READY-MIX CONCRETE COMPANY:  
AN EXPERIENTIAL EXERCISE IN MANAGEMENT THEORY

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ABSTRACT

This experiential exercise proposes a learning environment based on a physical representation of material covered over the span of one semester in a Management fundamentals class. The method of acquiring knowledge during this exercise is from taking an activity and turning it into an experiential learning exercise producing tacit knowledge. This exercise was originally designed for an entry-level course in Management fundamentals; however, it could easily be adapted for courses in Cost Accounting, Production and Operations, Human Resource Management, and, perhaps many more. The calculations and discussions go only an inch deep, due to the introductory nature of the course.

INTRODUCTION

Over the past ten years, I have been using the following exercise in my classroom to get my students engaged with the subject matter. It was never my intention to offer this exercise for more than what it is—a fun, easy-to-setup, interesting practicum that gets the students off the bench and into the game. Professors who observed this simulation, encouraged me to share this exercise with others in the field because it can be so easily adapted to illustrate so many different Management ideas. For, as my students have discovered, Yogi Berra was right, “You can observe a lot just by watching.” (Berra, 2008)

This exercise utilizes students to staff a production line producing a product—Ready-Mix concrete. Initially the production line is divided into six (6) work stations (see figure 1), and each student is given a specific task to perform to produce the final product. They must work under a set time constraint, and initially, work under a direct Supervisor. The duration of the simulation will run between 1-1½ hours, but can be shortened to fit into a 50 minute period (explained later with the third production run).

Learning Objectives

This exercise provides a physical demonstration of the following management principles:

- The four (4) functions of Management: Planning, Organizing, Leading, and Controlling (Fayol, 1930)
- Efficiency and Effectiveness (Gilbreth, 1911; & Kanigel, 1997)
- The Value Chain and its analysis (Porter, 1985)
- Job design and analysis, job rotation, job enrichment, job enlargement (Hackman & Oldham, 1980)
- Re-engineering (Hammer & Champy, 1993)
- Empowerment (Conger & Kanungo, 1988)
- The Learning Curve Affect (Hall & Howell, 1985)

Schedule the simulation after the explicit material, on the preceding topics, has been covered.

SUPPLIES NECESSARY

Ready mix concrete consists, for the purposes of this demonstration, of three components: sand, Portland cement, and an aggregate (usually gravel). I have substituted readily available materials that will make the exercise easier to setup; and, in some cases, materials are much lighter by weight for handling purposes. For this demonstration I have found that the following items are the best substitutes: (see table 1)

SETTING UP THE DEMONSTRATION

The production line consists of the following work stations: In-bound supplies; work station #1; work station #2; work station #3; inspection; and warehousing. For the first production run, set up three (3) workstations, one for each raw material, by

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Substitute</th>
<th>Amount</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement</td>
<td>Flour</td>
<td>5 pounds</td>
<td>Main ingredient’</td>
</tr>
<tr>
<td>Sand</td>
<td>Sugar</td>
<td>5 pounds</td>
<td>Main ingredient’</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Pinto Beans</td>
<td>5 pounds</td>
<td>Main ingredient’</td>
</tr>
<tr>
<td>Large Mixing Bins</td>
<td>Plastic Lasagna Pans</td>
<td>3 (w/lids)</td>
<td>Bulk storage</td>
</tr>
<tr>
<td>Concrete Bags</td>
<td>Plastic Storage Bags (1 quart size)</td>
<td>@ 120</td>
<td>Store final product</td>
</tr>
<tr>
<td>Scoopers</td>
<td>Plastic Spoons (reg. tableware)</td>
<td>3</td>
<td>Loading bags</td>
</tr>
</tbody>
</table>
placing each of the lasagna pans on a separate table. Fill each lasagna pan with one of the ingredients; then, set up a separate “In-bound supply” table somewhere in the room separate from the production area. Do the same with the warehouse for storing finished goods. You should set up all work stations as far apart as your classroom will allow (20-30 feet). I put the inbound supply and warehouse at the back of the room on opposite sides (see figure 1).

EXPLANATION OF EXERCISE TO CLASS

I explain the exercise to my class as follows: “Welcome to Nichols’ Ready-Mix Company. My name is Charles Nichols, and I am the owner and founder of this company. We are a national distributor of Ready-Mix Concrete to both retailers like Home Depot and Lowes, as well as end users such as General Contractors. We are expanding our operations, and I need to staff a new facility here in [your classroom city] as follows: (see table 2)

“Concrete consists of three basic ingredients: Sand, Gravel, and Portland Cement. Each bag of Ready-Mix Concrete contains these ingredients in the following ratio: 1 part cement, 2 parts gravel, and 3 parts sand. The production line works as follows:

1. The supply attendant assures that all workstations are supplied and ready for action. Then the supply attendant returns to the warehouse and issues one bag to the supply runner who transports the bag to the first Work-In-Progress (WIP) runner stationed at the first workstation (the cement). The supply runner then returns to supply and picks up another bag. Repeat.
2. The first WIP runner then hands the bag to the worker at the first station, and then returns to the supply runner for more bags. (repeat)
3. The worker at the first station puts one scoop of cement into the bag and hands it off to the second WIP runner.
4. The second WIP runner hands off the bag to the second work station, the sand, and then returns to the first

Workers Needed

<table>
<thead>
<tr>
<th>Position</th>
<th>Wage/hour</th>
<th>Location</th>
<th>Job Class</th>
<th>DL/IL/OH *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor</td>
<td>$12.00</td>
<td>N/A; moves around</td>
<td>Management</td>
<td>OH</td>
</tr>
<tr>
<td>Supply Attendant</td>
<td>$6.00</td>
<td>Inbound Supply</td>
<td>Clerk</td>
<td>IL</td>
</tr>
<tr>
<td>Supply Runner</td>
<td>$6.00</td>
<td>Between Supply/WKST #1</td>
<td>Material Handler</td>
<td>IL</td>
</tr>
<tr>
<td>Warehouse Attendant</td>
<td>$6.00</td>
<td>Warehouse</td>
<td>Clerk</td>
<td>IL</td>
</tr>
<tr>
<td>Warehouse Runner</td>
<td>$6.00</td>
<td>Between INSP and WHSE</td>
<td>Material Handler</td>
<td>IL</td>
</tr>
<tr>
<td>(3)Workstation Positions</td>
<td>$6.00</td>
<td>WKST 1, 2, &amp; 3</td>
<td>Laborer</td>
<td>DL</td>
</tr>
<tr>
<td>(2-4) “WIP” Runners</td>
<td>$6.00</td>
<td>Between WKST 1, 2, &amp; 3</td>
<td>Material Handler</td>
<td>IL</td>
</tr>
<tr>
<td>Inspector</td>
<td>$12.00</td>
<td>INSP Station</td>
<td>Inspector</td>
<td>OH</td>
</tr>
</tbody>
</table>

*DL = Direct Labor; IL = Indirect Labor; OH =Overhead
workstation for more WIP. (repeat)
5. The worker at the second workstation puts 3 scoops of sand into bag and gives it to the third WIP runner.
6. The third WIP runner hands the bag off to the third workstation, the aggregate, and returns to the second workstation for more WIP. (repeat)
7. The worker at the third workstation puts 2 scoops of aggregate in the bag and hands it off to the Inspector
8. The Inspector either accepts or rejects the bags at his/her discretion. Accepted bags are given to the warehouse runner, rejected bags are sent to rework.
9. The warehouse runner hands the bag off to the warehouse attendant who puts the bag into finished inventory.

“You will have two (2) minutes to see how many bags of concrete you can produce. The only ones that will count toward your total will be the ones actually in the warehouse ready for shipment. Are there any questions? Good luck! Now who wants to volunteer to participate?”

RUNNING THE EXERCISE

THE FIRST PRODUCTION RUN

I try to select students who might need some help with participation. I also pick someone that I know will be animated and vocal as the Supervisor. I assign each volunteer to a specific task, after he/she has signed a payroll roster (this helps me remember who participated). I instruct the Supervisor in private to be a really Theory X kind of manager, i.e., pushy, critical, loud, etc. I instruct the Inspector in private to examine each bag carefully and occasionally to loudly reject some of the products. I instruct the remainder of the class to cluster into groups of 3 or 4 and watch the process, and then look for ways to improve it.

Then, when everyone is in place, I set a timer for two minutes and begin the exercise.

As the exercise begins, I wander around at the front of the class, talking on my cell phone to imaginary customers about orders. I prod the Supervisor to keep production moving. The workers do the best that they can and usually the entire class really gets into the competition. When the timer goes off, I tell them to stop production and then have a student from the class count the bags in the warehouse. Most groups will produce between 15-20 bags on the first production run.

EVALUATING THE FIRST PRODUCTION RUN

I tell the workers to take a break (have a seat), and then we discuss what just took place. I begin with a discussion of efficiency and effectiveness. Explaining the only way we can measure these items is to establish a baseline for production and use this as a benchmark for future production runs. Effectiveness is defined as the meeting of objectives, which sometimes excludes quality, and we will then set out to establish future production quotas once benchmarks are established. Efficiency is discussed as the production of products at continually lower costs while maintaining the ratio of inputs vs. outputs. Finally, we discuss the Control function of management and why it is important for managers to understand the cost of production and the need to measure both efficiency and effectiveness.

I then determine the unit cost of all bags produced. We do this by enlisting the help of the class in determining what costs were involved in producing the concrete. I project a spreadsheet (see figure 2) on the screen and integrate “spreadsheet thinking” as I ask the students to come up with cost items to fill in the appropriate cells on the spreadsheet. You could, however, simply list the cost on the board. Keep the cost simple (for example, using $6 per hour because it works out to $0.10 per

### Excel Spreadsheet for Calculating Cost

**Figure 2**

<table>
<thead>
<tr>
<th>Simulation #1</th>
<th>Bags Produced</th>
<th>Bags Rejected</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>$ -</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Unit Cost</th>
<th>U/Meas</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Cost:</td>
<td>Total Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand (3)</td>
<td>0 ounce</td>
<td>$ -</td>
<td></td>
</tr>
<tr>
<td>Aggregate (2)</td>
<td>0 ounce</td>
<td>$ -</td>
<td></td>
</tr>
<tr>
<td>Portland Cement (1)</td>
<td>0 ounce</td>
<td>$ -</td>
<td></td>
</tr>
<tr>
<td>Bags Consumed</td>
<td>0 each</td>
<td>$ -</td>
<td></td>
</tr>
</tbody>
</table>

**Sub Total:** 0 $ -

<table>
<thead>
<tr>
<th>Labor: (rate/hour)</th>
<th>Rate/Minute</th>
<th># of Workers</th>
<th>Minutes</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers ($6)</td>
<td>0.10</td>
<td>2</td>
<td>$ -</td>
<td></td>
</tr>
<tr>
<td>Inspector ($12)</td>
<td>0.20</td>
<td>2</td>
<td>$ -</td>
<td></td>
</tr>
<tr>
<td>Supervisor ($12)</td>
<td>0.20</td>
<td>2</td>
<td>$ -</td>
<td></td>
</tr>
</tbody>
</table>

**Sub Total:** 0.50 0.00 6 $ -

**Fixed Cost:**

| Admin O/H          | $ -        |

| Grand Total Cost:  | $ -       |
minute, etc.). Take this opportunity to discuss variable costs vs.
fixed costs. Usually students come up with labor cost and
material cost first. I try to use the actual cost of the material. I
tell the class to assume that each scoop of the ingredients is one
ounce. Then I will tell them that I purchased a bag of flour and
it cost X and weighs Y. I then ask them to tell me how much
this is per ounce (TIP: figure your cost before class begins, just
in case your class is mathematically challenged). Repeat this for
all material cost, i.e., bags, sand, cement, aggregate, etc. Then,
figure labor cost at ten cents per minute for workers and 20 cents
per minute for the Supervisor and Inspector. Add in some
Administrative overhead. This can be any amount. Use $1 or
$10, it does not matter, just be consistent.

At this point, I will ask if we have missed anything. Some
minor things may be suggested by students, like providing
benefits for workers, and you can decide to add this or not. I
consider this a part of overhead. One important cost that tends
to be overlooked is the cost of producing the rejected bags. This
leads to a discussion of Quality and how maintaining quality at
the source can reduce operating cost.

DISCUSSION OF POSSIBLE PROCESS
IMPROVEMENTS

Once the unit cost of production is established, I then ask
the workers to meet together and the class groups to meet and
discuss what measures could be taken in order to both improve
the process and the quality of the product and, at the same time
reduce unit costs. Usually, the students will pick out the obvious
flaws in the production process, i.e., the long separation between
supplies, the workstations, and the warehouse. So, we
physically move the supplies into place near the first
workstation, and then move the warehouse close to final
inspection. This opens a discussion into job design and analysis.
During this discussion I ask the class what other things could be
done. I specifically ask about the size of the work force. Most
agree that with the work process more centralized, we do not
need the “Runners.” I make a big deal about firing these people
to initiate a discussion of Human Resource Planning.

I then ask the class if this workforce could operate as a self-
directed team. We have previously discussed teams in my class,
so this gives an opportunity to review and reinforce learning on
this topic. It is generally agreed, and I usually insist that we fire
the Supervisor. Since he was such a pain, everyone is glad to see
him go. Now I turn to the new “Self-directed” team and ask them
if there is anything that they would now do to improve the
process. Usually there might be some small adjustment. We
also establish production goals for the next run. Once those are
complete, I let them proceed with the second production run.

EVALUATING THE SECOND PRODUCTION RUN

Run the production line a second time for two minutes. Once the second run is complete, unit cost is recalculated. With
lower labor cost and less WIP travel time, unit cost usually goes
down even while producing more bags. Quite often though,
overall cost might remain the same, or even increase slightly.
This, of course is due to increased use of variable cost of goods.
However, unit cost will go down. This phenomenon is discussed
and then I turn the discussion to “Process Improvement.”

I ask the students once again to meet in their groups and try
to determine if this process of making concrete can be improved.
First, within the constraints of the classroom setting, and then, if
they could move this into a modern plant. Let the students’
imagination work here and record responses either on the board
or on newsprint. Suggestions will be something like providing
scoopers that are exactly the correct amount so that only one
scoop is necessary for each product. This will improve the
queuing at the three scoop location. This also leads to a
discussion of how this “improves the process.” Other
suggestions might include totally automating the plant or
eliminating the inspection function. TQM is now discussed and
the fact that having Quality at the source of production could
eliminate the additional inspection step. Another possibility for
cost savings is to eliminate the warehouse operations. This leads
to a discussion of “Just-in-Time” inventory/manufacturing. Finally, we discuss the possibility of eliminating any more
personnel. Usually, this is rejected by the class. We are now set
for the next production run.

THE THIRD AND/OR FINAL PRODUCTION RUN

Once all suggestions have been discussed and recorded, you
are now ready for the third production run. Depending on time
remaining, you have two options:

1) Proceed with production as previously discussed and
then go through another analysis. Take the opportunity
to rotate the workers to new positions and discuss Job
Rotation, or even take the opportunity to change the
work force and discuss the learning curve. If you have
the time to do this, it will enhance the outcome and
provide for more discussion material. After doing the
third run, then proceed to the second option, below.

2) If time is short, then open a discussion of “Process Re-
engineering.” This can be demonstrated, in its most
rudimentary form, by challenging the students to a little
contest. Tell them that you can run this operation with
just two employees and with no loss of production and
with no increase in cost. Most students cannot see how
this can be done. I demonstrate this by first moving
two tables together. Then I ask the students, “How can
we now balance the work load and eliminate
bottlenecks?” Usually, someone suggests that the bags
come pre-opened, thus eliminating this step. This can
open up a discussion of the Value Chain and the
importance of good supplier relations. Also, an
automated system that could take the final product from
the worker’s handoff right to the distribution system
(this can be simulated by having the worker literally
throw the bag onto another table). Finally, I suggest
that we really do have only two work stations needed,
each with three scoops. One is the sand alone (three
scoops) and the other is the aggregate plus the cement
(two scoops plus one scoop). We now set up the
production line with the sand on one table with the open
bags to the left, and the cement and the aggregate on an
adjacent or even the same table (literally a handoff) and
the distribution table to the right. This is a good time to
discuss Job enrichment and empowerment.
At this point we run the production line one last time (you will need to keep extra supplies on hand for refills). Students are usually amazed that the two people can pretty well match the work done previously, and how the unit costs have really gone down. At this point we wrap up our discussion. There is usually some discussion as to how long the two workers could keep up the pace, and when would they ask for more money since they were now doing the work of ten (10) people, or were ten (10) people doing the work of two (2)?

CONCLUSION

I have found that my students really get into this exercise. I always get comments along the lines that they have heard all of these terms before, but now they can actually see them in practice and more clearly understand their meaning. There are few moments more enjoyable than to see the “light” come on in a student’s eyes and realize that this student has really, finally understood both theory and application of concepts related to research topics. Isn’t that what real learning is all about?

Lastly, tidy up the classroom, time permitting. This can facilitate a discussion about whether workers should clean up their own messes or whether you should hire janitors, or should you out-source?

REFERENCES


