POP modeling of a green dorm

John Kunz
Class Deliverables

• For the Stanford Sustainable Dorm, submit
  – *POP model*
    • Level-1: the 10 product, organization and process elements that “cost” most
  – *Product, organization & process models* associated with the POP model
    • Level-1 CAD, organization, process models
  – *Description* of POP model content
  – *Description* of POP relationships (Design Narrative)
  – *Final presentation*
POP model content

• Columns
  – Product
  – Organization
  – Process (design + construction)

• Rows:
  – Functions
    • Program Function, Schedule, Cost, Sustainability, ...
  – Forms (design choices)
    • L1: x10
  – Behaviors (predictions)
Design narrative for L-0 POP model

Design-Construct Organization

PM

Plan Design

VDT

Design-Construct Project Duration

Human

Project RFIs

Reasoning

Representation

Information flow

Legend

Designer

Dorm Design

Simple calc

Number of Dorm Beds

Energy calc

Number of BTUs/year

PM

Plan Design

Designer

Dorm Design

Simple calc

Number of Dorm Beds

Energy calc

Number of BTUs/year

Legend

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# Example “Level-0” POP Model

<table>
<thead>
<tr>
<th>Product</th>
<th>Organization</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional requirements and</td>
<td>Required generic physical</td>
<td>Required major milestones and types</td>
</tr>
<tr>
<td>Measurable objectives</td>
<td>spaces, components and systems</td>
<td>of process activities</td>
</tr>
<tr>
<td>House 60 students</td>
<td>Design</td>
<td>Design</td>
</tr>
<tr>
<td>Sustainability &gt; 2002</td>
<td>Build</td>
<td>Build</td>
</tr>
<tr>
<td>comparables by 25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designed forms [~10 each for</td>
<td>Generic space, systems</td>
<td>Organization actors</td>
</tr>
<tr>
<td>Level-1]</td>
<td>and physical elements</td>
<td>Process Milestones and Tasks</td>
</tr>
<tr>
<td>Building Elements: Dorm</td>
<td>Design-build team</td>
<td>Design-build plan</td>
</tr>
<tr>
<td>Predicted behaviors</td>
<td>Capacity</td>
<td>Duration</td>
</tr>
<tr>
<td></td>
<td>RFIs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual Energy use (BTUs)</td>
<td></td>
</tr>
</tbody>
</table>
POP model content

- **Columns**
  - Product
  - Organization
  - Process (design + construction)

- **Rows:**
  - Functions
    - Program Function, Schedule, Cost, Sustainability, ....
  - Forms (design choices)
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Friday, Oct 15

• For the Stanford Sustainable Dorm, develop draft-1
  – POP model
    • Level-1: the 10 product, organization and process elements that “cost” most
  – Product, organization & process models associated with the POP model
    • Level-1 CAD (ADT, other?)
    • Organization (SV)
    • process models (SV, MSP, P3)
  – Description of POP model content
  – Description of POP relationships (Design Narrative)
• Design session results
Green Dorm Functional objectives

- House 60 students
- Energy savings of 25%
- Water savings of 25%
- Interior noise w/ windows closed - less than 30 db
- 50% open space on site
- 50% recycled materials used in construction
- Air quality - 10% above ASHRAE
- Recycling program on each floor
Green dorm architectural sketch
## POP model

<table>
<thead>
<tr>
<th>Function</th>
<th>Organization</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>House 100 students</td>
<td>Excellent stakeholder coordination</td>
<td>on time</td>
</tr>
<tr>
<td>Energy use &lt; 75% of 2002 comparable</td>
<td>Developer organization: design - build - operate</td>
<td>on budget</td>
</tr>
<tr>
<td>Water use &lt; 75% of 2002 comp</td>
<td>on budget</td>
<td>good product</td>
</tr>
<tr>
<td>Interior noise w/windows closed &lt; 30dB</td>
<td>Design QA</td>
<td>build</td>
</tr>
<tr>
<td>50% open space on site</td>
<td>Construction QA</td>
<td>operate</td>
</tr>
<tr>
<td>50% recycled construction materials</td>
<td>Operations QA</td>
<td>Reuse any trees that need to be removed</td>
</tr>
<tr>
<td>Five story</td>
<td>No disturbance &gt; 40 feet from building</td>
<td></td>
</tr>
<tr>
<td>2 person/apartment</td>
<td>Construction noise only 8-5, M-F</td>
<td></td>
</tr>
<tr>
<td>Support apartment-level recycling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Form

| 1 10 apartments/floor | contractor | Architectural design |
| 2 Solar panels | student reps | MEP design |
| 3 "C" foundation pad | architect | structural design |
| 4 laundry per basement | energy consultant | O&M management process |
| 5 elevators + stairs | LEED consultant | pre-project planning |
| 6 Common interior-facing corridor | Donor representative | construction |
| 7 low-water/energy use fixtures | SU operator representative | interior and exterior finishing |
| 8 1 bath/apartment | Regulatory agency: Santa Clara county(?) | Design-construction reviews (Monthly) |
| 9 | Community representative | PM/QA supervision |
| 10 | SU PM | Safety review |

### Behavior

| 1 Measurable observation of functions | FTE total (by month) | schedule conformance |
| 2 POE: Recycling practice | cost (by month) | budget conformance |
| 3 POE: energy use over year-1 | Rework volume (FTE-hours/month) | construction rework =0 |
| 4 POE: water use over year-1 | RFI count; latency | safety: LWI = 0 |
| 5 POE: interior Noise (db) | ECOs/month | design rework ~ 20% |
| 6 POE: resident satisfaction (H, M, L) | staff backlogs | noise < xx db |
| 7 POE: air quality (particulate/cc) | Coordination volume (FTE-hours/week) | O&M per schedule |
| 8 Decision wait time (days) |
| 9 |
| 10 |
POP model content

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Organization Model
Partial, Initial Narrative

What is the Form of Building

Access to Recycle Bins

How LEED Certifiable Is It?

Is it Green?

LEED Score

Our Green Measures

Do we improve the quality of life?

Number of Students per area, etc.

Provide Privacy?

Access to Community?

Number of Students Per room, etc.

Access to Light?

Amount of Daylight

Is it conducive to study?

Study Conductivity

Access to Recycle Bins

Recycle Areas

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Project Organization

What Organization will we use?

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## Process Model

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<thead>
<tr>
<th>Task Name</th>
<th>Oct 10, '04</th>
<th>Oct 17, '04</th>
<th>Oct 24, '04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>structural design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEP design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>O&amp;M management process</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-project planning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>interior and exterior finishing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design-construction reviews (Month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM/QA supervision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety review</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The diagram illustrates the project timeline with milestones and dependencies. The tasks are color-coded to indicate their status and interrelations. The dates Oct 10, '04, Oct 17, '04, and Oct 24, '04 represent key milestones in the project timeline.
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  – *Product, organization & process models* associated with the POP model
    • Level-1 CAD (ADT, other?)
    • Organization (SV)
    • process models (SV, MSP, P3)
  – *Description* of POP model content
  – *Description* of POP relationships (Design Narrative)
+/Δ of the 10/15 POP model

+  
- Intended goals → POP model → graphical representation
- Ability to visualize common project understanding
- Faster project delivery
- Understandable by someone not present
- Observe concrete relationships in POP

Δ  
- Missing cost/schedule predictions
- Lack of clear structural considerations
- Lack of constructability review
- Relationship with previous green-dorm work
- University Constraints?
Next Steps: What

• New content
  – Narrative content
  – Involvement with previous Green Dorm work
  – Build a CAD model (Level 1 ~10 elements)
  – Build VDT model (org. and process)
  – Energy/water comparison with base case (operational cost)
  – Define structural materials/systems → cost
  – Consider constructability issues
Next Steps: When

Original schedule
- Tu Oct 26: Review session-1; plan session-2
- Tu Nov 2: No class (Vote!)
- Tu Nov 9: Guest speaker – Jim Becker, Skanska
- Fri Nov 12: POP modeling session-2
- Tu Nov 16: No class
- Tu Nov 23: No class
- Tu Nov 30: Final presentations

New schedule:
- Tu Oct 26: Review session-1; plan session-2
- Tu Nov 2: No class (Vote!)
- Fri Nov 5: POP modeling session-2
- Tu Nov 9: Guest speaker – Jim Becker, Skanska
- Tu Nov 16: No class
- Tu Nov 23: No class
- Tu Nov 30: Final presentations
Next steps: observations

- Information on what participants did