Design a Textile Mill

You have been transported back to the 1840s. The wealthy capitalist investor, Mr. Buggé has just purchased the land along the Millstone River and is looking to build a textile mill to replicate the success of the factories in Lowell, Massachusetts. Your company has been offered the opportunity to submit a proposal that would essentially build and operate the mill in a manner that everyone makes money and Mr. Buggé receives a handsome profit. The proposal is due on March 16, 2017 when your team will present your idea to Mr. Buggé.

This assignment makes use of all the 21st Century competencies. There are multiple problems to be solved, crossover knowledge of science, math and business as well as historical understanding of the textile business at the time. You must be collaborative team members, information literate researches, creative and practical problem solvers, globally aware, effective communicators, and self-directed learners.

This project is open-ended in the design. That means you as an individual, and part of the team must think about this project. What should be in the written portion? How much will be orally presented? Will you draw your design? Will you create a 3d model of your design? What will your final piece be? What will you call my company? How will I know what it will look like? How long will it take me to make a profit? These are just some of the problems your team must solve. You will need to research the mill system beyond what we discussed in class in order to fully understand the needs of building and operating a successful industrial textile mill. At the end of the project you will be tasked with assessing yourselves, your teammates, and the group’s overall performance. In other words I want to know what you think you, your teammates, and group deserve.

Be creative! Think outside the box! Have fun!

Deliverables are:

- You will present your mill design complete with information in the packet on how it will work, costs, projected productivity, etc. BE PREPARED FOR QUESTIONS RELATED TO YOUR DESIGN, OPERATION AND BUSINESS ASPECT OF RUNNING THE FACTORY.
- Additionally you will need to turn in an individual annotated bibliography of your research separated by primary and secondary sources.
- Finally you will be reflecting back on the assignment, your own participation and group involvement as well as the working interactions of your teammates.

This assignment is worth 60 points in total. You will earn 10 each for the annotated bibliography and reflection and 40 for the research, design, construction, presentation and question responses.
### Period 2 Design Teams:

<table>
<thead>
<tr>
<th>Team A</th>
<th>Team B</th>
<th>Team C</th>
<th>Team D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jonathan</td>
<td>Anika</td>
<td>Abhik</td>
<td>George</td>
</tr>
<tr>
<td>Anirudh</td>
<td>Dougzie</td>
<td>Avital</td>
<td>Nisha</td>
</tr>
<tr>
<td>Gayathri</td>
<td>Vyas</td>
<td>Noah</td>
<td>Rohan</td>
</tr>
<tr>
<td>Claire</td>
<td>Dhiraj</td>
<td>Ishana</td>
<td>Amanda</td>
</tr>
<tr>
<td>Vinay</td>
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<td>Ritika</td>
<td>Aparna</td>
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### Period 7 Design Teams:

<table>
<thead>
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<tbody>
<tr>
<td>Sophia</td>
<td>Justin</td>
<td>Varsha</td>
<td>Ben</td>
</tr>
<tr>
<td>Robin</td>
<td>Ramya</td>
<td>Maria</td>
<td>Ezra</td>
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<tr>
<td>Jeffery</td>
<td>Mira</td>
<td>Ted</td>
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<tr>
<td>Lexi</td>
<td>Skandan</td>
<td>Joseph</td>
<td>Madeline</td>
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<td>Michelle</td>
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Introduction

A textile factory is a system of machines, workers, managers, power, and materials, all brought together to produce cloth and make money. The textile mills at Waltham, MA (1813) and then the mills at Lowell, MA (1824) were the first textile mills in the world that took in raw cotton, performed all of the manufacturing processes under one roof, and turned out finished cloth. Congratulations, your design firm has been chosen by that great entrepreneur Mr. Buggé to assemble his latest factory located along the banks of the Millstone River in a new town called Buggé, New Jersey.

The goal of this activity is for you to understand:
the scale of production and systems of manufacturing
how to staff and manage a mill
to solve complex relationships between people, power and machines
the process of producing textiles at the turn of the nineteenth century

• Materials:
  You are being supplied with an essay titled "Why A Factory?"
The architectural diagram of a factory floor

• A table of approximate wages paid at the time

The assignment
Textile mills, like other factories, are complicated systems. One of the key jobs of a factory owner or manager is to set up the machinery in the factory so that one machine produces just enough to supply the next process. It's not easy to balance the various machines so that the output of each stage would not produce too much or too little for the next stage.

Your job is to use the drawings and any other information supplied, then build and staff a factory. You need to answer the basic questions… How many machines, how many people, and how much money was needed to run a factory? While the numbers you are given will not be exact, they will closely represent the circumstances of an early 19th-century factory.

Setting up the factory--calculating the number of each type of machine--is only your first step. The factory manager (you) also have to fit the machines into the mill, consider how much money the machines would cost, and worry about finding the right workers to operate the machines. In addition, the manager had to run the mill to make money--paying for the machines, the workers, the power, and the raw materials.

These exercises show some of the mathematics that the mill manager had to do. It's mostly simple math--multiplication, division, and proportions. But for the mill manager,
the math was the easy part of the problem; the hard part was estimating the right relationships between the machines, knowing how fast machines ran, how much power they used, and how many people were needed to keep them running. Mistakes, for example buying the wrong machines, or hiring the wrong people, were expensive.

Finally you will be delivering a poster size graphic, or 3D version, of your design and explanation of how your factory is built and staffed. Be prepared to answer questions as stated on the introduction page.

EXERCISE 1: HOW MANY MACHINES?

Decide how many machines of each kind to buy for your factory. To do this, follow these rules that compare the input and output of each type of machine. Step 1 is to determine the ratios of the machines to one another, that is, how many of each of the other machines are there for each picking machine. Then you should move on to decide how many, and what kind of machines, you need in total.

Machines used in producing cotton cloth:

Carding machine. Straightens the fibers of raw cotton. A single picker can supply cotton for eight breaker-carding machines, the first step. The output of these machines then goes to the finishing breakers; for every breaker card there’s one finishing card. The carding machine produces "slivers," long loosely twisted pieces of cotton fibers which then go to the drawing frame, which draws and twists it. There are three kinds of drawing frames. You need one of each kind of drawing frame for every four finishing cards.

The drawing frame is the last of the preparatory processes. Next comes spinning. The first step is to turn the sliver into roving, which is done on a "speeder." The Lowell factories had two speeders for every three drawing frames.

The next step in spinning is to make the yarn. The Lowell mills used throstle spinners. Each speeder made enough roving to supply three throstle spinners. There were two kinds of throstle spinners, one kind for the warp yarn and one kind for the filling yarn. There were twice as many
warp throstles as filling throstles.

Next comes weaving, turning the yarn into finished cloth. First, the yarn must be "dressed," coated with a starch solution to make it easier to work. You need one dressing frame for every 16 looms.

Before the looms can be set up, you have to wind the warp, putting it on the warp beam. One warper will provide enough warp beams for 20 looms.

There are almost as many looms as all the other machines put together, 10 looms for every filling throstle.

**EXERCISE 2: HOW MUCH POWER?**

Now figure out how many machines the waterpower on the site can drive. At the Waltham mills, the limiting factor was power. A "millpower" provided about 85 horsepower, of which more than a third was lost to inefficiencies--so there was about 60 horsepower available to drive the machines. Each machine took about (on average) .186 h.p. How many total machines were there, and how many of each machine?

**EXERCISE 3: HOW MANY WORKERS DO YOU NEED?**

Here's how many of each machine a worker could operate:

**Women's jobs:**
One weaver could tend two looms.
A spinner could tend one filling throstle or two warp throstles.
One woman tended each drawing frame.
A woman could handle two speeders.
Each dressing frame required one woman; in addition, there was one woman for every two dressing frames who did "drawing in," drawing each thread through the harness and reed of the loom. "Sparehands" were trainees who were learning to work the machines. There was, on average, one sparehand for every four experienced women workers.

**Men's jobs:**
Men tended the pickers and carders; one man per picker and one man per ten carders, Overseers and assistant overseers were men: there was, on average, one of these managers for every thirty female employees.
Machinists kept the machines operating. There was one machinist for every 50 or so machines.

**EXERCISE 4: PAY DAY**
Each worker is paid a different amount. The wages were determined by a number of factors:
More skilled workers tended to get more than those less skilled.
Young workers tended to get paid less than older workers.
Women got paid less than men.
Workers with needed skills received more than those with common skills.

<table>
<thead>
<tr>
<th>Job Category</th>
<th>Wages Per Day</th>
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<tbody>
<tr>
<td>Weaver</td>
<td>.66</td>
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<tr>
<td>Spinner</td>
<td>.58</td>
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<tr>
<td>Drawer</td>
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<td>Speeder</td>
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<td>Dresser</td>
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</tr>
<tr>
<td>Drawing in</td>
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<tr>
<td>Sparehands</td>
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<tr>
<td>Pickers</td>
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<tr>
<td>Carders</td>
<td>.85</td>
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<td>Overseers</td>
<td>1.75</td>
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<tr>
<td>Machinist</td>
<td>1.27</td>
</tr>
</tbody>
</table>

What is the weekly payroll of your mill?

**EXERCISE 5: FLOOR DESIGN**
Examine the attached floor plans for each floor of the mill. The keys provide information about the floor plans. Using the information in Exercise 1, trace the flow of the material through the mill. (The first step, picking, is not shown; picking machines were kept in a separate building because they occasionally caught fire.) Why do you think that the
machines are set up the way they are? How would you change the setup to make it more efficient?

The architectural drawings below are supplied by Patrick Malone, Brown University, Providence, RI. Used by Permission.
Key to machines
Schematics of the various machines