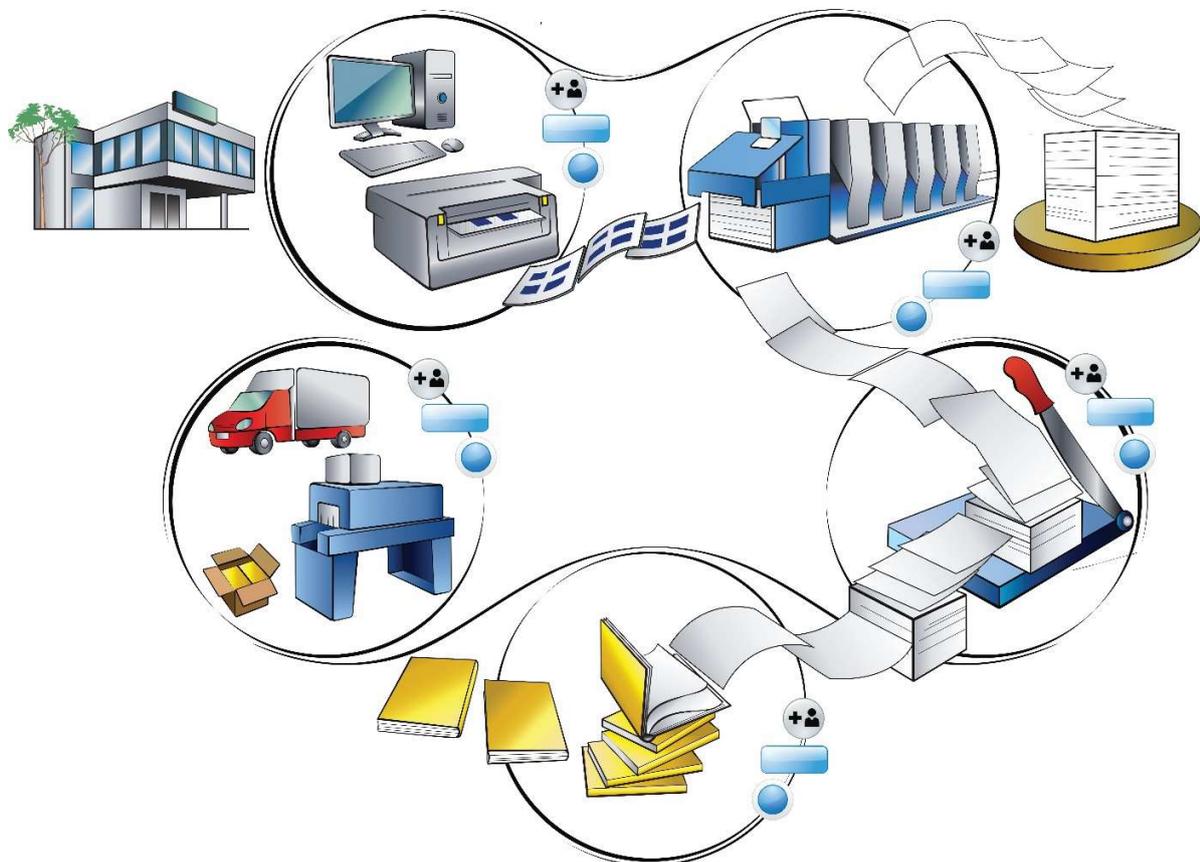


Printing-House Operations Game



1- The Game Overview

In this online simulation game different teams (players) compete each other in managing a printing house for a period of two year (730 days). This two-year simulated time happens in 5 hours (real time) for the game players. The winners of the game are the teams with the highest level of capital, which is considered to be the sum of available cash and the value of the machines in the printing house.

The players have to make decisions about the followings:

1. Procurement of raw materials (paper)
2. Raw material inventory level
3. Capacities of different stations (buying new machines)
4. Overtime policy at each station
5. Accepting or rejecting orders (printing books)

The players receive interest (20% annually) on their available cash. On the other hand, the value of the machines that they buy at each station depreciate as time passes (2% monthly). Machines at different stations require different number of workers and technicians. The printing house works 7 days a week with a regular 8 our schedule per day. The players can turn on “overtime” at each station, which results in 4 hours of overtime work for all machines in that station. Overtime can be turned on and off at any station at any time during the game.

The printing house has a fixed overhead cost (\$200,000 monthly) which is independent of the production rate and the number of machines. The overhead cost must be paid at the end of each month.

At the end of each month, the printing house has to pay the overhead cost as well as the monthly wages of workers and technicians. If the available cash is not enough to cover these payments, the cash level becomes negative (debt). The printing house can continue to work with a negative cash level as long as the amount of debt is not larger than three

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times the monthly payments to workers and technicians. If the debt reaches this level, the printing house is bankrupt and can no longer operate. When the cash level is negative, the printing house cannot buy new machines.

2- Demand

In general a printing house can print a wide variety of books that can differ in the number of colors, size, number of pages, binding, and cover type. For simplicity, we assume our printing house only prints a specific type of textbooks with the following specifications:

- Number of pages: 448
- Single color
- Size: Octavo: 6" × 9" (15×23 cm)
- Softcover and perfect (glued) binding

Each order consists of 10,000 copies of a single textbook title. If the printing house accepts the order, the printed textbooks should be delivered in 14 days, otherwise there is a penalty of \$10,000 per day of delayed delivery. The penalty will be deducted from the payment to the printing house. Customers pay \$140,000 to the printing house for each order delivered on time.

In this game the demand arrives at the printing house with a constant rate of 1 title per day during the first 6 months and 2 titles per day during the next 6 months.

To avoid delayed delivery penalty, the printing house has the option of setting the criteria to accept or decline orders depending on the number of standing orders (orders that are accepted but not delivered). See the detailed explanation in section “4-Headquarters”.

3- The printing house

The printing house prints only textbooks and consists of the following divisions:

- Headquarters

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- Preprint Station
- Printing Station
- Folding and Cutting Station
- Binding Station
- Packaging and Delivery Station
- Paper Warehouse

4- Headquarters

The main decision made at the headquarters is to set the criteria for accepting or declining each arriving order. This decision is based on the number of standing orders in the printing house. That is, the number of orders accepted but not delivered yet. The criteria for accepting a new order is that the current number of standing orders should be smaller than a threshold value “MAX STANDING ORDERS”. The game starts with a default value for this parameter, but the players can edit this value throughout the game.

When you click on the Headquarters icon on the game screen you can see the following information:

Order Acceptance

- Max standing orders (Decision Variable)
- Current standing orders

Financial

- Interest rate (annual)
- Overhead cost (monthly)

Demand

- # of copies per title
- # of pages per copy
- Revenue per order

- Guaranteed lead-time
- Order delay penalty

Machines

- Depreciation rate
- Technician wage
- Worker wage
- Hourly overtime technician wage
- Hourly overtime worker wage

5- Paper Warehouse

Printing machines print the content of the books on large sheets of papers (19.7×27.6 inches or 50×70 cm). On each side of these sheets 8 pages of a book can be printed. Therefore, each sheet can contain 16 pages (on two sides). These sheets are then folded and cut to produce 16 consecutive pages of the book.

To avoid any delay, the printing house keeps an inventory of paper sheets in its warehouse. Upon acceptance of an order, the paper needed for the order is transferred (if available) from the warehouse and placed next to the printing machine to be used.

The printing house uses either of the following two inventory policies to manage the paper warehouse:

- 1- Base-stock policy: The printing house set a base-stock level (in terms of number of sheets of paper). Whenever the inventory drops below this base-stock level, a replenishment order is automatically placed to a local supplier to bring the inventory level up to the base-stock level. It takes 3 days for the ordered paper to be delivered to the warehouse by the local supplier.
- 2- Bulk purchase policy: The printing house can purchase the paper from a manufacturer in bulk with a lower price. The printing house, however, has to pay

for the transportation cost per purchase from the manufacturer. It takes 20 days to transport the purchased paper from the manufacturer to the warehouse. Upon using the purchased paper, the inventory level drops. If the printing house does not purchase another bulk from the manufacturer, the inventory level eventually drops below the base-stock level and an automatic order will be placed to the local supplier.

When you click on the Paper Warehouse icon you can see the following information:

- Current inventory level
- Current paper in transportation
- Base-stock level ([Decision Variable](#))
- Local supplier price
- Local supplier delivery lead-time
- Bulk purchase quantity ([Decision Variable](#))
- Manufacturer price
- Manufacturer delivery lead-time
- Manufacturer transportation cost

6- Production Stations

The printing house has five production stations:

- 1- Preprint: This station makes the “plates” that are used by the printing machines to print the pages of a book¹. Plates are almost the same size as the paper sheets. If we want to print 10,000 copies of a book, each plate is used to print on one side of

¹ This printing method uses printing plates to transfer an image to paper or other substrates. The plates are usually made of a thin sheet of metal. An image is put on the printing plates using a photomechanical or photochemical process during a stage of production known as preprint—one plate for each color ink to be printed. Printing plates are attached to the plate cylinders on the printing machine. Ink and water are applied to rollers and then transferred to an intermediary cylinder (blanket) and then to the plate, where the ink clings only to the imaged areas of the plate. Then the ink transfers to the paper.

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10,000 sheets. Remember that on one side of a sheet of paper we print 8 pages. Therefore one plate is needed for each 8 pages of the book.

- 2- Printing: Using the plates produced at the preprint station, the printing machines print the content of the book on the paper sheets received from the warehouse (16 pages on two sides of each sheet).
- 3- Folding and Cutting: At this station, machines fold the sheets of paper in a way that, after cutting, 16 consecutive pages of the book is produced.
- 4- Binding: The cut pages are stacked and transferred to the binding machines. These machines bind the pages of the book by gluing them together (perfect binding) and place the softcover for each copy of the book.
- 5- Packaging and delivery: The packaging machines shrink-wrap the stacks of books. The packaged books are then sent to the customers.

The players can change the capacity of each station either through turning the overtime option on or off, or through buying new machines. Players can buy a new machine only when they have enough cash. The purchased machines cannot be returned or discarded. The values of the purchased machines are depreciated as time passes.

When you click on the icon of each production station you can see the following information:

- Processing rate per machine
- # of workers per machine
- # of technicians per machine
- Price of a new machine [€]
- Overtime at this station (Decision Variable)
- Buy machine (Decision Variable)
- # number of undelivered machines

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The processing rates are stated for each regular day (8 hours). It takes 10 days for a purchased machine to be installed and operational.

7- Playing the game:

When the game is initiated at the time announced, you can login to your account and see the game screen. To login, use the username and password that will be provided to you.

The login link:

<http://print.compete2learn.net/>

You can observe all the data related to different parts of the printing house but you cannot make any changes. After the game starts, you can make changes to the parameters of the game. Whenever a successful change is done, a green strip on the bottom of the screens prompts you that the change has been implemented successfully.

The image below shows different parts of the game screen. Click on each part of the printing house to see the related information and make changes.

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The available cash is shown to you during the game in the middle of dark blue strip on top of the screen. On the left, you can click on “charts” to see the information about the history of the certain parameters of the game at any time during the game. You can observe the graphs or download the related data.

You can also see the actions you have taken so far by clicking on “History” next to the “Charts” option. On the right of dark blue strip you can see the timer of the game. When the game starts, you can also see a “Ranking” options. By clicking on this option, you can see the ranking of participating teams in this game according to level of their capitals.

The existing number of machines in each station is written in a small gray box over each station symbol. It has the format of a cross sign followed by the number of machines (for example, if you see “x2” on a station symbol, it means there are two machines in this

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station). When you successfully buy new machines, this number will update after 10 days when the new machines are installed. After the game starts, the number of jobs waiting in the queue behind each station is written in a green oval on the edge of the station icon. During the game, the information on the screen updates every 10 seconds.

Important Notes:

- 1- It is best if you use one of the following browsers:
 - a. Chrome
 - b. Firefox
 - c. Microsoft Edge
- 2- When making changes in the system pay attention to the units. For example, the inventory “Base Stock Level” at the paper warehouse is in terms of “1000” of sheets.
- 3- The capacity of the packaging machine is in terms of the number of copies of the books (not the number of packages).