# **IE 4650 / 6650 Spring 2023 – Final Project Option 1**

**Project submission guidelines**

* See Canvas for the due date / times and penalties.
* Students may work in groups of up to ***four*** students on the Final Project. The task will depend on how many students are in the group!!!!
  + The names of the students who should receive credit for the assignment MUST be on the assignment at the time of submission.
* You may not access unauthorized assistance. The internet can be used as a static resource. This means that you can search for data, but interactive engagement is not allowed. You cannot engage in creating a question or post related to questions on Chegg, or any other platform in which other people provide problem solutions. If you find a post in which a student asked a question about an assignment question, you cannot use the data presented there, even though it is static to you. I will look for this assignment on Chegg.

You are interviewing for a company that provides consolidation and distribution services to grocery stores for certain brands. This question is provided as part of the interview prep in which you are being asked to design a warehouse environment. Some suppliers might deliver several times each day so don’t be confused if you find this is the case. The table below provides information that might be helpful.

* Products arrive from suppliers in cartons on pallets in quantities indicated in “order quantity.” All cartons on a pallet contain the same SKU (i.e., no inbound mixed pallets) and the number of cartons on each pallet is in “cartons/pallet.”
* Orders from customers are for one or more SKUs and each order can be for cartons, pallets, or both. The average weekly quantities for cartons and pallets are also found in “weekly demand.”
* The minimum practical number of locations for each SKU to be placed in the forward area has been determined and indicated in “min practical number.”

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SKU | Cartons/pallet | Order quantity | Weekly demand | | Min practical number |
|  |  | (pallets) | Cartons | Pallets | (Locations) |
| A | 4 | 26 | 14.5 | 25.8 | 4 |
| B | 12 | 6 | 15.3 | 22.7 | 3 |
| C | 25 | 13 | 10.0 | 23.5 | 2 |
| D | 4 | 26 | 32.3 | 11.5 | 6 |
| E | 24 | 8 | 9.4 | 0.9 | 5 |
| F | 6 | 8 | 12.4 | 22.3 | 2 |
| G | 24 | 13 | 41.7 | 8.1 | 6 |
| H | 15 | 13 | 12.6 | 25.8 | 4 |
| I | 20 | 4 | 4.2 | 15.7 | 1 |
| J | 4 | 26 | 32.2 | 10.5 | 4 |

Some additional information follows:

* Facility
  + Shipping and receiving are located in the same general area.
  + The forward area is close to shipping/receiving.
  + All aisles in the warehouse are 15 ft. wide, to ensure that the material handling system can operate safely
  + Busiest hour in the facility in the past year required 350 moves
* Pallets
  + All pallets are 48”x48”.
* Forklifts move all pallets
  + These can handle only one pallet at a time (e.g., no stacking allowed)
* Reserve area
  + Storage is single high using a random policy
  + manual pallet movers put and pick pallets in lanes on both sides
  + the total area is sufficiently large to handle all pallets received
  + pallets stored so lane width is 8 feet
* Forward area
  + dedicated storage
  + single high, single deep
  + forklifts are used for all picks and replenishments
  + 75 locations available
* Picking times
  + Pick from forward area (pallet on ground) = 3 minutes
  + Pick from reserve area = 5 minutes
  + Replenish forward area from reserve = 4 minutes

**Design requirements**

Construct a design of the reserve and forward pick areas. Then design requirements are: 1) minimize picking time in the forward area and 2) minimize the wasted floor space in the reserve area.

The client also wants to know how many forklifts are needed as well as the labor requirements to staff this facility. Assume all materials are delivered to the I/O point and are then moved and stored in reserve. Then, transfer pallets to forward if you determine any should be there.

***There are potentially two parts to the project. Groups of 1 or 2 only need to part 1. Groups of 3 or 4 need to do both parts!!!!***

1. Construct a design that meet the scenario outlined above that is the base case.

2. Construct an alternate design that has the following modifications to the above scenario:

* For safety, a decision to make all of the reserve two-high, two-deep is being considered. Assuming all SKU’s can be stacked two high, does this create more wasted space, how much more?
* There are now two forward areas – A and B.
  + Area A has the same picking times as base case.
  + Area B has a picking time of 1.5 minutes and a replenishment time of 4.5 min.

**Deliverables**

A report that outlines your methodology, results, and conclusions. You should submit two documents:

1. A PowerPoint presentation of no more than 15 slides (title slide does not count and your last slide should be a summary of conclusions that also does not count). You should show enough of your methodology to convince a decision maker that the analysis is correct, present the results in a succinct but comprehensive way, and clearly communicate your conclusions and recommendations. The structure of the presentation is up to you but please address the following at some point:

* Briefly describe the problem
* State all assumptions
* Describe your design process and calculations
* Clearly show results, conclusions, and comparisons

Note that the presentation can be a *maximum* of15 slides – but fewer are fine if you can make all the points more concisely. Quality beats quantity.

2. The calculation file that is built in the Excel spreadsheet provided.

* Input parameters tab – These are the parameters I want to be able to vary and see the correct result in the next two tabs.
* Reserve tab – Calculations related to the reserve area. Since I don’t know exactly what you are going to calculate here as an output for designing this area, make sure you highlight the cell(s) that have the information that you use to design the area.
* Forward tab - Calculations related to the forward area. ***If you have a group of 1 or 2, you only need the FORWARD – base sheet. If you have a group of 3 or 4, you will need to use both Forward sheets!!!***
  + If you choose to use the auction method, I will only check the accuracy of the bids if input parameters are changed. That is, you do not need to figure out a way to automate future iterations like selecting the highest bid and updating stuff – just that the initial bidding calculation are correct when the input tab is changed. ***If you use another method (which you can!!!)***, be sure to clearly explain it in the PowerPoint report. In either case, clearly indicate where the important results are located.