Using Situational Simulations to Collect and Analyze Dynamic Construction Management Decision-Making Data

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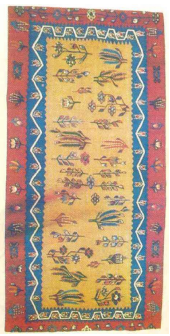
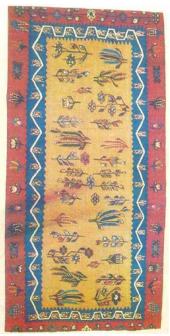


presented by: Nilufer Onder

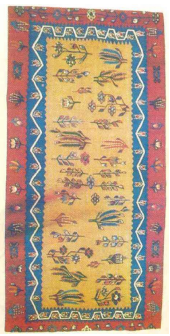
Overview

- ICDMA (Interactive Construction Decision Making Aid)
  - Features
  - ICDMA as a microworld
- Experimental Discipline
  - Designing experiments
  - Collecting data
  - Mining data



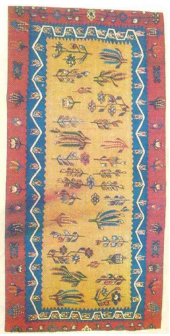
ICDMA

- Matt Watkins' M.Sc. Thesis (August 2008)
- Interactive Construction Decision Making Aid
- Construction management simulator
  - User takes role of managing construction projects
  - Complicating factors (rain, sickness, etc.)
- The user is the decision maker
  - Labor management
  - Material management



Dynamic Task Environment

- Construction management is a dynamic task environment
  - Events occur with time
  - Management decisions update the system status
- Complex yet confined
  - Number of possible decisions is very large
  - Major factors which can influence construction projects are present



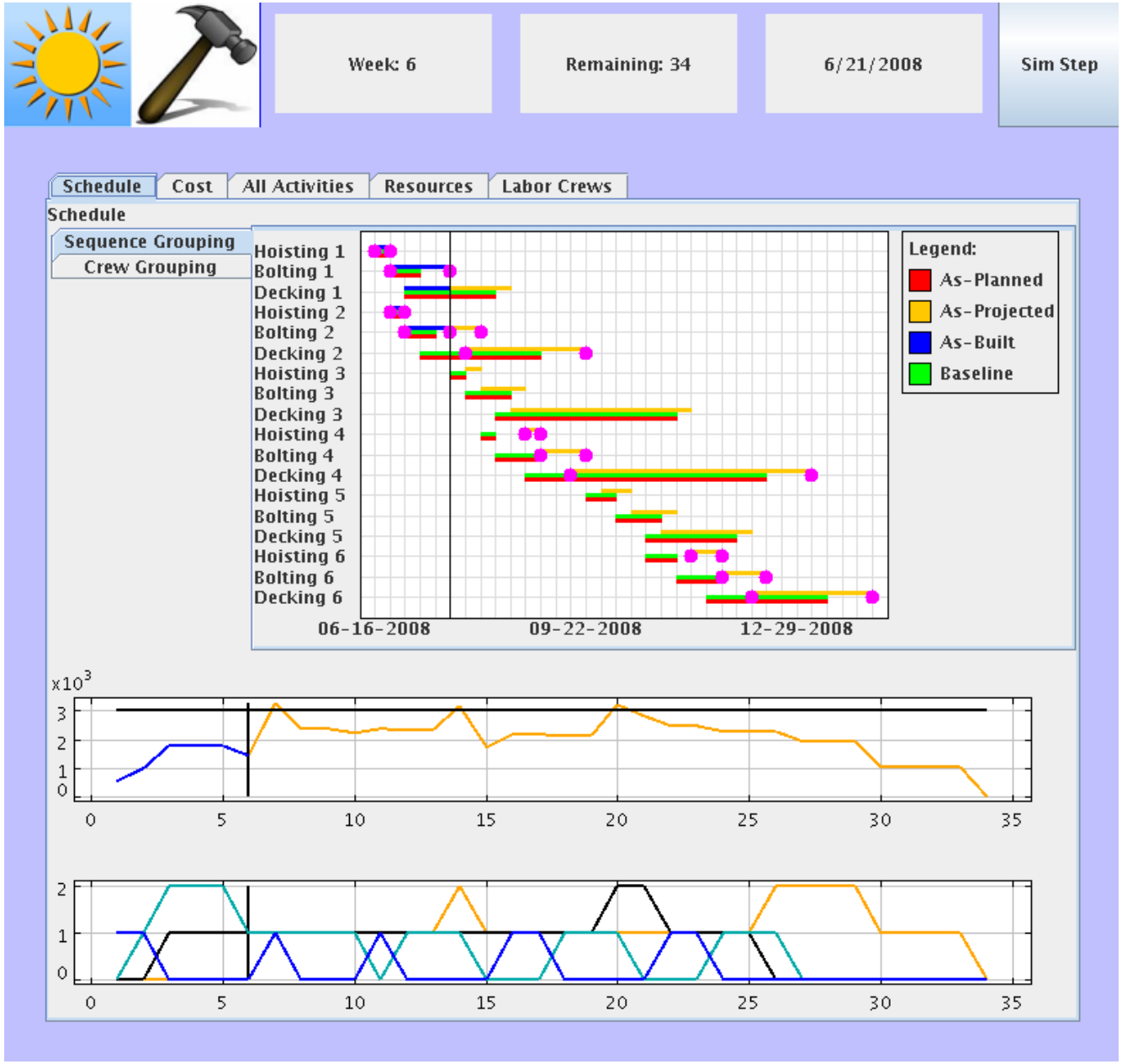
Construction Management

- ICDMA starts with a plan
- Plan changes due to events
  - External
  - Internal
- Manager must make decisions to mitigate damages

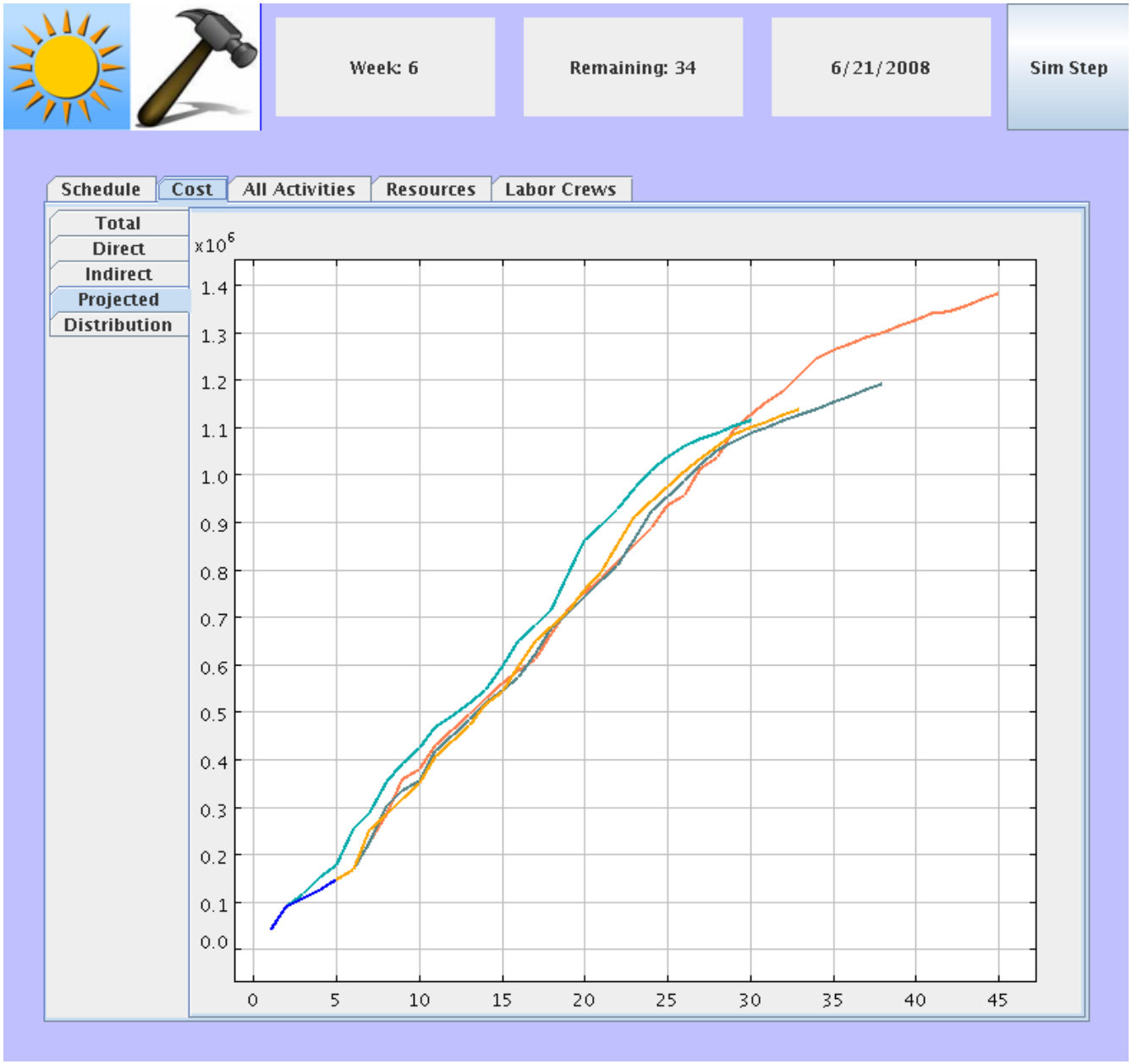
Example Project

- Steel frame building
- Hoisting, bolting, and decking activities for each floor
- Activity constraints (e.g., bolting cannot begin until hoisting is complete)
- A delay in one activity can cause a cascading delay in other activities

Schedule


Week: 6
Remaining: 34
6/21/2008
Sim Step
Schedule
Cost
All Activities
Resources
Labor Crews
Schedule
Sequence Grouping
Crew Grouping
Hoisting 1
Bolting 1
Decking 1
Hoisting 2
Bolting 2
Decking 2
Hoisting 3
Bolting 3
Decking 3
Hoisting 4
Bolting 4
Decking 4
Hoisting 5
Bolting 5
Decking 5
Hoisting 6
Bolting 6
Decking 6
06-16-2008
09-22-2008
12-29-2008
Legend:
As-Planned
As-Projected
As-Built
Baseline
x10^3
3
2
1
0
0
5
10
15
20
25
30
35
2
1
0
0
5
10
15
20
25
30
35

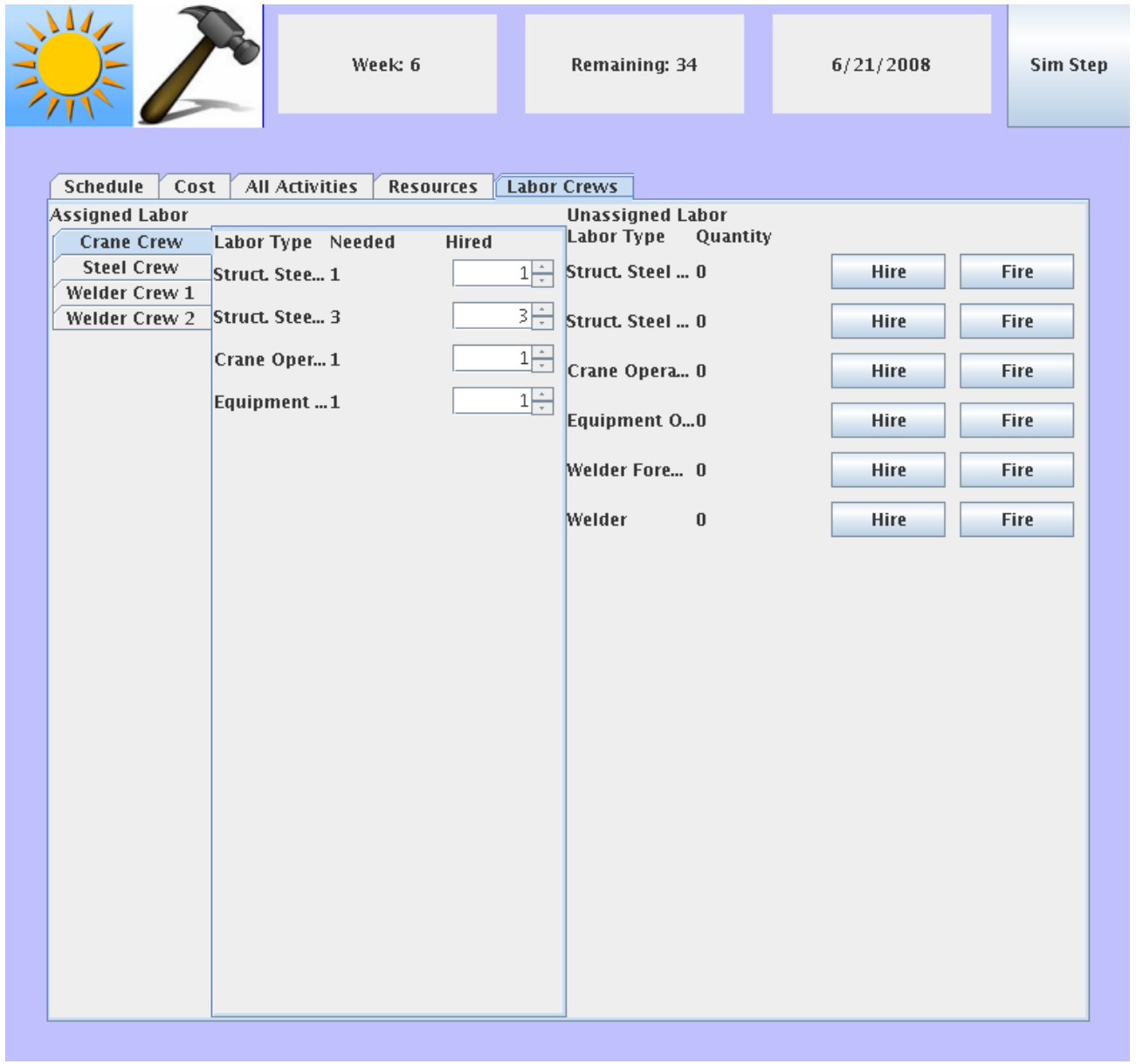
Cost


Week: 6
Remaining: 34
6/21/2008
Sim Step
Schedule
Cost
All Activities
Resources
Labor Crews
Total
Direct
Indirect
Projected
Distribution
x10^6
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
30
35
40
45

Activities

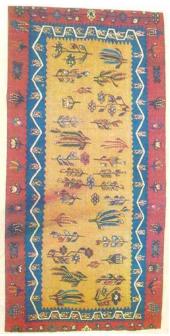

Week: 6
Remaining: 34
6/21/2008
Sim Step
Schedule
Cost
All Activities
Resources
Labor Crews
Hoisting 1
Bolting 1
Decking 1
Hoisting 2
Bolting 2
Decking 2
Hoisting 3
Bolting 3
Decking 3
Hoisting 4
Bolting 4
Decking 4
Hoisting 5
Bolting 5
Decking 5
Hoisting 6
Bolting 6
Decking 6
Cost Summary:
Total Cost: $77544.42
Material Cost: $31386.9
Labor Cost: $21048.0
CSI Division: concrete
Labor Crews: Welder Crew 1
Resources
Labor
Progress
Cost
Activity Completion
Completion (percent)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
30
Time
As-Built
As-Planned
As-Projected

Labor Management



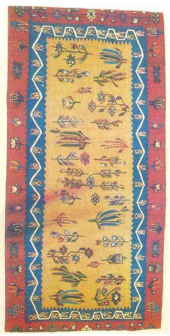
Microworld view

- Enable experimental research
- Relatively simple but has essential characteristics
- Can lead to generalizable results



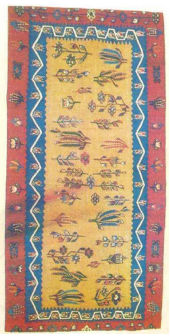
Microworld aspects

- Dynamics: high
  Both autonomous and user initiated changes
- Complexity: moderate
  Number of variables and coupling
- Opaqueness: high
  Invisible external events
- Dynamic complexity: high
  Side effects and ripple effects

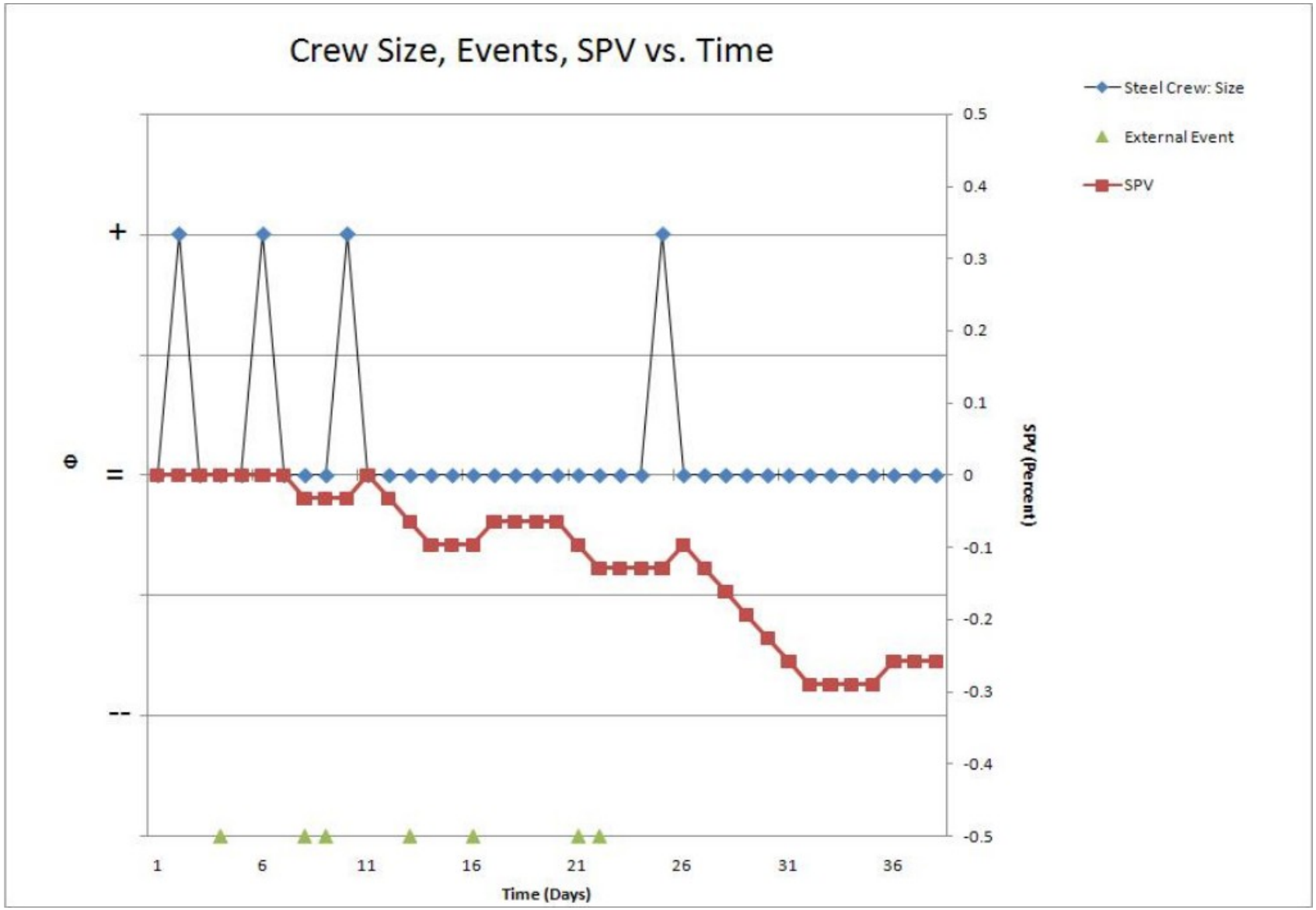


Experimental Procedure

- Design project scenario
- Add problems for the subject to solve
- Educate on the use of ICDMA
- Provide subject with project background information
- Let the subject try to complete the project
  Record the environment values and decisions

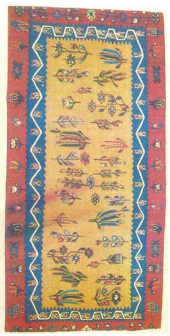


Graph analysis

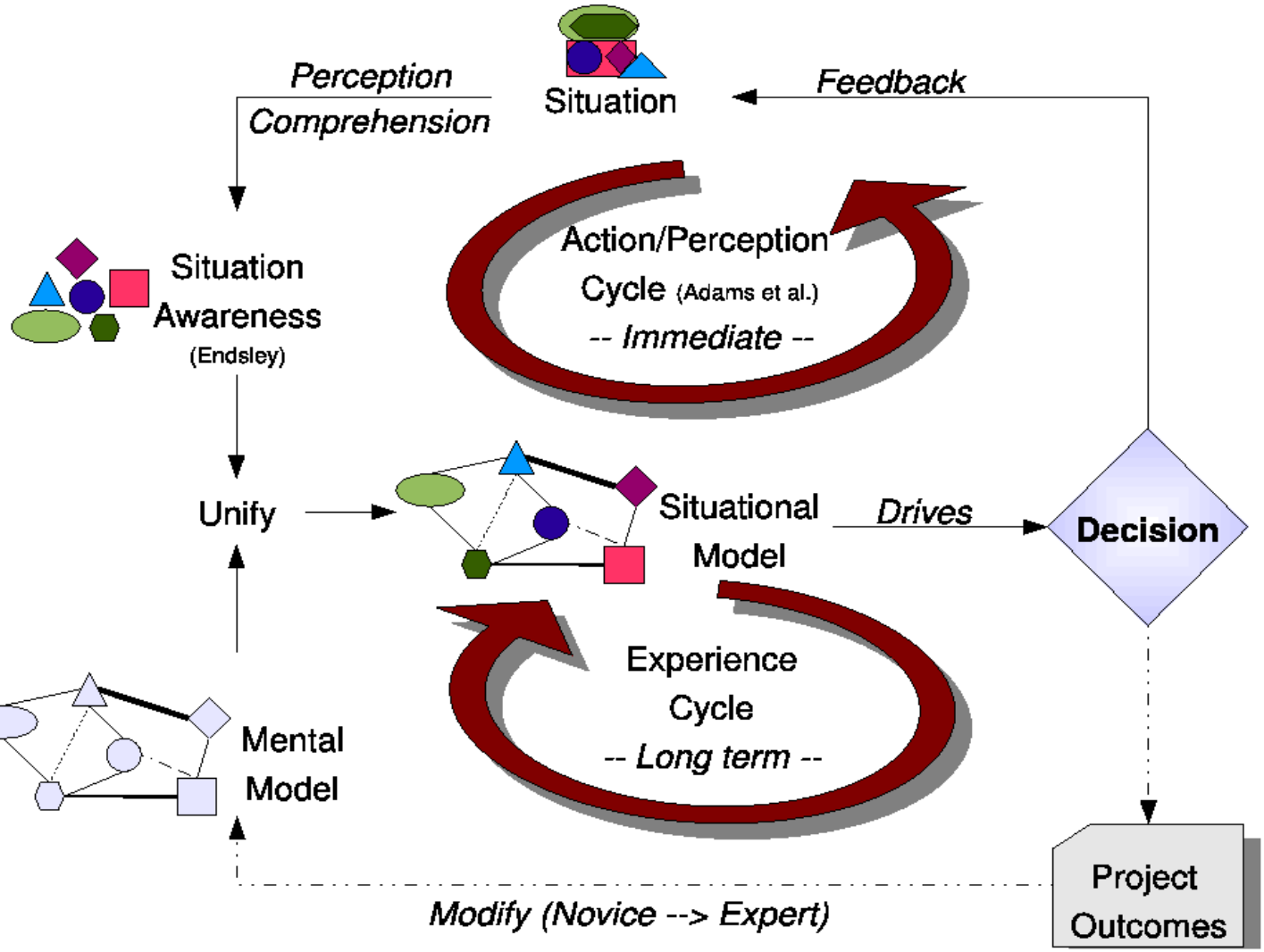


Desired features

- Flexibility in designing experiments
  - Can enter projects in the database
  - Copy and transform projects
- Rich constraints
- Fuzzy boundaries for microworld aspects

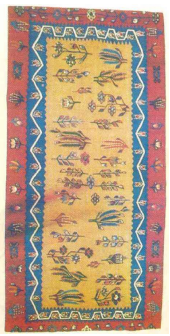


Decision Making



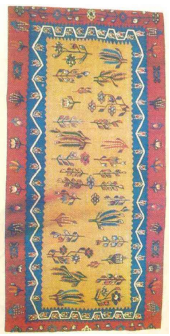
Experimental Design

- SUSP: Single User Single Project
- MUSP: Multiple User Single Project
- SUMP: Single User Multiple Project
- MUMP: Multiple User Multiple Project



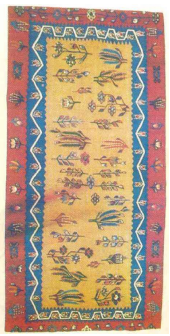
Mining for patterns

- Capturing expertise
- Response to various levels of information
- Prediction capability (on/off)
- Patterns
  - Simple rules
  - Graphical models
  - Probabilistic models



Conclusion and Summary

- A discrete event simulator for construction projects
- The decision maker is situated outside the simulation environment
- External events are coded in an opaque manner
- Assistance in predicting the future
- Future: Adjustable ”cognitive load”
- Future: Education system



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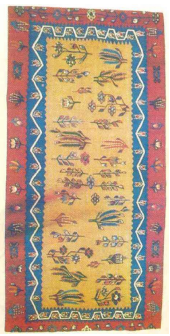

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