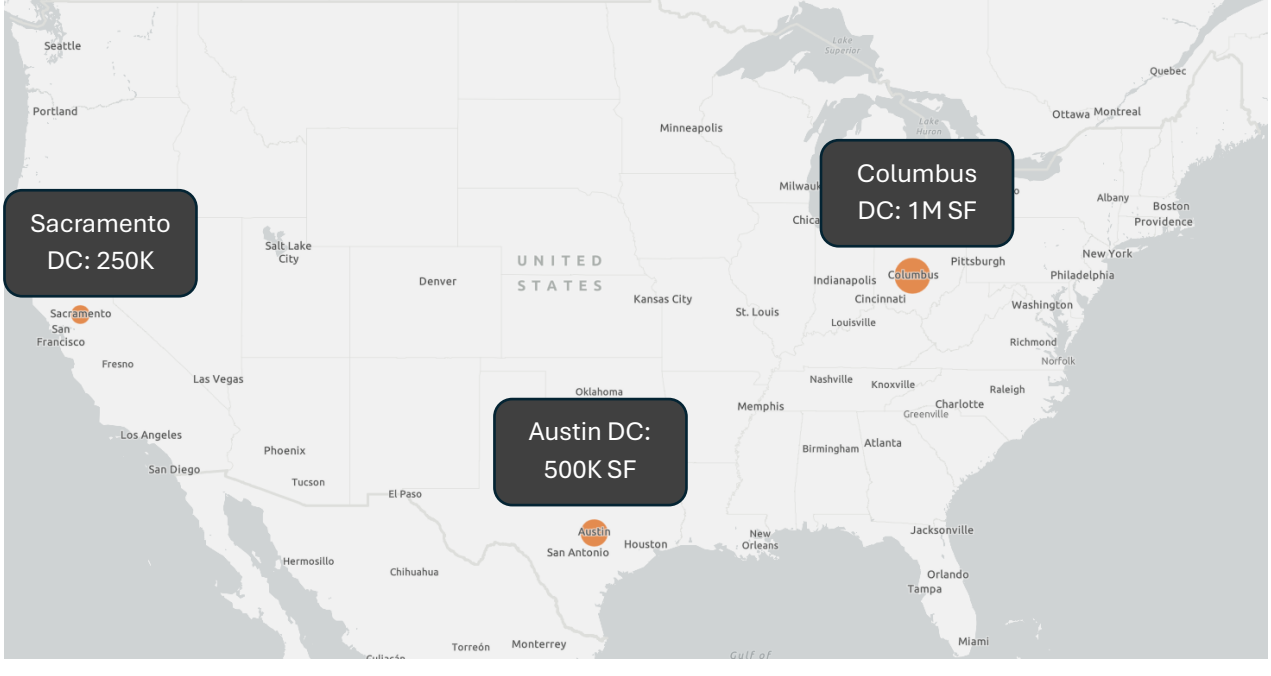
Junior Design Project Description
ISyE 350: Industrial and Systems Engineering Junior Design Laboratory
Professor Radwin, Fall 2025

Background:

The client for this project is a fictitious distributor, *InkCredible Supplies*. The company sells and ships school supplies throughout the United States from its three distribution facilities in Columbus, OH, Austin, TX, and Sacramento, CA. They currently offer five distinct product categories (Writing Utensils, Art Supplies (i.e., Glue), Textbooks, Desks, and Chairs), with multiple stock keeping units (SKUs) within each category.

InkCredible Supplies distributes all SKUs from all locations. Each building has three key functional areas: 1) receiving, 2) storage, and 3) outbound processing. Detailed information on each functional area can be found in the supplemental materials. Each distribution center's square footage and layout can be seen in the supplemental materials. All locations are owned.



InkCredible Supplies is planning on introducing a new product category: *Electronics*. There will be three new products under this category: headphones, laptops, and monitors. Each product will have one unique SKU, and each SKU will vary in size, storage, and outbound requirements. *InkCredible Supplies* believes the introduction of these new products will significantly increase their market share.

The Problem:

InkCredible Supplies is experiencing rapid growth throughout the United States and soon will not have the capacity to support anticipated customer demand for current products and new SKUs. The company has concluded that it requires additional storage capacity to meet the growing need.

The company's largest and most automated building is Columbus due to its central location. They believe this building noes not have the capacity to store additional SKUs within the new Electronics product category while also growing on hand levels of currently stocked items to meet the growing demand. Therefore, *InkCredible Supplies* is looking to grow capacity elsewhere in their network. They are considering doing one of six options. These include:

Keep Current Facilities:

- **Option 1:** Remodel the Sacramento and Austin facilities. The company is open to remodeling one or both locations.
- **Option 2:** Expand the Sacramento and/or Austin facilities.

Stay in the Current Market:

- **Option 3:** Lease an additional 250,000 square foot facility in one of the following cities: Santa Rosa, CA or San Antonio, TX.
- **Option 4:** Close the current Sacramento DC in favor of relocating to a new, 1 million square foot facility in the Sacramento area.

Expand the Network Footprint:

- **Option 5:** Invest in a new 1 million square foot facility in one of the following cities: Los Angeles, CA; Des Moines, IA; Albany, NY; Atlanta, GA.
- **Option 6:** Invest in two smaller (500,000 square foot) facilities located in any of the following cities: Los Angeles, CA; Des Moines, IA; Albany, NY; Atlanta, GA.

After initial review, the company has determined that there is no cost justification to take any of the above options unless a detailed design for each option is created to fully understand the costs and benefits. *InkCredible Supplies* is therefore seeking design expertise to make the best choice for their company for ensuring operational efficiency, product quality, workspace safety, sustainability, and flexibility for future growth. Using SKU demand forecasts, customer lead times, facility requirements, and associated costs, your team will design recommendations for *InkCredible Supplies* to expand their distribution network and support their growing customer demand throughout the United States over the next 10 years (January 2026 – December 2035).

Consulting design teams, consisting of three to five members in your Junior Design laboratory/discussion section, will be asked to consider one of the six alternatives. Every design team will work independently, under the guidance of the course TA (your engineering manager) and the course instructor (the client). After each final design is submitted, the company will compare each and determine the best path forward. Your assignment is to develop the *best* design for the option you are assigned for the company to consider. After you have received your team's assignment, see the detailed deliverables in the Request for Proposal below.

Request for Proposal (RFP):

InkCredible Supplies, a U.S. based distributor of school supplies requests design proposals for their expansion and growth into the next ten years. Design teams will be assigned one of each of the following alternatives:

Option 1: Remodel either the Sacramento, Austin or both facilities. This remodel can include any area of the building (inbound, storage, outbound). If the remodel includes racking changes, *InkCredible Supplies* will utilize *The Rack Pack* as the contractor. Their quotes for material, labor, and lead times are noted in the supplemental material. Current state, neither the Sacramento nor Austin facilities utilize automation. *InkCredible Supplies* is willing to introduce automation to these facilities provided there are strong analytics to back this decision. The primary areas they are interested in introducing automation are storage and outbound. They've received quotes from *Convey the Way* to introduce conveyance throughout their facilities, and *AutoMate,* a company that specializes in automated storage and retrieval systems. Details on their operational impacts, costs, and lead time can be seen in the supplemental materials. Additionally, specific considerations design teams assigned this option should review are:

- What product categories are at highest risk of exceeding capacities? Could this be solved by increasing storage capacity, throughput capacity, or both?
- What is the return on investment for the racking solution versus the automation?

Option 2: Expand either the Sacramento, Austin, or both facilities (see Figure xxx for the expansion options). Sacramento has the option to expand up to 250,000 square feet. Due to California laws, it will cost $2.00 per sq foot for the first 100,000 sq feet and $4.00 per sq foot for anything above 100,000 sq feet, as labor is more expensive and additional materials will be required to meet EHS (environmental, health, and safety) regulations. Austin can expand 200,000 sq feet at the cost of $1.50 per sq foot. The space can be used for storage of any type of product, and you should only expand as much as you believe is necessary based on the available resources and forecasted building capacity needs for the next 10 years. Additionally, specific considerations design teams assigned this option should review are:

- Are there potential disruptions during construction that could affect operations?
- What product category should be stored in the expansion area to support customer demand in the market?
    - How does the expansion affect how products are received and shipped? Would you consider changing the building layout to keep product categories in the same area?

Option 3: A new 250,000 square foot facility can be leased in either Santa Rosa, CA, near the Sacramento DC or San Antonio, TX, near the Austin DC. The Santa Rosa location can be leased for $5.00 per sq foot, while the San Antonio building can be leased at $4.00 per sq

foot. Details on the building dimensions can be seen in the supplemental materials. Current state, both buildings are empty. *InkCredible Supplies* will utilize *The Rack Pack* as the contractor for all racking. Their quotes for material and labor are noted in the supplemental materials. Additional, specific considerations design teams assigned this option should review are:

- Based on customer demand, transit times, and current DC capacities, which facility would benefit most from added capacity created by leasing a new building?
- What product category(s) should be stored in the leased facility?
- When completing the deliverables, ensure to provide detailed information on the new location **and** insights into any changes within the current DC (either Sacramento or Austin) now that some of their demand will be serviced by the new building.

Option 4: *InkCredible Supplies* is exploring if staying in the Sacramento area is in their best interest. They are considering moving out of their current facility and relocating to one of three nearby 1M sq foot facilities (see Figure xxx). *InkCredible Supplies* can sell their current building for $75 million dollars. Your task is to help the team evaluate and recommend which location they should move to. Additionally, specific considerations design teams assigned this option should review are:

- Real estate costs, and how they balance with other operational factors.
- Employee impact:
  - How would you manage the relocation of staff?
  - Keep in mind that not all employees may be will or able to commute to more distant locations.
- Transportation and logistics
  - Proximity to their transportation carrier, *CrossState Carriers*.
  - Access to major highways and freight routes.

Option 5: *InkCredible Supplies* has identified four potential locations to build a new 1M sq foot facility: Los Angeles, CA, Des Moines, IA, Albany, NY, or Atlanta, GA. Additional information on each location can be found in the supplemental materials. The new, larger facility would house the same, core operations of inbound, storage, and outbound processing. Your task is to help the team evaluate and recommend which location they could move to. Additionally, specific considerations design teams assigned this option should review are:

- Customer Reach:
  - How will each location increase customer reach?
  - Are there underserved markets that will benefit from a new location here?
- Transportation:

    - Proximity to their transportation carrier, *CrossState Carriers,* and how this may impact transportation costs.
    - Are there seasonal / weather risks that could disrupt operations?
- Other:
    - Is labor competitive? What are the average wages for employees?
    - Are there any hidden or long-term costs (rising property values, local regulations, etc.)?

Option 6: *InkCredible Supplies* would like to review the impact of building two new 500,000 sq foot facilities in two of four locations: Los Angeles, CA, Des Moines, IA, Albany, NY, or Atlanta, GA. The new facilities would house the same operations (receiving, storage, and outbound processing). Your task is to help the team evaluate and recommend which locations they should move to. Additionally, specific considerations design teams assigned this option should review are:

- Customer Reach:
    - How will each location increase customer reach?
    - Are there underserved markets that will benefit from a new location here?
- Transportation:
    - Proximity to their transportation carrier, *CrossState Carriers,* and how this may impact transportation costs.
    - Are there seasonal / weather risks that could disrupt operations?
- Other:
    - Is labor competitive? What are the average wages for employees?
    - Are there any hidden or long-term costs (rising property values, local regulations, etc.)?

InkCredible Supplies requests a detailed design proposal addressing each of the following components:

1. Response to the growing market.

Examine the costs and benefits of the decision to either renovate the current facilities, introduce new buildings within the current network, or expand the network by building distribution centers in new locations, depending on the option your team is assigned. Consider how much space will be needed for receiving, storage, and outbound. Consider transportation costs between facilities and customers, replenishment of materials from suppliers, and production capacity over the next ten years. Justify your design decisions to support the client's requirements for process capability with critical parameters for design and design components that are critical to quality (CTQ). Consider how your design impacts public health, safety, and welfare, as well as global, cultural, social, environments and economic factors.

2. Facility design of receiving, storage, and outbound operations.

Take into consideration the exact square footage and layout required for each element to ensure *InkCredible Supplies* has enough space to efficiently receive, store, pack, and ship products. Provide details on the flow of products throughout the building, the split between bin, pallet, racking, and hazardous material storage, forklift travel paths, potential bottlenecks, inventory policies, etc. Validate your design(s) with a Value Stream Map (VSM) and a rendering of your facility.

Tools and Methodologies to Consider for Proposal Development:

- Kanban
- Poka-yoke
- M.O.S.T.
- Six Sigma & Lean Manufacturing
- Point-of-Use Inventory Methodology
- Value-Steam Mapping (VSM)
- Pugh Matrix
- Affinity Diagram
- Critical to Quality Tree
- Failure Mode Effects Analysis (FMEA)

Deliverables

A preliminary design proposal (see course calendar for specific deadlines) prepared by each design team should outline their assigned design approach. The proposal should include a project mission statement and management plan, the team's approach to addressing the client requirements, critical parameters for design, and process capability, and details about concept design and selection.

A final presentation by each team describing the proposal will be made for the client before submitting the final design report. A final report prepared by each design team will provide detailed designs for the assigned approach, indicating expectations, reliability analysis and recommendations. Each group's final report should contain the following:

- **Capacity analysis:** Determine the required capacity for *InkCredible Supplies* to meet their forecasted demand over the next ten years.
- **Staffing**: Identify the number of team members required for all departments to ensure *InkCredible Supplies* meets the identified capacity.
- **Value Stream Map:** Create a VSM of the complete updated process for *InkCredible Supplies'* supply chain and operational processes based on the assigned option.
- **Facility Layouts:** Provide a detailed diagram of the *InkCredible Supplies* distribution facility. Note the square footage of each functional area, specifying the exact square footage allocated to each type of storage. Additional elements to include are the flow

of products, travel paths of forklifts and pedestrians, forklift charging stations, front offices, restrooms, etc.

- **Inventory Shelving:** For each type of storage, render an example bay, showcasing what items you'd suggest storing at each level. Consider incorporating components such as human factors constraints, capacity constraints, shelving flexibility, Kanban systems, 5S standardization, etc. in your design.
- **FMEA analysis:** Analyze components of your recommended design to identify potential failure modes and their causes and effects.

In addition to the requirements listed above, groups of four will have the opportunity to expand their knowledge of industrial engineering topics by selecting from the following options to include in the final recommendations. **Groups of three should select one option, groups of four should select two options, and groups of five should select three of the following options to complete**. The options are separated into three primary industrial engineering related categories, so teams can choose one from any category.

Manufacturing Activities (select one of the following)

- Inventory Analysis: Analyze and report the inventory management techniques that best suit *InkCredible Supplies* for this expansion. Considerations include but are not limited to; LIFO or FIFO, intended storage plans, methods of inventory tracking, etc.
- Developing SOPs: Create three well formatted standard operating procedure documents for processes that would be used in the *InkCredible Supplies* manufacturing facility.
- Plan for dealing with tariffs on international goods. The tax on materials such as steel and aluminum has been growing rapidly. As an importer, *InkCredible Supplies* is required to pay these high tariffs as they are manufactured using these raw materials. This trend is expected to continue and is putting pressure on distributors, who are struggling to keep their costs low while still maintaining a strong inventory level to best service customers. The increase in raw material costs also leads to higher prices for consumers, making it more difficult for distributors to sell their goods.

Human Factors Engineering Activities (select one of the following)

- Ergonomics and safety workstation design: While designing the *InkCredible Supplies* shelving layouts, focus on human factors considerations. Specify human factors and ergonomics considerations such as OSHA regulations, LEED certifications, salience and attention heuristics, mechanisms to prevent defects, and safeguards against fatigue and injury.

- Error prevention: From the results of the FMEA, develop three distinct, descriptive recommendations and implementation plans for how *InkCredible Supplies* can prevent possible failures from occurring.

Workforce Availability (select one of the following)

- Recruitment plan: One of the greatest difficulties faced by manufacturers today is recruitment and retention of employees. With a rapidly aging workforce and a growing demand for skilled workers, companies are struggling to find and keep the talent they need to stay competitive. The shortage of skilled workers is leading to higher turnover rates and increased competition for top talent. This, in turn, is driving up costs for companies and hindering their ability to meet production demands. Devise a recruitment plan for *InkCredible Supplies* that helps provide the necessary skilled workforce commensurate with the design.
- Employee retention plan: With unemployment rates at historic lows, manufacturers are struggling to find the skilled workers they need to keep their operations running smoothly. Because there is a shortage of these skilled workers, the industry faces a lack of availability in its workforce. This has led to increased competition in finding talent, ultimately driving up wage costs for many companies. Devise an employee retention plan for *InkCredible Supplies* that helps retain the necessary skilled workforce commensurate with the design.

Supply Chain Activities (select one of the following)

- Market research for competitors, pricing, etc.: Perform research on the school supplies distribution markets. These distributors can sell school supplies only, or have a wider assortment, but at least some of their stocked items are similar to those sold at *InkCredible Supplies*. Compile a detailed report of this information for *InkCredible Supplies* to use in their business decisions.
- Implementation plan for SAP: Research SAP and develop methods for how *InkCredible Supplies* can implement the software to enhance their business processes.
- Supply chain disruptions have affected almost every industry in the global economy since the COVID-19 pandemic. While things have begun stabilizing, the high value and volatile international tariff policies have disrupted the supply chain again. The after-effects of the pandemic, as well as natural disasters and geopolitical tensions, have left many companies facing increased uncertainty in their supply chains. Supply chain disruptions are causing longer lead times, higher costs, and lower product quality, which can all negatively impact on hand inventory levels, customer satisfaction, and overall profitability. Devise a supply chain plan that helps reduce lead times, costs and retains product quality.

Marketing Activities (select one of the following)

- Market research into potential new products, *InkCredible Supplies* should stock based on local customer demand. Ensure the products stay true to their brand and enhance the current portfolio. Provide data and support research.
- Identify newer business models, for example bundling items into a package customers can buy rather than purchasing each product individually, etc.