Engineering Management

EM 530 Applications In Constraints Management

Manual Simulation:

Multi-Project Management

The Bead Experiment

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Bead Experiment* Equipment List

Each team needs the following:

1 red bowl
3 red 6" plastic plates
1 blue bowl
3 blue 6" plastic plates
3 spoons

Each bowl has mixed together:
- ±25 orange beads
- ±20 black beads
- ±15 white beads

Find "beads" at a garden supply or arts/crafts and/or fabric store. The 3/4" in diameter beads are often called "glass accent marbles" are about and commonly used in still life arrangements or aquariums. They are FLAT on the bottom side and CURVED on the top side. (In a pinch, use any token that has two sides such as: pennies, nickels and dimes.)

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A simple environment to better understand the problems in the multi-project environments

A simple project: The Red Project

The project has three phases. In the Phase I, a person sorts mixed beads from the bowl onto three separate plates. Phase II cannot start until Phase I is complete. In Phase II, two individuals take the beads from the plate, place them flat side down, turn them flat side up and then return them to their separate plates. After all of Phase II is done, Phase III can begin. In Phase III one person takes the beads from the plates and puts them all back in the bowl. Pretty easy.
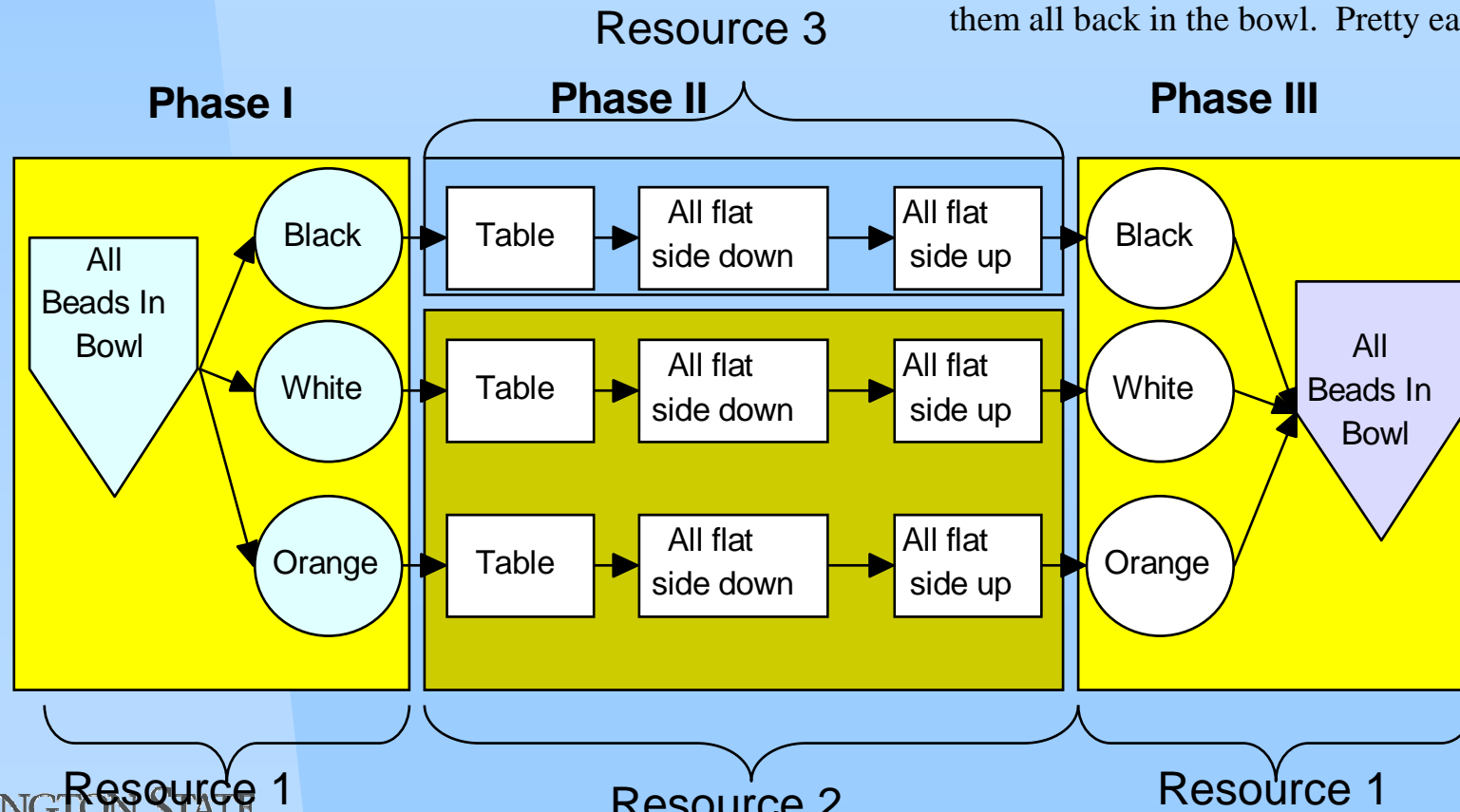
The Bead Experiment, Runs 2 Projects Simultaneously
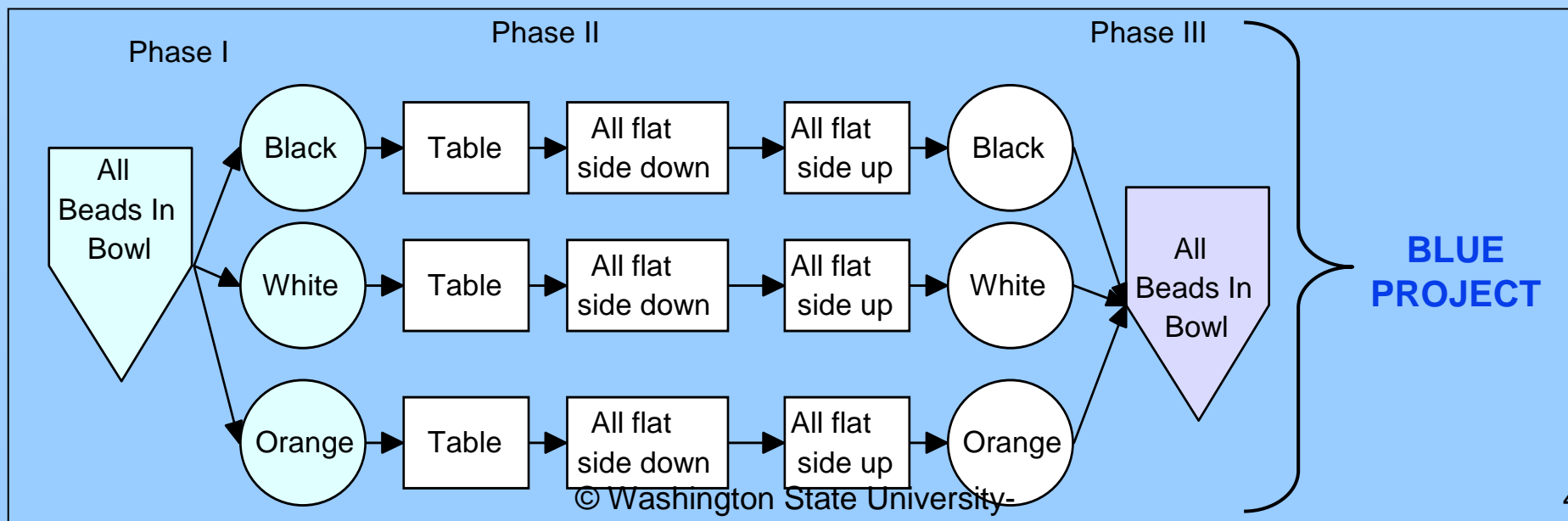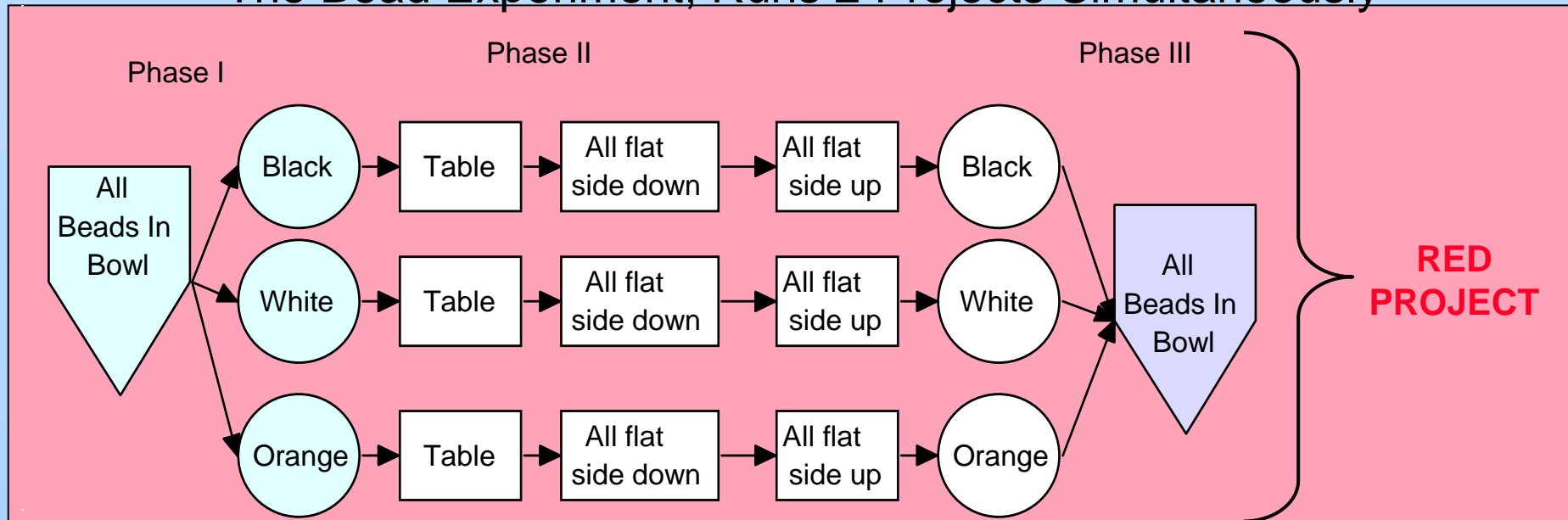
How to play

- **Each team is responsible for completing 2 projects – a "red" project and a "blue" project.**

- **Each team has the following:**

  - **A Red Project Manager: Manages resources-Encourages work on the red project.**

  - **Blue Project Manager: Manages resources-Encourages work onthe blue project.**

  - **A timekeeper: Records start and stop time for each project**

  - **3 resources:**

    - **Resource 1 does sorting at beginning (Phase I) and integration at the end (Phase III).**

    - **Resource 2 does processing (moving and "flipping") of orange and white beads.**

    - **Resource 3 does processing (moving and "flipping") of black beads.**

The "RULES" - Red and Blue Project Managers and Timekeeper

- **Red Project** begins first. When "start" is announced, **RED Project Manager** "releases" (e.g . gives red bowl with all beads, 3 red plates to Resource 1 and a spoon to each resource) for the red project.

- **Blue Project** will begin 10 seconds AFTER the red project ("funding delay from corporate") . The **Blue Project Manager**, when told to "start", will give blue bowl with all blue project beads and 3 blue plates to Resource 1.

- **Timekeeper must record the start times for EACH project.**

The "RULES" - Resource 1 [and project managers]

- Resource 1 **"sorts" beads onto the plates by color** _but MUST "multi-task" in groups of "3 moves"._
  For example: **when Resource 1 has only the red project, s/he can place 3 "scoops" of orange beads onto red plate #1, then must place 3 "scoops" of white beads onto red plate #2, then must place 3 "scoops" of black beads onto red plate #3. As soon as the blue project appears, the resource must "switch" from red project [e.g. 3 scoops of white beads if that's where s/he is in the process of doing on red project] to the blue project [e.g. 3 scoops of orange beads on the blue project plate], then do 3 scoops of black beads onto red project plate #3, switch to 3 scoops of white beads onto blue project plate #2, etc.)**

- **EACH** Project Manager **trys to keep the Resource 1 focused on** _THEIR_ **project and will take advantage [e.g. let resource keep working on their project] if the other project manager is not particularly aggressive or isn't paying attention!**

The "RULES" - Resources 2 and 3

- **Resources 2 and 3 CANNOT begin their work (e.g. taking beads off the plate, "flipping", and scooping back onto the plates) until ALL of the beads of the same color for the red or blue project are on their plates.**

- **Resource 2 and 3 will FIRST "scoop" beads with SPOON from the plate to the table (no pouring them out). "Flipping" commences <u>once all beads are removed from the plate onto the table</u> surface and as described below:**
  - ■**Essentially - SOME of the beads end up on the table "flat side up", the remainder are "flat side down". Resource 2 and Resource 3 must process or "check" each bead AFTER they've removed all the beads of one color/project onto the table surface.**
  - ■**If the bead is NOT "flat side down", the resources must "flip" the bead over by hand and slide it over to create a group of "checked beads". If the bead IS "flat side down", (they must touch the bead to check it), they only need to slide the bead to the "checked" bead group.**
  - ■**Once all same-color beads the project are checked for "flat side down", the process is repeated to get all the beads "flat side up".**

The "RULES"- (Resources 2 and 3 and Project Managers, cont.)

- **Resources 2 and 3 must THEN scoop the beads (no hands – spoon only!) back onto the plates. For example: Resource 2, will scoop orange beads [that are all "flat side up"] with the spoon to place them on the plate. Sometimes s/he will only get 2 or 3 orange beads in "1 scoop", other times s/he may get 5 orange beads in "1 scoop". When Resource 3 is working on his/her black beads - they'll be getting similarly-varied sized scoops.**

- <u>**Resources 2 and 3 must also continue to multi-task.**</u> **In other words, Resource 2 must cycle between doing** 3 scoops **of one color on the red project, then must moves to** 3 tasks **on a color on the blue project. Resource 3 just worries about alternating between the red and blue projects, working only on black beads each time.**

- *The Project Managers must make sure this is done - otherwise "their" project will fall behind!*

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The "RULES" - the "finish"

- **ONLY WHEN** *ALL BEADS OF A PARTICULAR PROJECT* **ARE BACK ON THE 3 SAME-COLOR PLATES CAN RESOURCE 1 CAN CONTINUE WITH THE NEXT STEP PHASE III.**

- **Resource 1 (still multi-tasking of course) will take 3 scoops of 1 project's beads (it may be the red, it may be the blue!) orange beads from the red plate back into the red bowl, then switches to do 3 scoops of orange beads for the blue project plate into the blue bowl, switches back to red project, etc.**

- **The Timekeeper ("cushy job"!) records the stop time for each project.**

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RECORD THE RESULTS

(We will only have one group in class. It is fun to have competition between groups.)

GROUP #	Red Project	Blue Project
1		
2		
3		
4		
5		
6		
7		
8		
9		

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OBSERVATIONS AND RESULTS

- **There will be much noise, confusion, etc.. Particularly if you have aggressive Project Managers.**

- **It becomes clear that Resource 2 is the "bottleneck" (constraint).**

- **It is not uncommon for the blue project to finish before the red project!**

- **Normal range of completion times is about 6 minutes to 12 minutes PER PROJECT.**

- **ASK STUDENTS/PARTICIPANTS what COULD or SHOULD be done to improve the outcome. Some will suggest "practice", or "process improvements." Most will agree they MUST remove multi-tasking and delay the start (e.g. "choke the release") of the second project if resources are expected to participate on both.**

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RE-RUN the simulation – modified rules.

- <u>NO multi-tasking.</u> **This means even if another "color" of beads or project comes along – finish the task on which you are working first.**

- **Resource 1 will FIRST scoop ALL orange beads from the red project onto the plate, THEN scoop ALL white beads for red project onto the second plate, THEN scoop ALL black beads for red project onto the third plate.**

- **BLUE PROJECT does not "get released" until Resource 1 is nearly done with the black beads from the Red Project.**

- **Resource 2 will begin work on all orange beads for red project tasks, THEN move to the white beads' tasks for red project. Then the blue project.**

- **Resource 3 will work only on black beads for red project until they're all done, THEN work on black beads for blue project.**

- **Timekeeper is to record start and stop time for each project once again.**

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RECORD THE RESULTS <u>NOW</u>

GROUP #	Red Project	Blue Project
1		
2		
3		
4		
5		
6		
7		
8		
9		

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OBSERVATIONS AND RESULTS

- **There will be much less noise and confusion.**

- **All participants (especially Resource 2) are much happier.**

- **Completion times for EACH project tend to be 1:45-2:30 minutes each.**

- **Some students will argue there's a learning effect. [This is minimal – You can run the simulation with a "control group" doing original process again with limited improvement. Or, run a control group without multi-tasking for their first trial and get almost identical results.]**

- **THE POINT? Scheduling projects by removing multi-tasking AND "choking the release" of subsequent project work based upon the load on the "bottleneck" resource is VITAL to managing projects correctly!**

- This is the part of the behavioral shift injections in the Theory of Constraints (TOC)-based method of project management called "critical chain".

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How did it work? Magic?

- **Multi-Tasking attempts to achieve efficient use of resources**

- **But Bad Multi-Taking prevents the efficient flow of projects.**

- **Multiple projects could not overlap. Resource 2 was delayed starting work. And, Resource 1 was delayed the integration step.**

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