Requirements and Benefits of Interactive Information Workspaces in Construction:

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Overview

- Workspaces today, 4D workspaces, interactive workspaces
- Task Framework for requirements/benefits of workspaces
Motivation: Observations of Project Meetings

Does information support decision-making tasks?

Did team utilize information?

Does this meet the milestones in the contract? How does this sequence impact productivity? When do we have access to this area? Why are you starting this activity on this date? What happens if...

Does information support decision-making tasks?

Did team utilize information?

Motivation: Observations of Project Meetings

Paper-Based Workspaces

Interactive Workspaces

4D Workspaces
Focus of Observations

Decision-Making Task Framework

- All these tasks are critical to decision-making
- Good decisions based on ability to perform predictive tasks
**Example of Current Practice**

When do we have access to Area C?

**Conclusions:**
independent unrelated views, must mentally relate information

**Analysis of Current Practice:**

1. When do we have access to XXX?
2. Can we use the space by this building?
3. Where are you placing the crane for erection of XXX?

<table>
<thead>
<tr>
<th>Task/Question</th>
<th>Complexity</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Contract A</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>Relationship/Task Input</td>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>
Analysis of Current Practice:

PREDICTIVE (10%)
Can we get access to the lagoon a week earlier?

DESCRIPTIVE (40%)
When do we have access to Area C?
What wall sections do these numbers refer to?
Where are you placing the crane for erection of XXX?

EXPLANATIVE (20%)
What's driving the finish times for the rides?

EVALUATIVE (30%)
Does this meet contractual milestones?

Most of the time is spent describing information and little time performing predictive tasks or 'what-ifs'.

Example of 4D practice

<table>
<thead>
<tr>
<th>Contract</th>
<th>Contract: Section 6A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of Area D is 8/30/99</td>
<td></td>
</tr>
<tr>
<td>Availability of Area E is 8/30/99</td>
<td></td>
</tr>
<tr>
<td>Availability of Area F is 8/30/99</td>
<td></td>
</tr>
<tr>
<td>Availability of Area G is 8/30/99</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions:
fewer views, but still need to look for relevant information and relate it
Motivation

- 4D practice improves time spent performing descriptive tasks, but does not lead to more predictive tasks.
- Goal: Improve time spent performing predictive tasks.

Workspace Performance Goals

Goals of workspace:
- Reduce time spent performing descriptive, evaluative, and explanatory tasks.
- Reduce effects of task complexity on accuracy, time, and task completion.
Results to Date

• Task Framework
• Workspace Mock-Up Scenarios
• Examples of communication between apps/info. Views

Lessons Learned

• Need standard set of communication messages/tags
• time, space, semantics tie info together
• need for empirical documentation of benefits
Designing and Evaluating Visualization Techniques for Construction Planning:

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Focus of Research

Predictive tasks
“what-if?”
“what happens when?”

Descriptive tasks
“who?, what?, when?, where?”

Explanatory tasks
“why?”

Evaluative tasks
“does this meet?”

Visualization technique

Choose/review alternatives

Selected alternative
**Research Vision**

Use annotative visualization techniques to relate information

**Research Objectives**

1) to empirically assess the usefulness of
   - overlay and
   - highlight visualization techniques
   for AEC decision-making tasks
2) to characterize the ‘fit’ between these visualization techniques and AEC decision-making tasks

**Highlight Example**

- visually relate information in different views
Overlay and Highlight techniques will:

- reduce time spent performing descriptive, evaluative, and explanatory tasks
- reduce effects of task complexity on accuracy, time, and task completion
Metrics to Perform ‘Fit’

- information type
- relationship types
- # of information
- visual form types

Fit Performance Task

Information Presentation

Adapted from Vessey (1991), Dennis and Carte (1998), and Pervan (1995)

Example of Performance Metrics

Analysis of Observed Decision-Making Task

- time
- accuracy
- task completion

Fit in Construction Decision-Making Tasks

Contract

General contractor

Schedule

CM Diagram

- access areas
- site availability

When do we have access to XXX?

Information relationship

2D text temporal chart

Contract

General contractor

Schedule

CM Diagram

- access areas
- site availability

accuracy: low
completed: no

time spent: 5 minutes

task complexity: medium
Method: Charette Test Trials

- Observe Current Practice
- Define Metrics & Design Test Trials
- Prototype CIW
- Test CIW

Interactive catalog
- Baseline metrics
- Set of performance metrics and formalization of test methods
- Demonstrations of CIW visualizations
- Documentation of test results mapping techniques to tasks

Current Work: Workspace Charrettes

- Interactive test to compare visualization techniques
- Uses browser, event heap, and java applets

Browser, java applet, 4D tool

Room Controller
- Theme Park Project
- Schedule

Event heap

Browser heap

Laptop

Question: What initiatives have changed in the revised schedule?
Current Implementation

- Front-end of workspace
- Minimal implementation, prototype only
- Sample Results

In Progress: Implementation

- overface
- workspace database
- project database
- implement small set of relational tags
Implementation Contributions