01/18: **Risks and Prototypes**

**The Capstone Experience**

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Michigan State University
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Risks and Prototypes

- Risks
  - Prototypes
Identifying Risks

• What You Don’t
  ▪ Know
  ▪ Understand
  ▪ Know How to Do

• Normally
  ▪ Major Project Features
  ▪ “Showstoppers”

• Varies From
  ▪ Not Familiar With But (Probably) Can Learn to
  ▪ Absolutely No Idea How to Do It

What are you worried about?
What should you be worried about?
Example Risks

Including but not limited to...

• Key Application Features
• Hardware Systems
• Software Systems
• Development / Programming Environments
• Programming Languages
• Etc...
Prioritizing Risks

• Classify Difficulty
  ▪ High: Very Hard, No Idea How to Do
  ▪ Medium
  ▪ Low: Not Hard, Probably Doable

• Classify Importance
  ▪ High: Showstopper, Must Have
  ▪ Medium
  ▪ Low: Not Vital, Nice to Have
Prioritizing Risks

The Capstone Experience
Risks and Prototypes
Case Studies: Basketball Apps

• Play Effectiveness
  ▪ Determine Effectiveness of Plays
  ▪ Record All Plays with Results
  ▪ Produce Reports of Effectiveness

• Player Timer
  ▪ Keep Track of Player Times
  ▪ Record Minutes Played and Rested
  ▪ On the Bench, During the Game
Basketball already had all three of these components.

I had some of these.
Basketball Apps Risks

• What SDK should I use?
• How do I program in Visual Basic?
• How do I make a GUI in VB?
• How do I interface VB with Access?
  ▪ Create/Open/Save a Database?
  ▪ Read/Write Records?
  ▪ Traverse Records?
• How do I do clocks in Windows?
  ▪ Game Clock?
  ▪ Wall Clock?

How would you classify these risks?
Mitigating Risks

• Use Existing Resources
  ▪ Including But Not Limited To
    o Product Demos
    o Book Sample Code
    o Downloadable Examples
    o Etc...
  ▪ Test Drive
    o Install
    o Compile
    o Extend
    o Etc...

• Build Prototypes
  ▪ Single Purpose
  ▪ Quick-and-Dirty

Nota Bene:
1. Check license if including in project.
3. Inform client.
Basketball Apps Risk Mitigation

• Game Clock
  ▪ Start /Stop
  ▪ Counts Down
  ▪ By Minutes/Seconds

• Handling Access Records
  ▪ Write Number
  ▪ Read Number
  ▪ Add Up Numbers

Start
Stop

19:55

Write 7
Read 14
Add Up 55
Your Risks?

• Team Auto-Owners
• Team Boeing
• Team Dow
• Team GE Aviation
• Team Meijer
• Team Motorola Mobility
• Team Mozilla
• Plex Systems
• Raytheon
• Team Spectrum Health
• Team TechSmith
• Team Urban Science

What are your risks?
Former Capstone Teams
• Men’s Basketball
• Ford
Risks and Prototypes

✓ Risks

➢ Prototypes
Prototypes

• Developed
  ▪ Early
  ▪ Rapidly

• Implement Subset of the Requirements

• Done for Variety of Reasons

• Are Not Finished Goods

• “Hacking” (Good Sense)
Why? Answer Questions

Help Determine...

• Specifications
  ▪ Functional
  ▪ Design
  ▪ Technical
• Usability
• How Existing Code Works
• Programming Languages
• Development Environments
• Operating Environments
• What to Panic About
• Etc...
Why? Determine Schedule

Determine how long it will take to...
• ...learn the new programming language.
• ...learn the development environment.
• ...learn the existing code.
• ...convert the existing code.
• ...convert the existing database.
• ...get libraries working.
• ...deploy the application.
• Etc....
Why? Reduce Risk

- **Operability**
  - How do we make a game clock?
  - Where do we store the data?
- **Interoperability**
  - How does the game clock work with other tablets?
  - How do the tablets all write to the same database?
- **Scalability**
  - Will the game clock propagate in real time?
  - Will the database engine keep up?
- **Reliability**
  - What happens if the clock tablet dies?
  - What happens if the database tablet dies?
- Etc...
Speed (to Write)

• Critical
• 2-3 Day Tasks
• Use Whatever Works
  ▪ RAD Languages
  ▪ SDK’s
  ▪ IDE’s
  ▪ Design Tools
  ▪ Wizards
  ▪ Sample Code
  ▪ Etc...
• Stop When Questions Answered
Tradeoffs: Speed (to Write) vs...

• Speed vs Best Practices
  ▪ Testing
  ▪ Documentation
  ▪ Security
  ▪ Software Engineering
  ▪ Usability
  ▪ Performance
  ▪ Coding Standards
  ▪ User Interface Standards
  ▪ Using Real Data
  ▪ Etc...

• Hence, Normally Not Appropriate in Final Deliverable
Challenge/Danger

• “Hack” Solution
  ▪ It works.
  ▪ It’s *a* way to do something.

  vs

• “Correct” Solution
  ▪ It works.
  ▪ It’s the “right” way to do something.
  (There may be more than one “right” way to do something.)
Basketball Prototypes Case Studies

• Play Effectiveness
• Player Timer
• Radio Stats
• Real Time Play Stats
• Plus/Minus
Play Effectiveness App

• Functional Specifications
  ▪ Determine Effectiveness of Plays
  ▪ Record All Plays with Results
  ▪ Produce Reports of Effectiveness
    o Each Play
    o # of Success / # of Attempts

• Design Specifications?
• Technical Specifications?
Initial Meeting with Video Coordinator

I Learned...
• Done After Game
  ▪ On Desktop Computer
  ▪ From DVR
• Lots of Plays (~ 200) in Play Book
• ~60-80 Plays Run Per Game
• Plays Categorized
  ▪ Early Offense 1,2 (i.e., Fast Breaks)
  ▪ Offense 1,2 (i.e., Half Court Plays)
  ▪ Special Situations 1,2 (i.e., Out of Bounds)
• Overwhelming

Can you relate?
Play Effectiveness Architecture

Basketball already had all three of these components.
Risks

• Learning Basketball Processes
• Programming in Visual Basic
• Making a GUI in VB
• Interfacing VB with Access
  ▪ Creating/Open/Opening/Saving a Database
  ▪ Reading/Writing Records
  ▪ Traversing Records
• Generating Reports in Access
• Etc...
BB Stats AV1

Fields
- P# Play Number
- T Time
- C# Clip Number
- EO Early Offense
- O Offense
- SS Special Situations
- R Result

Nota Bene
- Just Screen Layout
- No Code
- Never Have All Entries Filled at Once

### Game
- **Opponent**: Harvard University
- **Date**: July 4, 1776
- **Location**: Boston
- **Number**: 1776070401

### Play
- **P#**: 48
- **T**: 12:34
- **C#**: 426
- **EO1**: Run
- **EO2**: Gun
- **O1**: 1-4 Screen
- **O2**: Low Post
- **SS1**: SLOB
- **SS2**: Blah
- **R**: Two Pointer

### Roster
1. **00:00 00:00**: Adams, John
2. **00:00 00:00**: Jefferson, Tom
3. **00:00 00:00**: Washington, George
4. **00:00 00:00**: Franklin, Ben
5. **00:00 00:00**: Hamilton, Alex

### Notes
Feed to Adams. Washington always gets the rebound. Jefferson or Hamilton should take the shot.
What I Learned From AV1

• Wanted to Identify Plays Within a Possession
• Plays Categorized Series / Set
  ▪ Set is Variation on Series (“Parameterized Plays”)
  ▪ E.g.
    o Series: Thumbs
    o Sets: Up, Down, Circle
    o Plays: Thumbs Up, Thumbs Down, Thumbs Circle
  ▪ 1, 2 Notation
    o EO1 = Early Offense Series
    o EO2 = Early Offense Set
  ▪ ST (Special Teams) Missing
What I Learned From AV1

• Results Coded
  ▪ XN Missed N Pointer (X1, X2, X3)
  ▪ ON Made N Pointer (O1, O2, O3)
  ▪ FF Foul on the Floor
  ▪ TO Time Out
  ▪ Etc...

• Wanted to Record Notes on Defense

• Didn’t Care About
  ▪ Player Times
  ▪ Video Clip Number
BB Stats AV1

Fields
• P# Play Number
• T Time
• C# Clip Number
• EO Early Offense
• O Offense
• SS Special Situations
• R Result

Nota Bene
• Just Screen Layout
• No Code
  (Underneath)
• Never Have All Entries Filled at Once

So, from this to...
BB Stats AV2

Fields

- **PO#** Possession Number
- **PL#** Play Number
- **SS** Special Situations
- **DF** Defense

**Nota Bene**

- Just Screen Layout
- No Code (Underneath)
- Would **NOT** Have Entries in All Fields

### Details

**T** 12:34  **PO#** 12  **PL#** 17

**Spot:**

- **EO** Early Offense: Corner (Rescreen-Post)
- **OF** Zone Offense: Jersey - Side Ball Screen
- **ST** BLOB: Quick Post for Perimeter
- **SS** 2 For 1: Blah Blah

**R**

- **R2**
- **DF** Man-to-Man

**Notes:**

Feed to Adams. Washington always gets the rebound. Jefferson or Hamilton should take the shot.

**Game**

- **Opponent:** Harvard University
- **Location:** Boston
- **Date:** July 4, 1776
- **Number:** 1776070401
What I Learned From AV2

• Wanted to Grade Effectiveness of Plays

• Wanted to Record Player Steals and Assists (Remember this...)

• Needed to Navigate Plays and Possessions
**Play**

<table>
<thead>
<tr>
<th>PE#</th>
<th>Time</th>
<th>PL#</th>
<th>MSU</th>
<th>Op</th>
<th>Series</th>
<th>Set</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12:34</td>
<td>17</td>
<td>37</td>
<td>23</td>
<td>Early Offense</td>
<td>Corner (Rescreen-Post)</td>
<td>Great</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BLOB</td>
<td>Quick Post for Perimeter</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Zone Offense</td>
<td>Jersey - Side Ball Screen</td>
<td>So-So</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>O</td>
<td>Outstanding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Man-to-Man</td>
<td>Something Else</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 For 1</td>
<td>Blah Blah</td>
<td>Unreal</td>
</tr>
</tbody>
</table>

**Notes**

Feed to Adams. Washington always gets the rebound. Jefferson or Hamilton should take the shot.

**Roster**

<table>
<thead>
<tr>
<th>P</th>
<th>Player</th>
<th>S</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unbound</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Jefferson, Tom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Washington, George</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Franklin, Ben</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hamilton, Alex</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Commands**

- Next Play
- Next Possession
- Previous Play
- Previous Possession
- Delete Play
- Delete Possession
- Exit

**Game**

<table>
<thead>
<tr>
<th>Opponent</th>
<th>Location</th>
<th>Date</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard University</td>
<td>Boston</td>
<td>11/17/2003</td>
<td>1776070401</td>
</tr>
</tbody>
</table>
What I Learned From AV3

• Wanted...
  ▪ Grades to Be A, B, C, D, F
  ▪ Results to Be X1, O1, X2, O2,…
  ▪ Results Associated With Players
  ▪ Series/Set Combined
    (“Thumbs Up” Rather Than “Thumbs”, “Up”)
  ▪ To Record Player Rebound

• Will be used by...
  ▪ Video Coordinator, GAs, and Managers
  ▪ Very Familiar with DVR Controls

• Did **NOT** Want to Record Player Steals or Assists
BB Stats
Beta 1
First Version
With Code
What I Learned From Beta 1

• Entering a Play
  ▪ Some Things Calculated Automatically
    o Play/Possession Number
    o Score
  ▪ Most ThingsEntered With Mouse Via Pull-Down Menus
    o Series / Set
    o Result
  ▪ But Time Entered With Keyboard Via Typing Numbers

• Need
  ▪ Mouse-Only Input
  ▪ Easy Way to Adjust Clock
BB Stats
Beta 2
Still Not Much Implemented
BB Stats V1.0

The Capstone Experience

Risks and Prototypes
Basketball Prototypes Case Studies

☑ Play Effectiveness
  • Player Timer
  • Radio Stats
  • Real Time Play Stats
  • Plus/Minus
Player Timer App

• Keep Track of Player Times
• For Each Player Record
  ▪ Minutes Played
    o Game Clock Time
    o Consecutive & Total
  ▪ Minutes Rested
    o Wall Clock Time
    o Consecutive
• Must
  ▪ Be Usable on the Bench, During the Game
  ▪ Be Portable and Not Require Electrical Outlet
  ▪ Feel Like a Pen and a Clipboard
Player Timer App

Player Timer Application

Visual Basic

MS Access

Windows XP
HP Tablet PC

I had some of these.
Risks

• Learning Basketball Processes
• Implementing Clocks in Windows?
  ▪ Game Clock
  ▪ Wall Clock
• Very Limited Screen Real Estate
• Computing and Displaying Cumulative Times
• Hidden Risk ("Danger Will Robinson!")
Player Timer Development

• Knew Exactly What They Wanted, So...
• Designed “Final” Version
  ▪ User Interface
  ▪ Data Base Schema
  ▪ Etc...
• Coded “Final” Version
• Lab Tested “Final” Version
• Field Tested “Final” Version
  ▪ At a Scrimmage
  ▪ Totally and Completely Unusable
• Scrapped “Final” Version UI and Start Over

Huge Mistake!
Player Timer
Software Updates

- Enable Clock Adjustments (While Clock Stopped)
- Enable Check In/Out By Touching
  - Check In/Out Button
  - Player Name
  - Player Slot
- Allow > 5 Players Checked In (While Clock Stopped)
- Enable Pending Check In (While Clock Running)
- Eliminate All Modal Dialog Boxes
Basketball Prototypes Case Studies

✓ Play Effectiveness
✓ Player Timer
  • Radio Stats
  • Real Time Play Stats
  • Plus/Minus
### The Capstone Experience

**Risks and Prototypes**

<table>
<thead>
<tr>
<th>Michigan State University</th>
<th>13</th>
<th>19 / 23</th>
<th>83%</th>
<th>22</th>
<th>5</th>
<th>78</th>
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<tbody>
<tr>
<td>Brown, Shannon</td>
<td>3</td>
<td>0 / 4</td>
<td>100%</td>
<td>2</td>
<td>1</td>
<td>11</td>
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<tr>
<td>Hill, Chris</td>
<td>2</td>
<td>2 / 2</td>
<td>100%</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Netzel, Drew</td>
<td>2</td>
<td>1 / 2</td>
<td>50%</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Ager, Maurice</td>
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<td>2 / 3</td>
<td>67%</td>
<td>6</td>
<td>0</td>
<td>14</td>
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<tr>
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<td>2 / 2</td>
<td>100%</td>
<td>3</td>
<td>3</td>
<td>17</td>
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<tr>
<td>Torbert, Kelvin</td>
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<td>0 / 0</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>7</td>
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<tr>
<td>Bograkos, Tim</td>
<td>7</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>8</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Davis, Paul</td>
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<td>0 / 10</td>
<td>80%</td>
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<td>0 / 0</td>
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<td>0</td>
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<td>0</td>
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<tr>
<td>Ibo, Idong</td>
<td>11</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Gray, Marquise</td>
<td>12</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>Duke</th>
<th>12</th>
<th>17 / 24</th>
<th>71%</th>
<th>15</th>
<th>7</th>
<th>68</th>
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<td>4</td>
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<td>100%</td>
<td>1</td>
<td>3</td>
<td>13</td>
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<tr>
<td>Ewing, Daniel</td>
<td>5</td>
<td>2 / 4</td>
<td>50%</td>
<td>5</td>
<td>2</td>
<td>18</td>
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<tr>
<td>Melchionni, Lee</td>
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<td>1 / 2</td>
<td>100%</td>
<td>1</td>
<td>2</td>
<td>10</td>
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<tr>
<td>McClure, David</td>
<td>4</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nelson, DeMarcus</td>
<td>6</td>
<td>2 / 4</td>
<td>50%</td>
<td>3</td>
<td>0</td>
<td>8</td>
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<tr>
<td>Williams, Shelden</td>
<td>7</td>
<td>9 / 10</td>
<td>90%</td>
<td>5</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
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<td>8</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>10</td>
<td>0 / 0</td>
<td>-</td>
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<td>0</td>
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<td>0 / 2</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Pagliuca, Joe</td>
<td>12</td>
<td>0 / 0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</table>
### Real Time Play Stats

#### MSU vs Purdue

<table>
<thead>
<tr>
<th>EO</th>
<th>QSO</th>
<th>O</th>
<th>CEH</th>
<th>MOP</th>
<th>ST</th>
<th>Z</th>
<th>OB</th>
<th>SS</th>
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<tbody>
<tr>
<td>No Series</td>
<td>No Set</td>
<td>Break</td>
<td>Blitz</td>
<td>Early Offense</td>
<td>Carolina</td>
<td>Early Offense</td>
<td>Early Post</td>
<td>Early Offense</td>
</tr>
<tr>
<td>Break</td>
<td>Blitz</td>
<td>Break</td>
<td>Early Offense</td>
<td>Early Offense</td>
<td>Early Offense</td>
<td>Reversal</td>
<td>Early Offense</td>
<td>Rub</td>
</tr>
<tr>
<td>ZZZ Early Offense ZZZ EO 1</td>
<td>ZZZ Early Offense ZZZ EO 2</td>
<td>ZZZ Early Offense ZZZ EO 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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#### The Capstone Experience

Risks and Prototypes
Plus/Minus
Your Prototypes?

- Team Auto-Owners
- Team Boeing
- Team Dow
- Team GE Aviation
- Team Meijer
- Team Motorola Mobility
- Team Mozilla
- Plex Systems
- Raytheon
- Team Spectrum Health
- Team TechSmith
- Team Urban Science
Risks and Prototypes

 ✓ Risk

 ✓ Prototypes
What’s ahead?

• Team Status Report Presentations
  ▪ **PowerPoint Template**
  ▪ Due Midnight, Sunday, January 22
  ▪ Email to Dr. D.
    ○ Subject: Team <Company Name>: Status Report
    ○ Subject: Team Auto-Owners: Status Report
    ○ Attachment: team-<company-name>-status-report-presentation.ppt
    ○ Attachment: team-urban-science-statue-report-presentation.ppt
  ▪ Dr. D. Will Combine Into Single PowerPoint
    ○ To Speed Things Up During Meeting
    ○ Do NOT Modify Master Slide Page
  ▪ Each Team Presents
    ○ Using Dr. D.’s Laptop
    ○ At Most 5 Minutes (Rehearse Timing)
    ○ Single or Multiple Presenters (Your Choice)

The key word is “status”.
What’s ahead?

• All-Hands Meetings
  ▪ M, 01/23: Team Status Reports
  ▪ W, 01/25: Schedule and Team Work
  ▪ M, 01/30: Team Project Plan Presentations
  ▪ W, 02/01: Team Project Plan Presentations
  ▪ M, 02/06: Team Project Plan Presentations
  ▪ W, 02/08: Team Project Plan Presentations
What’s ahead?

- Project Plan Presentations
  - PowerPoint Template
    - Download Now
    - Read the Read Me Slide (Over and Over and Over...)
  - Submission
    - Both Project Plan Document and PowerPoint Slide Deck
    - Due Midnight, Sunday, January 29
    - See Submission Instructions in Template
  - Presenting
    - 3 Teams Per Meeting Over 2 Meetings
    - Schedule Posted Sunday Evening
    - Strict 15 Minute Time Limit
    - Use Team Member Laptop
      - Bring Power Cord
      - Test In Meeting Room
    - Rehearse
    - 5% of Final Grade
    - Business Casual Dress
  - Formal Team Photos
    - Immediately Following Meeting
    - In Capstone Lab
01/25: Schedule and Team Work

The Capstone Experience

Dr. Wayne Dyksen
Department of Computer Science and Engineering
Michigan State University
Fall 2011