Welcome

• Thank you for joining us for this College of Continuing Educations webinar.

• The Chaotic World of Project Management

• Moderator: Julia Dugan
  Information Center Representative
  College of Continuing Education
Please submit questions at any time during the webinar. Questions will be addressed as time permits at the end of the webinar.

To submit questions:
• On the upper left-hand portion of screen click the “Ask a question” button.
• Type your question and click send.
Webinar Recording

• A link to a recording of this webinar will be e-mailed to all registrants.

• You can expect to receive the webinar link in the next few days to the e-mail you submitted during your registration.
Robert J. Monson

• He has over 20 years experience managing projects in all types of industries.

• He received his Ph.D. in industrial engineering at the University of Minnesota with a specialization in the area of project management and psychology.

• He also has a Bachelor of Mechanical Engineering degree from the University of Minnesota, Institute of Technology, and a Master of Manufacturing Systems Engineering from the University of St. Thomas. Currently, Bob is employed with Carestream Health.
The Project Life-Cycle

- **Project Initiation**: Planning how the project will fit into the organization.
- **Project Planning**: Defining how the objectives of the project will be met.
- **Project Execution**: The actual running of the project.
- **Project Control**: How will the project manager status and control the project?
- **Project Close-Out**: Recording and learning for use on future projects.
Typical Spending Profile

- Project Initiation – 5%
- Project Planning – 15%
- Project Control +
- Project Execution – 75%
- Project Close-out – 5%
Typical Spending Profile

- Project Initiation – 5%
- Project Planning – 15%
- Project Control +
- Project Execution – 75%
- Project Close-out – 5%

Makes the most sense to focus here
We need a common understanding

- What constitutes a project?
  - What are you going to do?
  - How long will it take?
  - What will it cost?

- The triple constraint:
  - Specification, Schedule, and Budget
  - Typically you get to pick two. The third is implied
How can we follow all the rules, procedures, actions, planning, diagrams, calculations, and rules of project management…and still have spectacular failures?
Why do we care about chaos?

- Self-organizing systems
  - We all operate within organizations
  - Organizations have specific characteristics that are brought out due to self-organizing
  - We will examine what chaos predicts about our organizations
  - We will examine what we can do to improve our probability of project success
So what is Chaos?
Chaos

- **What is Chaos?**

- **Chaos Theory**: Field of study of mathematics, physics, and philosophy studying the behavior of dynamic systems that are highly sensitive to initial conditions
  - “The Butterfly Effect”

- Because small differences in initial conditions cause widely divergent outcomes in chaotic systems, long-term predictions are nearly impossible even though these systems should be deterministic
  - Determinism: every cause has one unique effect, and vice versa
Lorenz Experiment

- 1960 MIT
- Computer weather-model
- Changed initial decimal accuracy
Chaos Theory

- Tells us that predictions in environments with many moving parts are not probable
- Tells us that we cannot understand all the moving parts and interactions
- Implies that to be successful PMs we must understand chaos and the resultant impact
Examples of Chaos surround us once we understand what to look for...
Double Arm Pendulum
The Fibonacci Spiral

 Governed by a simple equation:

\[ R = ae^{\beta \theta} \]
The Fibonacci Spiral
\[
\frac{a}{b} = 1.618 \text{ !!! golden ratio}
\]
\[ \frac{a}{b} = \frac{a'}{b'} = 1.618 \]

golden ratio
Golden ratio

1.6

Golden ratio

1.6

1
Let’s consider what we are expecting in a chaotic system...
Chaos

- Purely a mathematical concept
- Used when a first order differential equation describes the behavior of a dynamic system
- Dynamic – Multiple moving parts
- Example: \( P_n = R \times P_{n-1} (1 - P_m) \)
Different areas of the set will appear to be similar, although there are differences.
Sensitive Dependence

- The system will be highly sensitive to initial conditions and any disturbances
The system will approach all possible solutions over time.
Aperiodic

- The system will appear to reach identical positions over time, but they may differ significantly.
Predictable / Unpredictable

Depending on your position in the solution set, the system may be predictable or unpredictable (nearness to critical mass)
Imagine a simple case

<table>
<thead>
<tr>
<th>A</th>
<th></th>
<th></th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Imagine a simple case
We can model the effective behaviors of a system like this

- Consider the number of moving parts
- Consider how often those agents interact with one another
- Define how the interaction will impact the system behavior
- Allow the system to self-organize
Chaos and Complexity

- The Bak Sandpile model
  - Defines the behavior of a simple system
  - Representative of many physical and organizational systems
  - Provides insight into an appropriate method to plan and manage systems
How does the model work?

- Complex Systems are frequently governed by simple rules

1. Add 1 item randomly to any pile
2. If any pile $\geq 4$ items, distribute 4 items
The Sandpile model

- When the number of interactions is considered as compared to the amount of introductions:
  - There will be more than 1.1 million interactions caused by 10,000 interruptions
  - A factor of 100:1 interactions
  - Chaos **amplifies** our bumps in the road
The Sandpile Model

- Examples utilizing a 3 X 3 matrix
  - Previous example
- Larger examples do not exhibit such a dramatic edge effect
  - 25 X 25 model used most commonly
  - Use simulation to provide behavior information
25 X 25 matrix, 2000 pts
25 X 25, 2M points, 1875 Normalized
Conclusions to be drawn

- A self-organizing system will organize itself into a critical state
- This implies that catastrophes are imminent and of high probability
- Thus the system is susceptible to any disturbance
A practical Example

- Imagine you are running your computer
- Things are slowing down a bit
- We get impatient with a process and then click another area, requesting further processing
- The delay is extended significantly
  - The interaction is greater than the sum of the individual delays
Microsimulation of road traffic with a time-continuous model

<table>
<thead>
<tr>
<th>Start</th>
<th>1: Ring Road</th>
<th>3: Lane closing</th>
<th>5: Traffic Lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>2: On-Ramp</td>
<td>4: Uphill Grade</td>
<td>6: Lane Changes</td>
</tr>
</tbody>
</table>

Time: 0:35

- Average Density: 42 Vehicles/km/lane
- Truck Percentage: 20%
- Time Warp Factor: 3.0 times
25 X 25, 2M points, 1875 Normalized
So what does this mean to me?

- Plan your project with no more than 75% utilization of your people
- It will take 40 hours to do 30 hours of work
  - Due to the interactions and disturbances
- If you schedule at 75%, more work will be done than if you schedule for 100%
- If I schedule for 40 hours of work, the delays will be greater than the sum of the individual delays, resulting in less than 30 hours of work completed
Predictability of complex systems is effective in a generalized sense
- I cannot know when and where earthquakes will occur, but I can know approximately how many to expect and typical magnitudes
- Overall I will have a good idea what energy will be imparted by the earthquakes
- This is good enough to know how to design structures for the region

Project Management requires predictability in order to achieve plans and projections

You cannot know all the details and moving parts, and must plan accordingly
To increase probability of success, we need to dramatically increase operational predictability.

Scheduling work with a consideration for 75% efficiency provides this added predictability.

- Since we do not know what specific disturbances will occur.
- We do not know when they will occur or what magnitude they will be.
- But we know that on average that 25% of our time will be consumed by them.
Conclusions

- A complex system will organize itself into a critical (or unstable) state
- We know that a certain amount of disturbances and resultant avalanches within our project is unavoidable
- We don’t know specifics, but we know 25% of our time will be consumed by interdependencies in the system
- We can increase our probability of success by planning personnel at 75% capacity, which should be treated as our maximum productivity
- We need to slow down to speed up
メトロノーム同期 (32個)
Synchronization of thirty two metronomes

2012年09月14日，池口研究室前廊下にて撮影
Filmed at Ikeguchi Laboratory, on September 14, 2012.
Questions?
Look for e-mail with link to presentation in the next few days. Upcoming Project Management course dates:

- **Introduction to Agile Development** – October 18, 2013
- **Project Execution, Monitoring, and Control** – October 22 & 24, 2013
- **Project Management Foundations** – October 25, 2013
- **Project Initiation** – November 1, 2013

For more information

www.cce.umn.edu/professionaleducation

612-624-4000
References

- http://vwisb7.vkw.tu-dresden.de/~treiber/MicroApplet/
- www.santafe.edu/~ole/oslo.html
- www.mindware.com