The big idea:
Integrated Product, Organization and Process design can support, at least, the design, fabrication, assembly and use of new products
## This week overview

<table>
<thead>
<tr>
<th>Day</th>
<th>Take-home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday</td>
<td><em>Introduction:</em>&lt;br&gt;<strong>Theory:</strong> ICE, organizational modeling, big data, templates, VDC POP/FFB framework, types of models&lt;br&gt;<strong>Practice:</strong> ICE session with Templates, Organization-process model and analysis (SimVision) lab</td>
</tr>
<tr>
<td>Thursday</td>
<td><strong>Theory:</strong> Project definition&lt;br&gt;<strong>Practice:</strong> Organization-process model and analysis (SimVision), continued, and big data (SEE-IT) labs</td>
</tr>
</tbody>
</table>
The next three weeks we will …

• Do integrated design and analysis with VDC and the ABC of your POP - FFB based on a PBS, OBS and WBS using ICE, templates and big data …
Tuesday Learning goals

- Get basic familiarity with the POP project framework of VDC
  - Product – Organization – Process (POP)
  - Function – Form – Behavior (FFB)
- Understand class organization, opportunities, methods and expectations
- Motivate interest in Integrated Design enabled by VDC:
  - Opportunities in practice
  - Fun, power and job opportunities of models, model-based analyses
• Big ideas: Integrated design and analysis; elements of VDC
• Introductions
• Models: how to recognize and use different types
• Business goals and objectives
• Course goals (and non-goals)
• Course Organization
• ORID
Introductions

Briefly, please share

• Name
• Field of study
• One personal goal for this class
Agenda

AM session
• Welcome
• Introductions
• Course overview
• VDC models and templates
• ICE-1: Work session-1
• ICE-1 session debrief

PM session
• ICE-1: Work session-2
• ICE-2 session debrief
• Project definition and templates in some detail
• Load web site and software

9 July 2013
Chalmers Integrated Product, Organization and Process Design
Traditional product models

+: Work in practice

\( \Delta \): Ambiguities to stakeholders

\( \Delta \): computer analysis ...?

- Show value to owner
- List components
- Estimate cost
- Plan construction
- Identify interferences
Models

- Physical
- Statistical
- Mathematical
  - Symbolic
  - Graphic
Virtual Design and Construction:
Fundamental method of this integrated design and analysis class

- Use of integrated multi-disciplinary computer-based performance models and analyses of design-construction projects
  - **Product** (building, device, service)
  - Organization
  - Work Process
- to support (explicit, public) business objectives
  - **Describe**: Visualize and describe project
  - **Explain** reasons for designs and choices
  - **Evaluate** choices
  - **Predict** project performance
### Multidisciplinary Design and Analysis – using VDC

<table>
<thead>
<tr>
<th>Disciplines:</th>
<th>Design</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Architecture</td>
<td>• Virtual</td>
<td>• Model-based when possible</td>
</tr>
<tr>
<td>• Engineering</td>
<td>• Graphical</td>
<td>• Quantitative when possible</td>
</tr>
<tr>
<td>• Construction</td>
<td>• Object-based</td>
<td>• Multi-Stakeholder</td>
</tr>
<tr>
<td>• Operations</td>
<td></td>
<td>• Graphical description</td>
</tr>
</tbody>
</table>

**Stakeholders:**

- Design – build professionals
- Owner
- Others
Integrated design and analysis Big Ideas

- Build VDC project models early and often, before committing large money or time
- What
  - Objectives, Designs and Behaviors of Product, process, organization
- How:
  - Detailed: to show the product, process, organization entities that use > 10% of project time, money
  - Virtual: in the computer
  - Visual: multi-discipline, multi-view, for multiple stakeholders
  - Integrated: relating the product, organization and process
  - Objective-based: set and track explicit public objectives
Plus-Delta of Civil Engineering

- Provides fixed physical assets and wealth
- High global demand for infrastructure and housing
- Opportunity to impact global climate challenge significantly
Plus-Delta of Civil Engineering

- Provides fixed physical assets and wealth
- High global demand for infrastructure and housing
- Opportunity to impact global climate challenge significantly
- Low productivity \(\rightarrow\) compete with other ways to spend $  

*US Department of Commerce, compiled by P. Teicholz*

- High energy use and rising energy costs

*Guillermo Gomez, PUCChile*

- Structural reliability \(<\) societal need (Chile)
An example - Malmo, Sweden:

The best example of sustainable development in the world:
  – Best design and analysis methods (~2000)
  – Best construction methods
  – Project provides some good data on performance vs. predicted

But
  • Energy: 20 of 20 buildings used more than predicted
    – Prefabrication needed for intended energy performance
  • Land: much greater density needed even for next project
    – Development model did not last even a decade
  • Data granularity: so coarse that improvement difficult to plan
  • Human capital: people on project mostly lost to next phase
An example - Malmo, Sweden: Message: measure performance

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- Best design and analysis methods (~2000)
- Best construction methods
- Project provides some good data on performance vs. predicted

But

- Energy: 20 of 20 buildings used more than predicted
  - Prefabrication needed for intended energy performance
- Land: much greater density needed even for next project
  - Development model did not last even a decade
- Data granularity: so coarse that improvement difficult to plan
- Human capital: people on project mostly lost to next phase
Malmo, Sweden: Actual energy much worse than Predicted

Estimated & Observed District Heating Energy in Malmo, Sweden by Building
Malmo, Sweden: Actual energy much worse than Predicted
Fundamental issue: outcome reliability

- Structures (Chile, post-earthquake) -- good:
  - ~500K/~5M homes damaged or destroyed: $<2\sigma$
  - ~4 joint failures /~100 in (collapsed) buildings: $2\sigma$
  - 4/~10,000 post-1985 buildings collapsed in major damage area: $>3\sigma$

- Energy – not good:
  - 20/20 buildings used more energy than predicted – Malmo, Sweden, 2001 (range 70 – 340% greater)
  - 121 LEED buildings use 30% more energy per square foot than average for U.S. buildings

- Neither structure nor energy performance meets societal needs
Fundamental issue: *process reliability*

- **Structures (Chile, post-earthquake)**
  - ~4 joint failures /~100 in (collapsed) buildings: $2\sigma$
- **Sources of failure - infrequent but important problems:**
  - quality of joint construction, material composition, soft story design, asymmetrical designs
- **Energy:**
  - ↑ prediction variability:
    - ↑ Inter-tool with same designer
    - ↑ Inter-consultant with same tool
  - ↑ component performance variability, e.g., infiltration from leaky building joints (Malmo)

- **Structure and energy performance:**
  - Good (historically), but
  - *Neither meets societal needs ➔ need to manage risk*
# AEC Breakthrough Objectives

<table>
<thead>
<tr>
<th></th>
<th>Practice: 2002</th>
<th>Objective: 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Schedule</strong></td>
<td>1-6 y Design</td>
<td>1 y Design</td>
</tr>
<tr>
<td></td>
<td>~1.5 y Construct</td>
<td>&lt; .5 y Construct</td>
</tr>
<tr>
<td></td>
<td>Variance 5-100%</td>
<td>Variance &lt; 5%</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Variance 5-30%</td>
<td>Variance &lt; 5%</td>
</tr>
<tr>
<td><strong>Delivered quality</strong></td>
<td>Large Variance</td>
<td>0 variance, by POE</td>
</tr>
<tr>
<td></td>
<td>Good?</td>
<td>Great, by POE</td>
</tr>
<tr>
<td></td>
<td>Productivity impact?</td>
<td>++ productivity</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Good</td>
<td>Better</td>
</tr>
<tr>
<td><strong>Sustainability</strong></td>
<td>Poor</td>
<td>25% better than 2002</td>
</tr>
<tr>
<td><strong>Globalization</strong></td>
<td>Some</td>
<td>&gt;= 50% of supply and sales</td>
</tr>
</tbody>
</table>
(Multiple) Predictable performance objectives: 
*Changed in 2010

<table>
<thead>
<tr>
<th>Controllable</th>
<th>Process [Conformance to plans]</th>
<th>Outcome [Performance]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product, organization, process designs</strong></td>
<td><strong>Latency:</strong> mean $\leq 1$; 95% within 2 working days</td>
<td><strong>Safety:</strong> 0 lost hours</td>
</tr>
<tr>
<td><strong>Coordination activity:</strong> planned, explicit, public, informed $&gt; 90%$</td>
<td><strong>Field-generated Requests for Information:</strong> 0</td>
<td><strong>Schedule:</strong> 95% on-time performance</td>
</tr>
<tr>
<td><strong>Facility managed Scope:</strong> 100% of items with $&gt; 2%$ of value, time, cost or energy</td>
<td><strong>Rework volume:</strong> 0 (for field construction work); objective = 10-20% (virtual work)</td>
<td><strong>Cost:</strong> $\geq 95%$ of budgeted items within 2% of budgeted cost</td>
</tr>
<tr>
<td><strong>Prediction basis:</strong> $&gt; 80%$ of predictions founded</td>
<td><strong>Function (quality) conformance (%)</strong>: $\geq 99%$</td>
<td><strong>Delivered Scope:</strong> 100% satisfaction</td>
</tr>
<tr>
<td><strong>Design versions:</strong> 2 or more $\geq 80%$</td>
<td><strong>Schedule conformance (%)</strong>: $\geq 80%$</td>
<td><strong>Sustainability:</strong> $&gt; 75%$ better energy, water, materials, than 2002, profitably</td>
</tr>
<tr>
<td><strong>Staff trained in VDC:</strong> $\geq 4$/project</td>
<td><strong>Cost conformance (%)</strong>: $\geq 95%$</td>
<td><strong>Success</strong></td>
</tr>
</tbody>
</table>

- **Success**
Wasted human, technical, and biological resources
VDC models use and require lots of tools

- Learning use of these tools beyond scope of this class

<table>
<thead>
<tr>
<th>Project specifications</th>
<th>Product</th>
<th>Organization</th>
<th>Process</th>
<th>Integrated project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product functional objectives (goals)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Product systems and components scope</td>
<td>yes</td>
<td>yes</td>
<td>some</td>
<td>names</td>
</tr>
<tr>
<td>Product behavior specification and values</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Organization functional objectives (goals)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Organization responsibility for components, systems &amp; tasks</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>names</td>
</tr>
<tr>
<td>Organization scope</td>
<td>yes</td>
<td>names</td>
<td>names</td>
<td>names</td>
</tr>
<tr>
<td>Organization behavior specification and values</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Process Task functional objectives (scope)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>names</td>
</tr>
<tr>
<td>Process Task scope</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Process behavior specification and values</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Project goals and assessed goodness</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Project options</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Project preferences, qualitative threshold values</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Integrated design and analysis – using VDC – provides

Integrating theoretical framework to

- Describe functional intent and designs
- Describe and predict engineering behaviors
- Systematically manage projects and the business using the predictions and observed data, to
  - Achieve measurable business objectives
  - Address reliability
VDC model content:
VDC templates help make managerial levers visible to all

- Elements of a project that can and must be managed:
  - *Product*
  - *Organization*
  - *Process* (design + construction)

- Views of each element that can and must be managed
  - *Functional intent*
    - Program Function, Schedule, Cost, Sustainability, ….
  - *Form* (Scope) -- design choices for project elements
    - Physical, organizational, process task elements
  - *Behaviors* (predicted, observed)
    - Quality (Functional performance), Cost, Schedule, Safety
In-class exercise - Tuesday

For a new-generation smart phone app, sketch and define:

- **Product**
  - Functions: product design intent, to include
    - Functions
    - User interface (UI)
    - Additional services
  - Design forms: designed scope, e.g., buttons, ...
  - Behaviors: observable (or estimated) performance, e.g.,
    
    \[
    \# \text{designed buttons} = \# \text{actual} = 3
    \]

- **Organization**: teams to design, build, test
- **Process**: tasks to design, build, test
In-class exercise - Tuesday

Deliverables:
- **Sketches**: product, organization, process
- **Templates** (you create them):
  - Deliverables
  - Metrics and Assessed performance
  - Controllable factors
  - Risks and Next Steps

Process:
- Groups of ~4
- 20 minutes for ICE session x 2
- 10 minutes for presentations, discussion after each session
- Lunch break between sessions
Submission-1: Homework for this week

Deliverables:

- **Sketches**: product, organization, process
- **Templates**: – Deliverables

<table>
<thead>
<tr>
<th>Lab Deliverables</th>
<th>Planned deliverables</th>
<th>Deliverable format</th>
<th>Responsible team, individuals</th>
<th>Receiving team</th>
<th>Due date</th>
<th>Due date met (Yes/No)?</th>
<th>Expected LOD</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM per spec</td>
<td>BIM</td>
<td>Each individual</td>
<td>class</td>
<td>today</td>
<td>Yes</td>
<td>per spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIM conformance check</td>
<td>Excel spreadsheet</td>
<td>Class partner</td>
<td>class</td>
<td>today</td>
<td>Yes</td>
<td>per spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room schedule</td>
<td>Excel spreadsheet</td>
<td>Each individual</td>
<td>class</td>
<td>today</td>
<td>Yes</td>
<td>per spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window and door schedule</td>
<td>Excel spreadsheet</td>
<td>Each individual</td>
<td>class</td>
<td>today</td>
<td>No</td>
<td>per spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4D animation</td>
<td>Movie in .avi format</td>
<td>Each individual</td>
<td>class</td>
<td>today</td>
<td>Yes</td>
<td>per spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments on 4D</td>
<td>Annotations on BIM</td>
<td>Each individual</td>
<td>class</td>
<td>today</td>
<td>Yes</td>
<td>per your judgment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Submission-1: Homework for this week

Deliverables:
- **Sketches**: product, organization, process
- **Templates**:
  - Deliverables
  - Metrics and Assessed performance

### Deliverables:
- **Sketches**: product, organization, process
- **Templates**:
  - Deliverables
  - Metrics and Assessed performance

### Metrics

<table>
<thead>
<tr>
<th>Name</th>
<th>Comment</th>
<th>Target value</th>
<th>Tolerance: +/5</th>
<th>How to use in management</th>
<th>Source of data</th>
<th>Type [P, O]</th>
<th>Stakeholders who saw data last week</th>
<th>Collection frequency</th>
<th>Objective Weight</th>
<th>Predicted/measured value (how you are doing)</th>
<th>Assessed value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Quality: POE satisfaction wrt program (%)</td>
<td>100</td>
<td>5</td>
<td>Guide commissioning, next job</td>
<td>Client assessment</td>
<td>O</td>
<td>Owner only</td>
<td>Turnover time &gt; 6-24 months</td>
<td>40</td>
<td>86</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>Cost conformance to plan (item actual - predicted/predicted)</td>
<td>100</td>
<td>5</td>
<td>Plan next job</td>
<td>Client assessment</td>
<td>O</td>
<td>PM only</td>
<td>Turnover time &gt; 6-24 months</td>
<td>40</td>
<td>86</td>
<td>1</td>
</tr>
<tr>
<td>T</td>
<td>Schedule conformance to plan (%)</td>
<td>100</td>
<td>10</td>
<td>Plan next job</td>
<td>Client assessment</td>
<td>O</td>
<td>All on team</td>
<td>Turnover time &gt; 6-24 months</td>
<td>40</td>
<td>86</td>
<td>1</td>
</tr>
<tr>
<td>P</td>
<td>Predicted Cost conformance to plan (item actual - predicted/predicted)</td>
<td>100</td>
<td>5</td>
<td>Attention management</td>
<td>Periodic project progress report</td>
<td>P</td>
<td>Subteam only</td>
<td>Weekly</td>
<td>40</td>
<td>86</td>
<td>1</td>
</tr>
<tr>
<td>I</td>
<td>Production schedule conformance to plan (%)</td>
<td>90</td>
<td>10</td>
<td>Attention management</td>
<td>Periodic project progress report</td>
<td>P</td>
<td>Owner only</td>
<td>Weekly</td>
<td>40</td>
<td>86</td>
<td>1</td>
</tr>
</tbody>
</table>
Submission-1: Homework for this week

Deliverables:

- **Sketches**: product, organization, process
- **Templates**:
  - **Deliverables**
  - **Metrics and Assessed performance**
  - **Controllable factors**

<table>
<thead>
<tr>
<th>Factor Type</th>
<th>Factor</th>
<th>Range of options</th>
<th>Constraints</th>
<th>Action(s) for this week</th>
<th>Action Taken? (Yes, Partial, No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Detail of water line in 3D</td>
<td>Features of size from 1 mm to &gt; 1m</td>
<td>None important</td>
<td>Model features size &gt; 20 mm</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>Location of in-water equipment</td>
<td>Adjust both equipment location, water width/depth profile</td>
<td>Size of equipment</td>
<td>Model equipment located in water this week</td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>Number of BIM authors</td>
<td>&lt;1 – many FTEs</td>
<td>Adjust author count up and down slowly</td>
<td>Budget BIM author work</td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>Number of BIM reviewers</td>
<td>Author team – hundreds</td>
<td>Size of BIM review facility</td>
<td>Budget BIM reviewer work</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Construction duration</td>
<td>6 months to 2 years</td>
<td>Need to plan prefabrication early to shorten construction period</td>
<td>Get owner preference</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>Size of weekly pre-con tasks</td>
<td>One task for whole team/week to all tasks with &gt; 0.5 FTE-day</td>
<td>Availability of staff to plan, manage schedule</td>
<td>Build short-interval production plan and schedule at feasible LOD</td>
<td></td>
</tr>
</tbody>
</table>
Submission-1: Homework for this week

Deliverables:

- Sketches: product, organization, process
- Templates:
  - Deliverables
  - Metrics and Assessed performance
  - Controllable factors
  - Risks and Next Steps

### Risks - Example

<table>
<thead>
<tr>
<th>Identified risk</th>
<th>Potential impact of risk ($, time, effort)</th>
<th>Severity: Low, Medium, High</th>
<th>Parties affected by risk</th>
<th>Individuals responsible for mitigating design, approval</th>
<th>Earliest analysis/last responsible moment dates</th>
<th>Mitigation activity</th>
<th>Resolution date met (Yes/No)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM ready partner teams available</td>
<td>Dramatic schedule</td>
<td>High</td>
<td>Client</td>
<td>Early partner relationship team</td>
<td>Day-1/ end of concept phase</td>
<td>BIM training for partner staff</td>
<td>Best estimate</td>
<td>BIM ready partner teams available</td>
</tr>
<tr>
<td>Sea level rise</td>
<td>Costs/curtailed operations</td>
<td>Medium</td>
<td>Operations</td>
<td>Concept design team</td>
<td>Day-1/ end of Concept</td>
<td>Dikes</td>
<td>100%</td>
<td>Sea level rise</td>
</tr>
<tr>
<td>Government plan OK</td>
<td>Delay open day</td>
<td>Medium</td>
<td>Operations</td>
<td>Core group</td>
<td>Day-1/ facility open</td>
<td>Engage government review</td>
<td>Next quarter</td>
<td>Government plan OK</td>
</tr>
<tr>
<td>Paint spec unclear or inappropriate</td>
<td>Cost: use contingency; schedule delay</td>
<td>Low</td>
<td>Client</td>
<td>Core group</td>
<td>Day-1/ facility open</td>
<td>Vet across different examples</td>
<td>Next year</td>
<td>Paint spec unclear or inappropriate</td>
</tr>
</tbody>
</table>

### Next Steps

<table>
<thead>
<tr>
<th>Personal goal or objective</th>
<th>Action (what you plan)</th>
<th>Process (how you will do the work)</th>
<th>Frequency (how often you will do the work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next quarter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group goal or objective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tuesday afternoon

- **ICE session**: project definition using templates
- SimVision lab (continued Thursday)
- Introduction to Big Data; **SEE It Lab**
Business uses of VDC template models

• At a glance, identify:
  – Most important (e.g., top-10) Functions and Scope (Forms) of the Product, Organization, Process?
  – Metrics to measure; current predicted behaviors?
• Identify product, organization and process elements with greatest risk.
• For the most important or highest risks, check that:
  – Product forms have associated actors and tasks with risks that compound or mitigate the product element risk;
  – Organization actors have associated forms and tasks with risks that compound or mitigate the actor risk;
  – Process tasks have associated actors and product forms that mitigate the product element risk, not compound it.
• Evaluate goodness of design re objectives, alternatives; compare with other designs
<table>
<thead>
<tr>
<th>Week</th>
<th>AM session</th>
<th>PM session</th>
<th>Reading</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week-1</strong></td>
<td><strong>Tuesday</strong>&lt;br&gt;July 9</td>
<td><strong>ICE session</strong>: project definition using templates&lt;br&gt;SimVision lab</td>
<td>Kunz &amp; Fischer 2007</td>
<td>Download SimVision</td>
</tr>
<tr>
<td><strong>Thursday</strong></td>
<td>July 11</td>
<td><strong>Continue SimVision lab</strong></td>
<td>Kunz, et al., 1998</td>
<td>Submission-1: due midnight, July 12</td>
</tr>
<tr>
<td><strong>Week-2</strong></td>
<td><strong>Tuesday</strong>&lt;br&gt;July 16</td>
<td><strong>Submission-1 Examples</strong></td>
<td>Vité Project handbook&lt;br&gt;Garr, et al.</td>
<td>Assessment-1: due 5pm, July 15</td>
</tr>
<tr>
<td><strong>Thursday</strong></td>
<td>July 18</td>
<td><strong>Big ideas of product, organization and process design</strong>&lt;br&gt;<strong>ICE session</strong>: initial project definition of group project</td>
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</tr>
<tr>
<td><strong>Week-3</strong></td>
<td><strong>Tuesday</strong>&lt;br&gt;July 23</td>
<td><strong>Initial student presentations</strong>:&lt;br&gt;<strong>ICE session</strong>: project definition w/organization analysis and optimization&lt;br&gt;SimVision charrette to analyze and optimize a predefined baseline organization</td>
<td></td>
<td>Submission-2: model and analysis summary&lt;br&gt;due midnight July 19&lt;br&gt;Good Example</td>
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<tr>
<td><strong>Thursday</strong></td>
<td>July 25</td>
<td><strong>Total Economic Impact (TEI)</strong></td>
<td>Assessment-2: due midnight July 19</td>
<td></td>
</tr>
<tr>
<td><strong>Week-3</strong></td>
<td><strong>ICE session</strong>: add checklists and refine business plans for your project</td>
<td><strong>Final presentations</strong>: Business plan proposals for further work based on initial product, organization and process design and analyses</td>
<td>Submission-3: Business plan due midnight July 26&lt;br&gt;Good example 1, 2</td>
<td></td>
</tr>
</tbody>
</table>
Course Goals

• Use the method of Integrated Concurrent Engineering (ICE);
• Build and interpret simple descriptive models of the Product, Organization and Process (POP) of projects using Excel-based templates;
• Build and interpret organization and process models using the SimVision tool;
• Experience use of "big data" – access and interpret the status of large volumes of operational energy system data;
• Create checklists to assure initial readiness for and final completeness of tasks that high uncertainty and for which the knowledge required exceeds that of any individual;
• Create a business plan to obtain significant funding for an enterprise of personal interest.
Course Non-goals

- Study every system ever built
- Study every visualization/AI/design/planning technology
- Development expertise
- Preparation for technology research
- Survey understanding only
- Excessive work
Course organization

• Instructor:
  – John Kunz (kunz@stanford.edu)
    • Office Hours: after class, and anytime my office door is open
• Class Schedule: 11:10 - 12:30 and 1:30 to 4:00 on Tuesdays and Thursdays
• Classes will meet in the CIFE lab, Room 292, Y2E2, Please work in groups of about three for ICE sessions and to prepare submissions. Please read and take assessments on your own.
• Web site: http://www.stanford.edu/~kunz/Chalmers
### Details

- **Lab login id:** su\CEE242
- **Password:** orgdes242
- **Dinner in Palo Alto:** Thursday July 18 or 25?
- **Apps** for your laptop:

<table>
<thead>
<tr>
<th>Week</th>
<th>AM session: 10:00 – 12:00</th>
<th>PM session: 1:00 – 3:00</th>
<th>Reading</th>
<th>Assignments</th>
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</thead>
<tbody>
<tr>
<td>W-1</td>
<td>Course Introduction: VDC, ICE, POP, FFB, MACDAD - John Kunz</td>
<td>POP lab</td>
<td>Kunz &amp; Fischer 2007</td>
<td>Download SimVision;</td>
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<tr>
<td>Monday</td>
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<tr>
<td>July 11</td>
<td></td>
<td>SimVision lab to analyze and optimize a pre-defined organization</td>
<td></td>
<td>Lab submission: due 5 pm July 12</td>
</tr>
<tr>
<td></td>
<td>Organization Modeling - Ray Levitt</td>
<td></td>
<td>Kunz et al., 1990</td>
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</tr>
<tr>
<td>W-1</td>
<td>Introduction to</td>
<td>Vite Project handbook</td>
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<tr>
<td>Tuesday</td>
<td>Organization design in SimVision</td>
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<tr>
<td>July 12</td>
<td>ICE session: project definition w/organization design - John Kunz and Ray Levitt</td>
<td>POP, P, O and P models: due 5pm, July 14</td>
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<tr>
<td></td>
<td>Organization design in SimVision</td>
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<tr>
<td>W-1</td>
<td>Optimization in SimVision</td>
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<tr>
<td>July 14</td>
<td>Optimization in SimVision</td>
<td>ICE session: project design w/organization design - John Kunz and Ray Levitt</td>
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<tr>
<td>W-2</td>
<td>Optimization in SimVision</td>
<td>ICE session to add checklists and refine business plans</td>
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<tr>
<td>Monday</td>
<td>Organization design in SimVision</td>
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<tr>
<td>July 16</td>
<td>Optimization in SimVision</td>
<td>ICE session to add checklists and refine business plans</td>
<td></td>
<td></td>
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<tr>
<td>W-2</td>
<td>Introduction to</td>
<td>Develop business plans for future work - Ray Levitt</td>
<td></td>
<td>Description and analysis of optimized organization design: Checklists due 5pm July 19</td>
</tr>
<tr>
<td>Tuesday</td>
<td>checklists - John Kunz</td>
<td></td>
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<tr>
<td>July 19</td>
<td></td>
<td>Final presentations: Business plan proposals for further work based on initial product, organization and process design and analyses</td>
<td></td>
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</tr>
<tr>
<td>W-2</td>
<td>ICE session to add checklists and refine business plans</td>
<td>Business plan: due 5pm July 22</td>
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<tr>
<td>Thursday</td>
<td>ICE session to add checklists and refine business plans</td>
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</tr>
<tr>
<td>July 21</td>
<td>ICE session to add checklists and refine business plans</td>
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</table>
## ORID +/- Analysis

### Objective Level
- To examine the data
- To identify factual information

### Reflective Level
- To encourage connections
- To encourage free flow of ideas and imagination

### Interpretive Level
- To identify patterns and determine their significance or meaning
- To articulate underlying insights

### Decisional Level
- To propose next steps
- To develop an action plan
- To make decisions
- To experience “coming together”

<table>
<thead>
<tr>
<th>Level</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>How do you see? What factual statements can you make based on the data?</td>
</tr>
<tr>
<td>Reflective</td>
<td>What surprised you? What encouraged you? What discouraged you? How does this make you feel?</td>
</tr>
<tr>
<td>Interpretive</td>
<td>What does the data tell us? What are insights for you? What is the good news? What are limits? What else is there to learn?</td>
</tr>
<tr>
<td>Decisional</td>
<td>What are next steps? What decisions can we make? What is our action plan for moving forward?</td>
</tr>
</tbody>
</table>
ORID +/-: Focused Conversation and Analysis

<table>
<thead>
<tr>
<th>Objective</th>
<th>Reflective Positive</th>
<th>Reflective Negative</th>
<th>Interpretive</th>
<th>Decisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you recall seeing?</td>
<td>What do you feel positive about?</td>
<td>What do you find negative?</td>
<td>What sense do you make of it?</td>
<td>What agreements can be made now?</td>
</tr>
</tbody>
</table>

(c) 2010
Tuesday afternoon

- Interaction: Working Together
- Came up w/ new idea in group
- Smart Boards
- Classroom, Stanford
- Example of Big Data
· Did not know what to write in MATRIX - in ICE EXERCISE - 2
· Sometimes hard to follow Lesson structure
· Software did not work
· How to use Smart Boards
Insights

Parts of meetings that are useless

in 20 mins go from problem to pretty good by idea

Simple to gather data; hard to make sense

Companies do not use data they have
DECISIONS

- DESIRE who does what within group
- 20 min exercises
- See examples of all frameworks we use
Student-mentioned important content from day-1 (JK perspective)

Interaction: Working Together
Came up w/ new idea in group

Integrated concurrent engineering (ICE)
Un-mentioned important content from day-1 (JK perspective)

Familiarity with the integrated POP project framework of VDC
- Product – Organization – Process (POP)
- Function – Form – Behavior (FFB)
- Perspectives that a project can and must manage
**FUNCTION**
- Choose card
- Add new card
- Pay
- Swipe between cards

**DESIGN**
- 1 Scroll View
- 2 Buttons
- 1 Swipe View
- Logo, see sketches

**BEHAVIOR**
- Ease to choose a card
- # of cards

**PRODUCT**

**ORGANIZATION**
- Builders
- Testers
- Designers

**PROCESS**
- Design
- Build
- Test

**COST**
- Cost
- Quality
- Schedule
Reflections - Thursday

•
Details

- Career planner July 18 – OK
- Dinner at our home: July 25 or 18?
- Submission-1
Product design forms: 3D drawing
Modeled objects:

- Walls
- Floors
- Windows
- Doors
- Columns
Model (SV)
- Organization
- (Design) work process

Simulation behavior predictions:
- Gantt chart
- Risks
Integrated Concurrent Engineering (ICE)

Given

• Objective = “extreme collaboration” (1 week)
• Excellent POP software
• Collocated team
• iRoom
• Good generic POP model
• SD (DD) phase

Performance change

![Graph showing performance change](image)

![Graph showing duration](image)
Templates and checklists

**Templates**: standard representations

- POP model: Function, Form, Behavior of P, O, P
- Breakdown structures:
  - Product
  - Organization
  - Process
- Task content: object, action, resources (crew, equipment)

**Checklists**: Tasks and OK that was done well

- Run ICE sessions
- Create POP models
- Process to define project, build BIM, exchange data, do analyses (x5)
Example Checklist

Surgical Safety Checklist

- Before induction of anaesthesia:
  - (with at least nurse and anaesthetist)
  - Has the patient confirmed his/her identity, site, procedure, and consent?
    - Yes
  - Is the site marked?

- Before skin incision:
  - (with nurse, anaesthetist and surgeon)
  - Confirm all team members have introduced themselves by name and role.
  - Confirm the patient’s name, procedure, and where the incision will be made.

- Before patient leaves operating room:
  - (with nurse, anaesthetist and surgeon)

Necessity for success: “monitor and challenge”
<table>
<thead>
<tr>
<th>Templates</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0. Project summary - background</strong></td>
<td>Background</td>
</tr>
<tr>
<td><strong>Included</strong> 1. Specification of intent - wants**</td>
<td></td>
</tr>
<tr>
<td>BIM Uses</td>
<td>Example</td>
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<tr>
<td>Deliverables</td>
<td></td>
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<tr>
<td>BIM content specification</td>
<td></td>
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<td>Coordination Commitments</td>
<td></td>
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<tr>
<td>ICE session pre-plan</td>
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<tr>
<td>Metrics - Client intent and project objectives</td>
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<tr>
<td>Controllable factors</td>
<td></td>
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<tr>
<td>Operations Agreement</td>
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<tr>
<td>Team Charter</td>
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<tr>
<td>Application of VDC</td>
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<tr>
<td><strong>2. Models of project design content - dos</strong></td>
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</tr>
<tr>
<td>Personal BIM - snapshot</td>
<td>Example</td>
</tr>
<tr>
<td>Personal organization design - snapshot</td>
<td></td>
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<tr>
<td>Task Commitments - production plan</td>
<td>Example</td>
</tr>
<tr>
<td>Design versions</td>
<td></td>
</tr>
<tr>
<td><strong>3. Predicted and measured project performance – attributes</strong></td>
<td></td>
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<tr>
<td>Personal BIM-based analysis - snapshot</td>
<td>Example</td>
</tr>
<tr>
<td>Personal metrics - graph</td>
<td>Example</td>
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<tr>
<td><strong>4. Evaluated project performance – gots</strong></td>
<td></td>
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<tr>
<td>Assessed performance</td>
<td>Example</td>
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<tr>
<td>Risks</td>
<td>Example</td>
</tr>
<tr>
<td>Assessed VDC status</td>
<td></td>
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<tr>
<td>VDC Methods Application Assessment</td>
<td></td>
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<tr>
<td>Comments</td>
<td></td>
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<tr>
<td><strong>5. Planned next steps</strong></td>
<td></td>
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<tr>
<td>Next Steps</td>
<td></td>
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<td>Force Field</td>
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</tbody>
</table>

Last updated 7/3/2013
Big data

- SEE IT: extract energy use data for this building from Building Management System (BMS)
- ~750,000 points – this room
- How do you interpret these data?

![Graph showing energy use data over time]
Big data

- SEE IT: extract energy use data for this building from Building Management System (BMS)
- ~750,000 points – this room
- How do you interpret these data?
How we spend time in meetings

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

**EXPLANATIVE (20%)**
- What drives the finish times for the rides?

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

**EVALUATIVE (30%)**
- Does this milestone meet contract?
Submission-1: *due midnight July 12 (Friday)*

Task: describe and analyze your project and organization design for a pre-defined test case

Submit:
- Template file (group submission)
- ORID analysis on what you learned this week
Skills for success

- Good engineer: design, analyze, manage
- Research methods
- Communication
  - Written/Oral
  - Programming
  - Colleagues, sponsors, stakeholders
- Integrated use of quick-response, careful analysis, reflection
Speculations: VDC

VDC will enable a small number of collaborating stakeholders to do rapid Multidisciplinary Design and Analysis.
Learning goals

• Get basic familiarity with the POP project framework of VDC
  • Product – Organization – Process (POP)
  • Function – Form – Behavior (FFB)
• Understand class organization, opportunities, methods and expectations
• Motivate interest in Integrated Design enabled by VDC:
  • Opportunities in practice
  • Fun, power and job opportunities of models, model-based analyses
What do you have? ... What do you want?

2013?, ... 2015?
## This week overview

<table>
<thead>
<tr>
<th>Day</th>
<th>Take-home</th>
</tr>
</thead>
</table>
| Tuesday   | **Introduction:**<br>**Theory:** ICE, organizational modeling, big data, templates, VDC POP/FFB framework, types of models  
**Practice:** ICE session with Templates, Organization-process model and analysis (SimVision) lab |
| Thursday  | **Theory:** Introduction to big data  
**Practice:** Organization-process model and analysis (SimVision), continued, and big data (SEE-IT) labs |
The big idea:
Integrated Product, Organization and Process design can support, at least design, fabrication and assembly

John Kunz