Left Panel
CIFE Seed Proposal VIS0201
<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>Alternative 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2D Plan View</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Elevation View</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Section View</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3D Perspective</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4D Visualization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Challenges</strong></td>
<td></td>
<td>Higher thermal loads</td>
</tr>
<tr>
<td><strong>Performance Level</strong></td>
<td></td>
<td>More stringent indoor air requirement</td>
</tr>
</tbody>
</table>

**Qualitative Panel**
Center Panel
Developing iRoom visualization technologies to balance cross-disciplinary decision factors

A cost and risk analyses approach to evaluate conceptual alternatives
Objective

enable decision-makers (non-AEC professionals and technical professionals) to evaluate and assess architectural design alternatives more effectively

How?

develop iRoom decision-support views that –

• address interdisciplinary life-cycle impacts through a total project view
• translate technical terms into more easily understandable costs and risks

Based on

two retrospective case studies and the CI FE Flagship/Partner Project

Deliverables

(1) iRoom decision-support views through:

   an evaluative vocabulary and a mechanism for quantifying decision impacts

(2) an iRoom guideline and demonstration of concrete application scenarios
Motivating Case Studies

(1) Helsinki University of Technology
- Auditorium-600 project in Finland
- Decision on architectural feature

(2) Genentech, Inc.
- Biotechnology project
- Decision on spatial configuration (laboratory vs. office location)
• The owner held a design review meeting

• Project architect presented two architectural alternatives: skylight and strip-windows

• Owner representative moderated the meeting and the decision-making process

• During conceptual design phase, building owners make major decisions that have life-cycle influences on their capital facilities

• Building owners hire owner representatives and architects, who coordinate the consultants
• The decision makers were not able to mentally relate all information from the many binders and report.
• The discussion focused on spatial configurations and architectural features.

• Architects drive the meetings where renderings and models surround decision-makers.
• Without technical AEC background, the clients are more attentive to visual materials.
• Rather than choosing between two set alternatives, the owner preferred a hybrid solution

• The team present estimated the difference in cost by adding the component costs from the available cost estimate proposal

• The owners found the cost difference acceptable and went ahead with the hybrid design

• As clients better comprehend the project, they come up with suggestions or “what if” questions

• Available information is discipline-specific, requires decision-makers to mentally synthesize it
The hybrid design revoked mechanical and structural assumptions and led to:

1. Higher thermal loads > larger duct sections > interstitial conflicts
2. Budget ceiling led to cheaper but deeper prefabricated structural system > rework, extra coordination, and change order at the field
3. Higher thermal loads > increase operation cost
4. Less efficient building systems > energy inefficiency > higher cost and adverse impacts

- Ad hoc evaluation and assessment based on the architect’s/owner representative’s technical and interpersonal experiences
- There is no formal mechanism or tool to visualize the ripple effects of a project alternative
VIS0201 proposes a balanced view:

Through iRoom visualization technologies, “cost”, and “risk”

<table>
<thead>
<tr>
<th>Quantitative Factors</th>
<th>Utilize a total cost impact approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rough cost estimates often neglecting interdisciplinary and life-cycle impacts</td>
<td></td>
</tr>
<tr>
<td>Design Cost</td>
<td>$165,000</td>
</tr>
<tr>
<td>Material Cost</td>
<td>$32,000</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$48,980</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$245,980</td>
</tr>
<tr>
<td>Design Cost</td>
<td>$165,000</td>
</tr>
<tr>
<td>Material Cost</td>
<td>$32,000</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$48,980</td>
</tr>
<tr>
<td>Coordination/Rework Cost</td>
<td>$72,30</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$1,364.55</td>
</tr>
<tr>
<td>Life Cycle Operation Cost</td>
<td>$2,113.64</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$3,796.48</td>
</tr>
</tbody>
</table>

Micro Focus

Microscopic discussion of architectural features and spatial configurations

Macro Focus

Assess potential risks across interdisciplinary and life-cycle factors

Qualitative Factors
Precedents

Build upon previous CIFE research:

- Divita (ontology and circle integration)
- Liston (interactive workspace)
- Staub-French (ontology)
- the Virtual Design Team (SimVision)

Approach

Perform retrospective studies on two case examples, capture the experiences from structural engineering, building systems, and facility maintenance.
Research tasks—to develop decision-support views

- Capture and formalize ripple relationships
- Evaluate
- Quantify
- Run cost and risk analyses with VITE and TEI approach
- Visualize
- Design and implement iRoom “executive summary” view
Research tasks—to develop decision-support views

- capture assumptions from different disciplines
- analyze the alternatives through a generalized ontology
- qualitatively evaluate potential cross-disciplinary impacts
Research tasks—to develop decision-support views

- Quantify
- Visualize
- Evaluate

- run cost analyses (LCC, TEI approach)
- conduct risk analyses (VITE/SimVision)
Research tasks—to develop decision-support views

- design and implement iRoom “executive summary” view
- costs and risks as communication vehicle
Research deliverables

(1) iRoom decision-support views

(2) an iRoom guideline for linking decision-support applications

(3) demonstrations of application scenarios
   (case studies and flagship project)
In Support of CIFE Goals

From “2002 Call for Seed Proposal”

• extending display and visualization technologies “iRoom”

• visualization of related project data from different discipline perspectives

• user interfaces for different stakeholders’ “project dashboard”

• methods to identify, manage, and minimize the direct costs of facility management

VIS0201 will take the proposed “CIFE Flagship Project” or the Joensuu University Project by CIFE’s Finnish Partners as a test case
The Reasons

Why iRoom?
To establish a visual focus, leverage on multiple displays, and generate executive summary views

Why costs and risks?
Like graphics or animation, they are communication vehicles to translate technical decision parameters to quantifiable and more easily understandable terms

Why conceptual design alternatives?
influence level, baseline set, relative comparison

Why cross-disciplinary?
To elevate decision-making from a microscopic to a macro focus specifically structural, mechanical, and facility maintenance
**Evaluate:**

<table>
<thead>
<tr>
<th>Architectural</th>
<th>strip windows AND skylight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>grid change… no</td>
</tr>
<tr>
<td></td>
<td>% of thermal load… small</td>
</tr>
<tr>
<td></td>
<td>equipment change… no</td>
</tr>
<tr>
<td>Maintenance</td>
<td>durability, replacement… more vulnerable</td>
</tr>
<tr>
<td></td>
<td>life span… shorter</td>
</tr>
</tbody>
</table>

**Quantify:**

Olof Granlund BSLCC

Vite SimVision Solutions

VITE SimVision

Assessment Panel
Developing iRoom visualization technologies to balance cross-disciplinary decision factors

A cost and risk analyses approach to evaluate conceptual alternatives
Right Panel
Presented by Martin Fischer and Calvin Kam
• Leveraging life-cycle value during early project phase
- Leveraging life-cycle value during early project phase
Analyses of today’s practices

- Micro Focus (e.g., architectural domain specific)
- Macro Focus (e.g., balancing architectural, structural, MEP, construction, and life-cycle interests)
- Quantitative Factors (e.g., cost)
- Qualitative Factors (e.g., aesthetics, risks)
Analyses of today’s practices

Balance relies on the consultants’ technical experiences, due diligence, and interpersonal skills.

Quantitative Factors

Rough cost estimates often neglecting interdisciplinary and life-cycle impacts

Qualitative Factors

Microscopic discussion of architectural features and spatial configurations

Micro Focus

Macro Focus
VIS0201 proposes a balanced view:

Through iRoom visualization technologies, "cost", and "risk"

- **Quantitative Factors**
  - Utilize a total cost impact approach that accounts for interdisciplinary rework, extra coordination, and life cycle impacts
  - Rough cost estimates often neglecting interdisciplinary and life-cycle impacts

- **Qualitative Factors**
  - Assess potential risks across interdisciplinary and life-cycle factors
  - Microscopic discussion of architectural features and spatial configurations

- **Micro Focus**
  - Microscopic discussion of architectural features and spatial configurations

- **Macro Focus**
  - Assess potential risks across interdisciplinary and life-cycle factors
**Total Cost Approach**

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Base Case</th>
<th>Alternative 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Cost</td>
<td>$165,000.00</td>
<td>$165,000.00</td>
</tr>
<tr>
<td>Material Cost</td>
<td>$32,000.00</td>
<td>$32,000.00</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$48,980.00</td>
<td>$48,980.00</td>
</tr>
<tr>
<td>Coordination/Rework Cost</td>
<td>$72,308.00</td>
<td></td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$1,364,555.00</td>
<td></td>
</tr>
<tr>
<td>Life Cycle Operation Cost</td>
<td>$2,113,644.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$245,980.00</td>
<td>$3,796,487.00</td>
</tr>
</tbody>
</table>

**Operation Cost (Present Value)**

**Risk Impact and Likelihood**

**Quality Risk**

**Quantitative Panel**