14	11
unconfirmed orders	0	0	0	0

day	week	month	Desktop	Laptop	Linux	MMedia
Jul 3, 2005						
Jun 26, 2005						
Jun 19, 2005					15.0	
Jun 12, 2005				80.0	15.0	
Jun 5, 2005			15.0		15.0	15.0
May 29, 2005					15.0	30.0
May 22, 2005			30.0	40.0		15.0
May 15, 2005			15.0			
May 8, 2005						
May 1, 2005						

stock on hand: Desktop 10.0, Laptop 1.0, Linux 2.0, MMedia 0.0

committed stock: Desktop 370.0, Laptop 11.0, Linux 30.0, MMedia 40.0

invoices to pay: Desktop 3, Laptop 1, Linux 1, MMedia 3

sales

messages	Desktop	Laptop	Linux	MMedia
RFQs to answer	0	0	0	0
in negotiation	67	61	46	71
orders to confirm	0	0	0	0

day	week	month	Desktop	Laptop	Linux	MMedia
Jul 3, 2005						
Jun 26, 2005						
Jun 19, 2005						
Jun 12, 2005						
Jun 5, 2005					6.0	
May 29, 2005			38.0	32.0	26.0	16.0
May 22, 2005			203.0	19.0	25.0	12.0
May 15, 2005			80.0	31.0	6.0	43.0
May 8, 2005			129.0		11.0	26.0
May 1, 2005						

in transit to cust.: Desktop 0, Laptop 0, Linux 0, MMedia 0

delivered to cust.: Desktop 4, Laptop 5, Linux 9, MMedia 5

unpaid invoices: Desktop 2, Laptop 3, Linux 6, MMedia 4

game time: Jun 3, 2005 00:00

game paused: 792 of 5004

statistics

Stock: on hand

Legend: MMedia (red), Desktop (blue), Laptop (green), Linux (yellow)

Received | Sent | Compose

Subject:

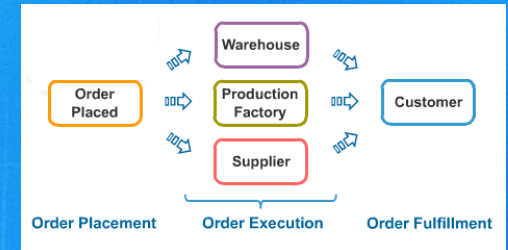
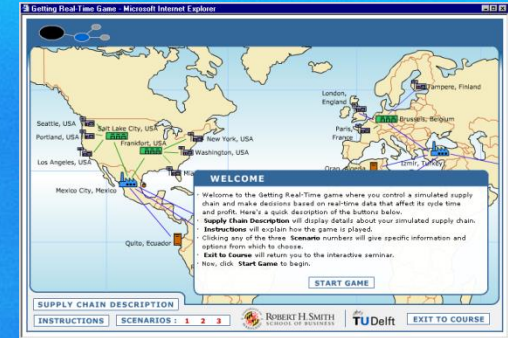
Financial Statements

day	week	month	May 1, 2005	May 8, 2005	May 15, 2005	May 22, 2005	May 29, 2005
income dollars			94	140	112	60597	46675
expenses dollars			10974	9172	7084	5530	15498
total dollars			189120	180087	173115	228183	269259

News

Example case: Supply chain

- Conclusions
 - flexible solutions for supply chain management
 - side-by-side comparison provides insight
 - focus on output
 - simulation libraries for programming languages (Java) used
 - programming libraries form the basis for further development such as games
 - serious games can be developed with a discrete simulation model as 'core'
 - this aligns well with decision making

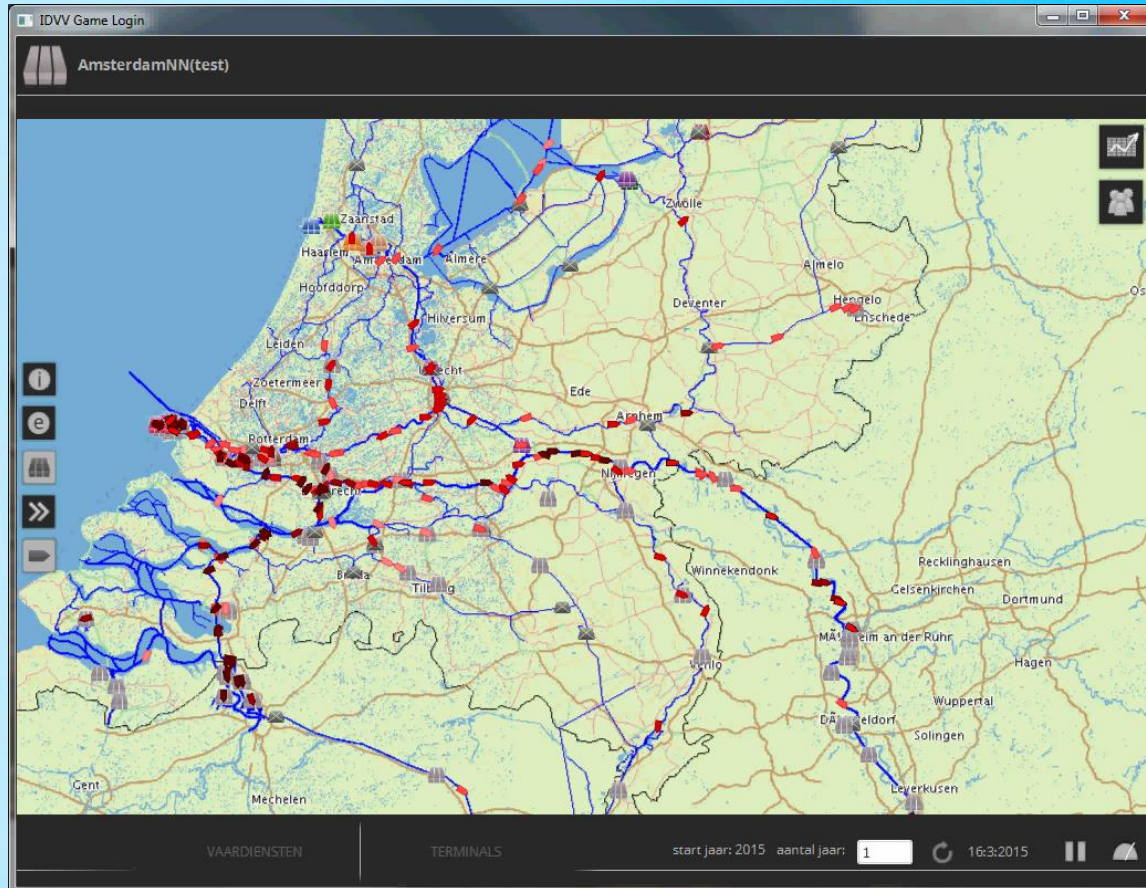


Example case: Barge transport

- Observations:
 - policy studies for long-term transport solutions are hard to carry out
 - need for data-based, fact-based models
- Challenge: models for long-term policy studies using micro-simulation
 - data-driven
 - usable in policy-making sessions
- Question: are micro-level models fast enough and usable in this setting?
- Goal: a micro-level model for barge transportation in The Netherlands that can be used in a policy setting



Example case: Barge transport



Example case: Barge transport

- Conclusions
 - micro-level simulations proved to be possible and effective for long-term decision making
 - discrete-event formalism created fast models
 - participants could use the model and were fully engaged



Thank you for your attention!

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on our discussion forum