# meng 293 - Project Management & Social Responsibility

final project

**Groups**: Each group shall consist of 1 or 2 people.
**Due**: This project should be handed in before midnight on the last day of regular classes (9 December 2016).

Imagine you are working on your final year student project. You are the project coordinator for your group. It is the first week of the project and you discover that you have 5 project members, including yourself. After some discussion, your group selects an interesting industry sponsored project.

**The Project**

You have been asked to come up with a new gripper for a robot whose job it is to insert light bulbs into sockets during a manufacturing operation. The light bulbs are about the size and shape of typical automotive light bulbs. The sizes of these light bulbs vary somewhat but the bases are all of the same style. See the picture.

**Background Provided by the Client**

To insert one of these light bulbs the gripper must:

- Grab the glass of the bulb gently but firmly,
- Move the bulb to the correct location,
- Move it into the socket so the edges of the bulb don't crash into the edges of the socket,
- When the bulb is of sufficient depth the bulb is turned to align the pins on the bulb's base with slots in the socket,
- Once aligned the bulb is then pressed and twisted all in one motion until the bulb seats itself at the bottom of the socket.
- Finally, the robot must give the bulb a little jiggle and pull to ensure it is perfectly placed.
- Once satisfied, the robot gripper releases the glass bulb and moves away ready for the next bulb.

**To Get This Final Year Project Going, Do the Following**

a. Step back from the specific request and re-define the problem in the most general way you can.

b. Use the techniques of "being creative" to articulate at least 20 different approaches for solving this most general problem.

c. Now get focussed again.
Your client actually asked for a "gripper".
Investigate grippers on the internet and think.
(Provide some pictures and references so I have some idea of what you looked at.)

d. Develop a set of **Requirements** for this design and carefully list them out.
(Make sure one of your requirements is that the materials used and the techniques of manufacture shall consider the sustainability of the product.)

e. **Define the interfaces**.

f. Use the techniques of "being creative" to come up with **at least 10 different gripper concepts** and arrangements that would do the job.
(Where did your ideas come from? Reference your gripper concepts back to the internet sources that inspired them or state that a particular concept was somehow "original".)

g. Formally **evaluate** (score), using a tabular format, your gripper designs based on the requirements you developed.
You should be left with two potential winners.

h. One at a time, take each of the **two designs** and explore it.
    a. First draw out a version of the design that is way too complex. That is a version of your design that has too many parts and moves in awkward ways. Criticize it.
    b. Now create a next iteration of the design where you have concentrated on combining functional elements to reduce the number of parts.
        i. Think about what each joint and connection does and simplify the design by modifying the way the device moves.
        ii. Refine the materials used and the techniques of assembly required so that the product is as sustainable as is possible and practical. Take a look at this simple web site: <link>
        iii. Really work at this part. Go over your design again and again.
        When done, your design should be elegant and approaching the level of mechanical art.
    c. Clearly show what you did to the design to transition it from the poorly designed version in "a" to the much better design version in "b".
    d. Now work on the aesthetic. Make your design look really great.
    Articulate what look you were after (show pictorial examples of where your inspiration came from) and what you did to try and achieve that look.

i. Of the two designs, you have been detailing, **pick one** to take a bit further.
Imagine that you are going to really build a prototype of this design, with a mind to then making and selling about 200 more. This last step is centred on planning out the prototyping process (not the manufacturing process). During prototyping you will be making just one, but one that looks and works just like the version that will be finally manufactured. Here is what to do:
    a. Think through the steps you would have to go through to take your gripper from concept to constructed prototype. As you think through what steps are needed create a **spider diagram** that clearly shows the interconnections between one step and the next.

    b. Write a **specification** for your gripper (be specific: size (mm x mm), material (grade of aluminum), lifting capacity (N), range of motion (mm), etc.).

c. Review your spider-diagram and identify, using a scale of 1 to 5, areas that **worry you** (1 is not worried, 5 is most worried). Mark on your spider diagram these scores and, for any item with a score of 2 or more, what it is that worries you.

d. For each worry-item, do a **mini-spider diagram** that identifies the worry, then create tasks to do what ever is necessary to bring this worry-item down to a worry level of 1. You are attempting here to create a design where everything is known so that you can simply move through the design, analysis, manufacture and packaging stages in a smooth, trouble-free fashion.

e. Estimate **how long each step would take** if it were just your group going through the prototyping process. Estimate the duration of each step and write it into each bubble on the spider diagram.

f. Take all these tasks (and there will be a fair number of them) and create a **Gantt chart**. Call it Gantt Chart #1. Remember this is your Final Year Student Project. You will only have 10 weeks to do the actual work.

g. For each task identified on Gantt Chart #1, assign a **specific number of people** to do the work (1, 2, 3, 4 or 5 people for each task). Once done, sum the total number of people utilized during any week (or day) over all project tasks. Are all group members fully engaged and utilized during each moment of the project? Are their project periods when then total people demand exceeds the number of people you have in your group? Probably.

   **Redo your Gantt and people utilization plan** so everyone is engaged, at a reasonable pace, throughout the project. Call this Gantt Chart #2. This is your plan.

h. Produce a **network diagram** of Gantt Chart #2. Calculate the ES, EF, LS, LF and slacks for each task and clearly identify the critical path tasks.

i. Produce a cost estimate for each task and work out an **overall project cost**.
   i. Get real purchase prices from real suppliers. A list of some will appear on the course website.
   ii. Consider shipping and taxes.
   iii. Pretend that you and your group members will get paid $20/hour for your efforts. Don't just think – 7.5 hours in a day, 5 days a week.
   Really think about how many real hours each task will take and use those.

j. Formalize all this into a **wonderfully organized report**. Not formal, no CAD drawings, hand-done Gantt charts and network diagrams are fine. It all simply needs to be super-organized, nicely laid out and easy to follow. Put ALL your rough notes in an appendix at the back of your report.