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# Facility Layout for Puck Custom Enterprises

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# Facility Layout for Puck Custom Enterprises

## **Problem Statement**

Puck Custom Enterprises (PCE) has experienced tremendous growth resulting in a need for a facility expansion and additional manufacturing equipment. PCE opened their first manufacturing facility in 2010 producing dragline systems for manure spreading applications. They quickly grew out of their facility resulting in four expansions in 2011, 2012, 2014, 2015. PCE has once again grown out of their facility. There's an insufficient amount of facility space and manufacturing equipment to handle their customers demand. PCE is planning on another expansion, they are unsure of how to layout the new facility and where to place the machines. Facility design is one type of job that graduates of industrial technology can pursue. There are many other companies looking to design new facilities or redesign old facilities. The techniques used to solve PCE's problem are commonly used by these graduates and companies to similarly layout their facilities.

## **Disciplines**

Bioresource and Agricultural Engineering | Industrial Technology

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# IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering (ABE)

TSM 416 Technology Capstone Project

## Facility Layout for Puck Custom Enterprises

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## 1 PROBLEM STATEMENT

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Puck Custom Enterprises (PCE) has experienced tremendous growth resulting in a need for a facility expansion and additional manufacturing equipment.

### Problem Statement

- PCE opened their first manufacturing facility in 2010 producing dragline systems for manure spreading applications. They quickly grew out of their facility resulting in four expansions in 2011, 2012, 2014, 2015.
- PCE has once again grown out of their facility. There's an insufficient amount of facility space and manufacturing equipment to handle their customers demand.
- PCE is planning on another expansion, they are unsure of how to layout the new facility and where to place the machines.
- Facility design is one type of job that graduates of industrial technology can pursue. There are many other companies looking to design new facilities or redesign old facilities. The techniques used to solve PCE's problem are commonly used by these graduates and companies to similarly layout their facilities.

## Business Case Statement

- A. **What** - Once PCE builds their expansion, it will be important to layout the new facility in a way that minimizes transportation waste, and increases production.
- B. **How Extensive is the Problem** – This problem effects the growth of PCE’s business and results in a large amount of potential profit lost.
- C. **When** – This problem has been occurring nearly every year since they opened their first manufacturing facility. It is once again time to expand, therefore it is time for another facility layout.
- D. **Where** – This problem deals with PCE’s manufacturing facility
- E. **Why** – This problem is an opportunity because it opens up a clean slate to reorganize the layout of their facility and machines. This allows opportunity to increase production and minimize transportation waste within the facility.
- F. **Who Cares About the Problem** – It is very important to PCE as this is a very large business opportunity that could boost their business. The results of this pertain to people of surrounding areas due to new job potentials.

## 2 GOAL STATEMENT

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- A. PCE is seeing an increase in demand for their products. They have a major expansion set to meet those demands. With this expansion PCE is looking to resolve a number of problems with their current facility. Their current facility layout is extremely inefficient with a lot of transportation waste and that is solely because of how the machines and departments are positioned. They are seeking our assistance to develop a more efficient facility layout that they can implement after the expansion.
- B. Our improvements will be measured by the increase in output of products. The company will be able to make parts faster thanks to the improved layout. Our improved layouts will reduce both transportation and motion waste.
- C. Our parameters were measured in two ways. First, was the shortest travel distance from raw stock to final product. This was measured using a computer program that uses department locations and travel paths to determine the travel distance. Using the data, we were able to determine the shortest travel distance, resulting in the best layout. We also used the number of assembly and fabrication bays to evaluate the layouts. Our client requested as many bays as possible therefore a larger number of bays helped determine the better layout.
  - Tangible results for our project will be faster manufacturing times for their products. The expansion and addition of new machines will also improve output of products to fill demand.
  - An intangible deliverable for our project is that the company will be able to expand their product line in the future and have the space to add more equipment if necessary.
  - The project outcome will be implemented when the company expands their facility.

- **Main Objective(s) and Specific Objectives**
  - The main objective is to develop a machine and facility layout with the company's current and future machines under the new expansion and current buildings. Our new design needs to allow the company to be flexible so they can manufacture a wide range of products.
  - It is imperative to design a facility that meets the client's criteria and constraints:
    - Client criteria #1: Create a machine layout incorporating their equipment.
    - Client Criteria #3: Machine layout located mostly in original northwest building.
    - Client criteria #2: The design must consider department locations in such a way that reduces travel distance.
    - Client Criteria #4: Maximize the number of fabrication and assembly bays.
    - Constraint #1: Pillars are located in such ways that make machine placement difficult.
    - Constraint #2: Four feet must be kept around machines for maintenance and safety.
    - Constraint #3: Stock must easily be fed into the machines.
- **Rationale** - By creating an addition to their facility our client will be solving a number of issues.
  - Example 1 – Reducing travel time of parts from raw stock to final product.
  - Example 2 – Reduction of assembly time of products.
  - Example 3 – Increase in production due to more fabrication and assembly bays.

### 3 PROJECT PLAN/OUTLINE

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#### A. Methods/Approach

- Reference Material(s):
  - The program we used to design all of the facility layout designs was AutoCAD, we also used an AutoCAD ad-in program called FlowPlanner to calculate the travel distance of products from raw stock to warehouse.
  - We used Richard Muther's systematic layout planning techniques to determine the locations for the machines in relation to one another. The tools we used from Muther are a closeness relationship diagram and a dimensionless layout diagram as seen in the appendixes.
  - We also used the manufacturer's online websites and catalogs to determine the machine dimensions.
- **Data collection:**
  - By using the dimensions that we found from the machine manufacturer's websites and catalogs we were able to create machine blocks to be implemented into our AutoCAD files.
  - We talked to our client to determine the importance of each machine being next to each other. We came up with a scale of 1-4 to determine machine positioning next to each other. 1 being the machines had no correlation, and 4 being that there was a direct connection between machines and they should be placed near each other.

- This data of 1-4 helped create our closeness relationship diagram and dimensionless layout diagram.
- The last piece of data that we collected was the travel distance of products from raw stock to warehouse which was gathered by using FlowPlanner.
- **Skills:**
  - To understand the problem that PCE has been facing we had to go to their facility to know how the current facility operates. This allowed us for a better insight as to their needs for the expansion.
  - The drafting and design classes that we have taken though Iowa State were the most beneficial to completing this project. In these classes we learned the skills necessary to use AutoCAD. In addition to these classes we also had taken a facility planning course where we learned about FlowPlanner which helped with analyzing the layouts between one another.
- **Solutions:**
  - Our group created three AutoCAD drawings that would be evaluated against one another to determine which facility layout would be the most beneficial to PCE.
  - We evaluated each layout based on the FlowPlanner distance that was calculated. We also used the amount of assembly and fabrication bays to determine which layout would fit the needs of PCE the best.
  - The client had requested that we maximize the amount of fabrication and assembly bays and also try to minimize travel distance between the departments within the facility.
  - We weighted the travel distance at 60% of the total score and the number of bays at 40%. With these ratings, we determined which layout was the best for the company and suggested our third layout to be the best for their needs, seen in our graphical abstract.
  - Our proposed solutions all have the same machine layout that was approved by our client at PCE, the only difference between the three facility layouts are the locations of the other departments within the facility.
  - Our proposed solutions are consistent with the main objective of the project, they all have incorporated the machinery that they will be adding and determining a logical place for the rest of the departments within the facility.
- **Organization:**
  - As a group we met as a group once a week on Mondays at 11:00 a.m. for two hours to divide up the work that was to be done that week.
  - We initially met with the client at PCE in January to ask questions in person and to better understand the facility and the general flow of material through the current facility.
  - We then contacted our client at PCE with general questions that came up throughout the project, the main course of communication between the client and the group was via email.
  - Our first major milestone in the project was to create three facility layouts before spring break, March 10<sup>th</sup>. We sent the facility designs to the client and

received notice that there were some changes in the designs that were necessary.

- The second milestone was to have the changes made to the designs by March 31<sup>st</sup> so we could confirm the designs before our practice presentation on April 3<sup>rd</sup>.
- When setbacks were encountered and we had to expedite our work to stay on schedule we divided up the work evenly between group members so that one person was not stuck with the whole workload by them self.

#### **B. Results/Deliverables**

- The timeline of this project has been from January 2017 to April 2017.
- The main deliverables of the project were to present our client with three AutoCAD files that would have a facility design with a proposed machine layout. We also would be suggesting which of the three designed we felt was the best by running all three through a program called FlowPlanner which is an add on to AutoCAD
- The deliverables for the project were kept consistent with the project objective and the scope of the project.
- The project was completed by April of 2017 which was as scheduled.
- Following up with the completion of the project we have sent PCE all three of our detailed drawings of the three layouts in an electronic format so they can inspect them in detail as to the positioning of each machine and department with in the facility.

## **4 BROADER OPPORTUNITY STATEMENT**

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- A.** Our project will be interesting to most people because growth and expansion are so common in today's world. We feel that we have laid out our project in a way that can be understood by the average individual who does not have a background in our field. We feel that our project was explained in detail and does not require further questions.
- B.** The effects of the proposed addition to Puck's facility will allow for an increase in energy efficiency during the winter because of the combination of the two existing building into one. The increase in overall square footage will allow for an increase in bays with allows for an increase in production, which in turn will increase the required number of employees; this will give the opportunity to bring jobs to the community. The biggest effect of the expansion will be felt in the food industry with the increase in the manure application that will be available. With more fertile land the fields will provide higher yields.
- C.** There are several businesses that would be interesting in both an increase in facility size and a reorganization of the facility layout. With today's manufacturing companies continuously trying to improve efficiency and become more lean a new layout and addition would allow for the proper change. We feel the steps we took to design a facility layout can be applied to any company expansion and be effective.
- D.** Many industries such as the automotive and manufacturing industry would be interested in properly placing their equipment and assembly lines to maximize their efficiency and to reduce the time spent on moving parts around the facility.
- E.** There are some costs associated with the reorganization of the machines and the cost of building the new facility but in the long run as long as there is a high demand in the market for Pucks

products and they can meet their production requirements they will be able to profit from the expansion fairly quickly.

- F. As companies continue to grow they will always add additions or do a full remodel of their entire facility in order to meet their demands for company's products.
- G. Before companies decide to go with a renovation or expansions they have to look at their growth rate, how much more product are they going to sell in the future, and what will be the approximate payback period for the renovation or expansion. With all these considerations, companies have to determine if this renovation or expansion will help their company grow and make them more profitable. At first the renovation or expansion will cost quite a bit of money, but if you look at it in terms of future profitability, and then companies will be able to make more products and cover the cost for the renovation or expansion.

## 5 PROJECT SCOPE

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- A. The area within the original facility and the expansion were the main boundaries for this project. From the start of this project we had to consider the building support pillars and work around them when implementing out machine design and facility design. We did have a change in scope at the beginning of our project, we initially planned to create a process flow for the products that PCE creates. This was difficult to do because the company has several different products that they make and they have no defined flow of material. The change of scope was driven by our group because there was not enough information to complete a process flow within the facility.
- B. Areas of the business included:
  - Raw Stock Storage
  - Machine Area
  - Fabrication Bays
  - Assembly Bays
  - Paint Room
  - Warehouse
  - Shipping Dock
- C. Areas of the business not included:
  - Offices
  - Main Entrance
  - Maintenance Shop
  - Outside Storage
- D. Items outside of our scope

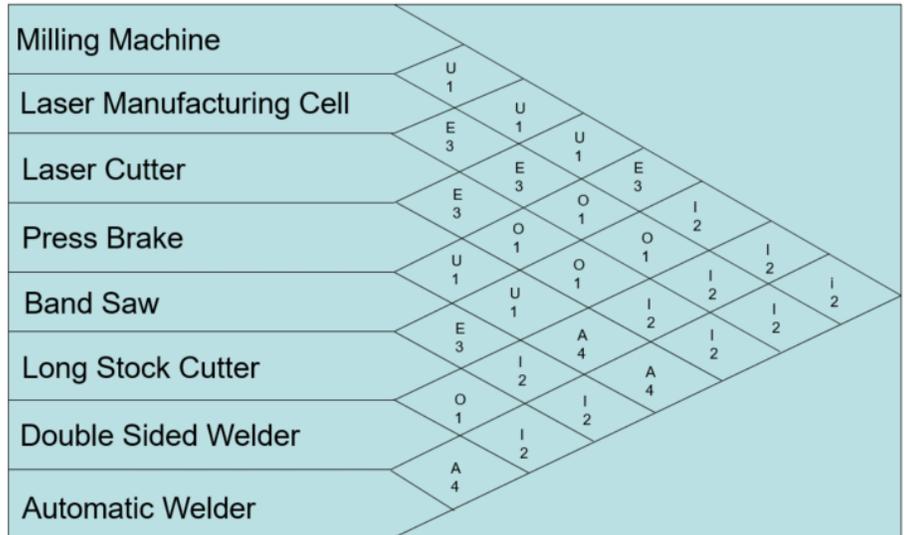
## 6 APPENDIXES

### Reason Codes:

- 1) Doesn't need to be close
- 2) Close, but not highest priority
- 3) Close proximity
- 4) Client requested next to each other

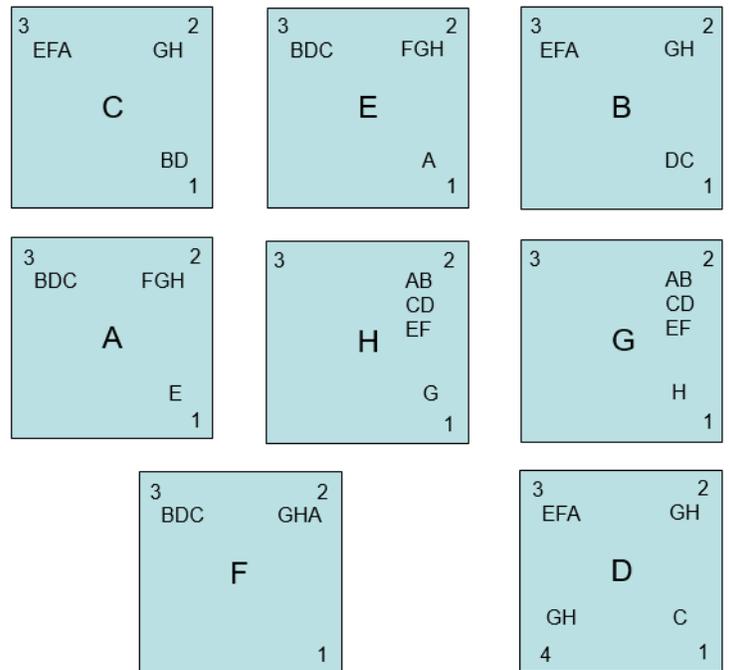
### Rating Symbols:

- A: Absolutely necessary
- E: Especially important
- I: Important and core
- O: Ordinary
- U: Unimportant



### Key:

- 1) Machines don't need to be near each other
- 2) Machines should be close to each other, but it's not too important
- 3) Machines should be in close proximity
- 4) Client requested the machine be next to each other (most important)



- A) Milling Machine
- B) Laser Manufacturing Cell
- C) Laser Cutter
- D) Press Brake
- E) Band Saw
- F) Long Stock Cutter
- G) Double Sided Welder
- H) Automatic Welder