OPT

Material From:
"The Goal" and "The Race"
By Goldratt and Fox

OPT (Optimized Production Technology)

A computer based management system used for production planning and scheduling, seeking the goal of throughput maximization through the following:

- Balanced flow, not capacity
- Minimization and /or elimination of bottlenecks
- Variable lot sizes

Also know as: "***Theory of Constraints***"

OPT Philosophy

The Goal: ***To Make Money***

Measures:

1. ***Net Profit***
2. ***Return on Investment***
3. ***Cash Flow***

OPT Operational Measures

1. ***Throughput***

   The rate at which goods are sold

2. ***Inventory***

   Any raw materials, components, and finished goods that have been paid for but not sold

3. ***Operating Expenses***

   The cost of converting inventory into throughput

   - Direct or indirect labor
   - Energy
   - Capital facilities

How to Achieve The Goal

By the following:

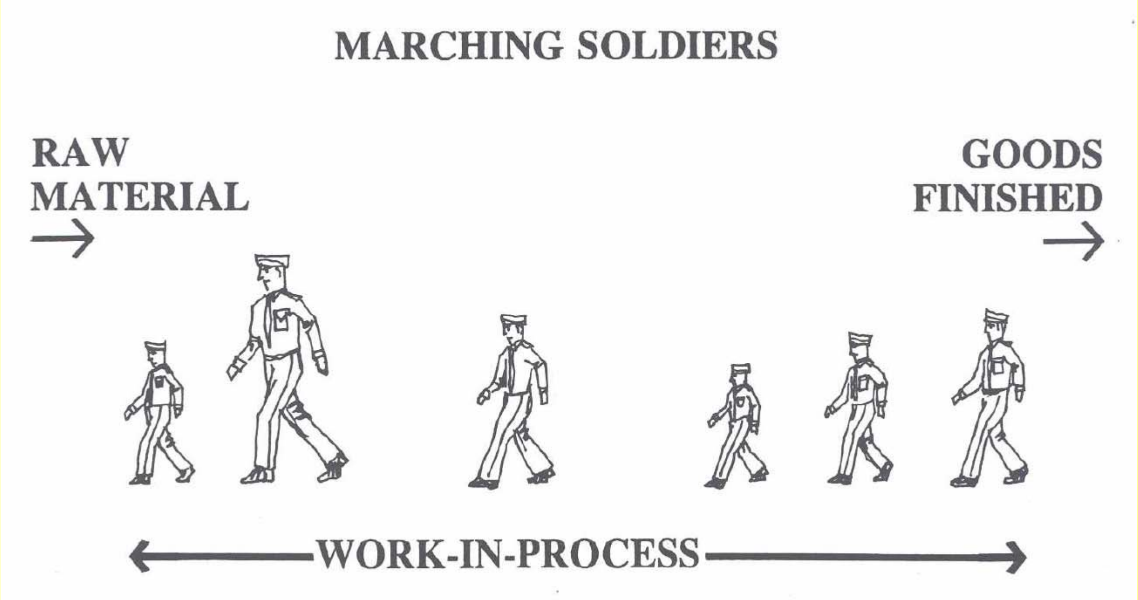
- Increasing throughput
- Decreasing inventory
- Decreasing operating expenses

OPT Key – "*Identify Bottlenecks*"

Bottleneck: A point of storage in the manufacturing process that holds down the amount of product that a factory can produce.

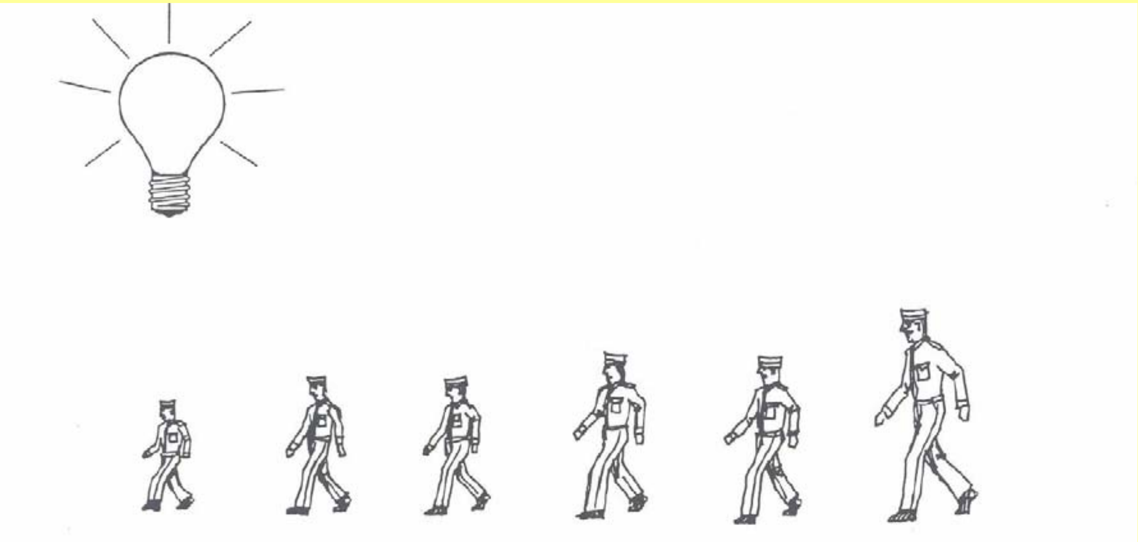
The basic approach is to identify bottlenecks, and concentrate on keeping them 100% busy, then find ways to increase throughput at the bottleneck, subject to demand.

Troops Analogy (I)



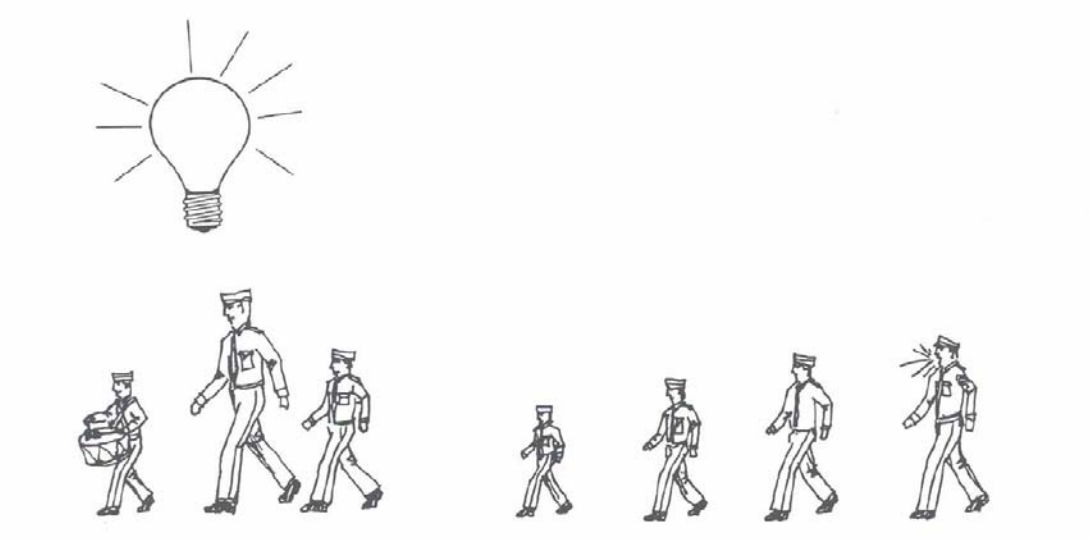
- Spreading troops mean high inventories (e.g. work in process). Closely packed troops mean lower inventories.

Troops Analogy (II)



- Rearranging the soldiers reduces spreading. By putting the slowest soldiers at the front and the fastest ones in the rear.
  - Good Idea, but may be impossible to put the slowest operation into the first operation

Troops Analogy (III)



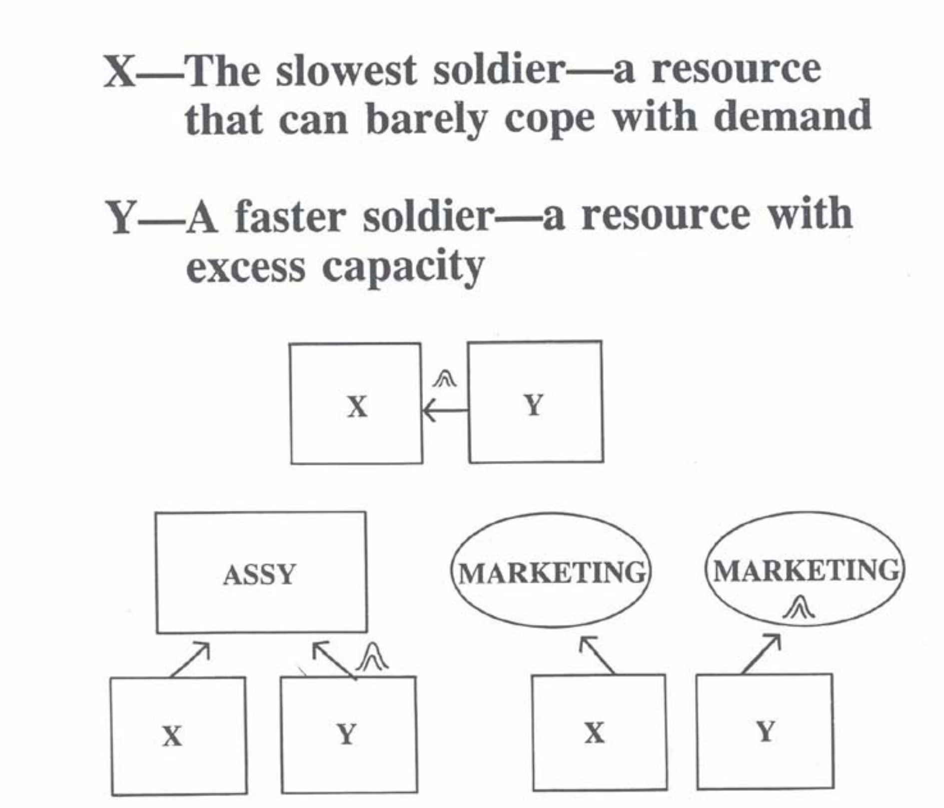
- Put Drummers in front row to set the pace and sergeants urge the soldiers to close any gaps.
  - Sergeant is the expeditor and drummer is the material management system assisted by a computer

Troops Analogy (IV)

- "*If a worker doesn't have anything to do, let's find him something to do.*" – This mentality will cause workers to work at their own paces.

Troops Analogy (V)

- The causes of excess inventories is when each worker works with full capacity.

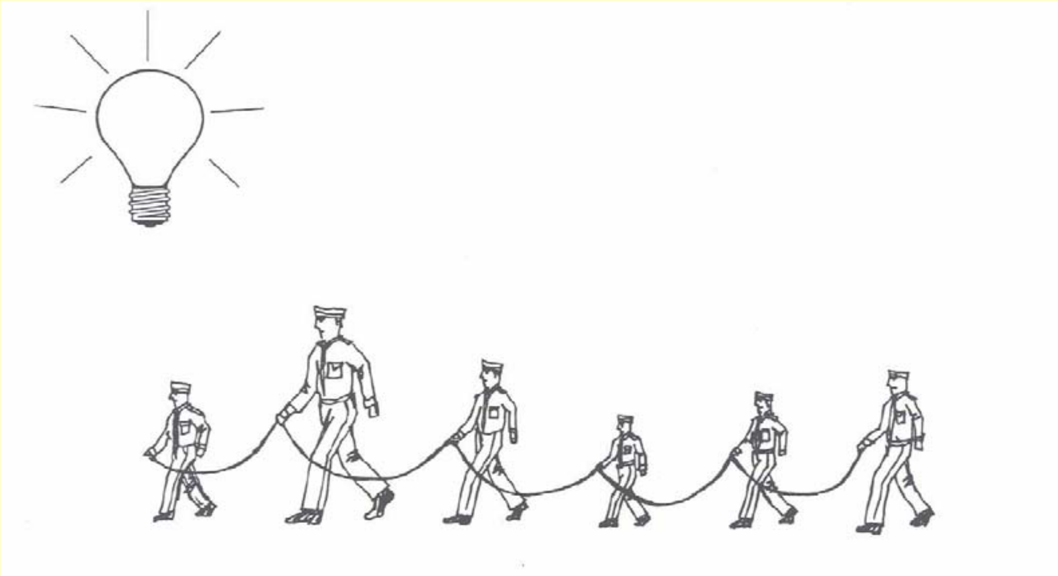


Troops Analogy (VI)

- Does the drum beat according to the constraints of the plant or according to some unrealistic assumptions ..

  Like:
  - Infinite capacity
  - Predetermined lead times
  - Fixed, constant batch sizes

Troops Analogy (VII)

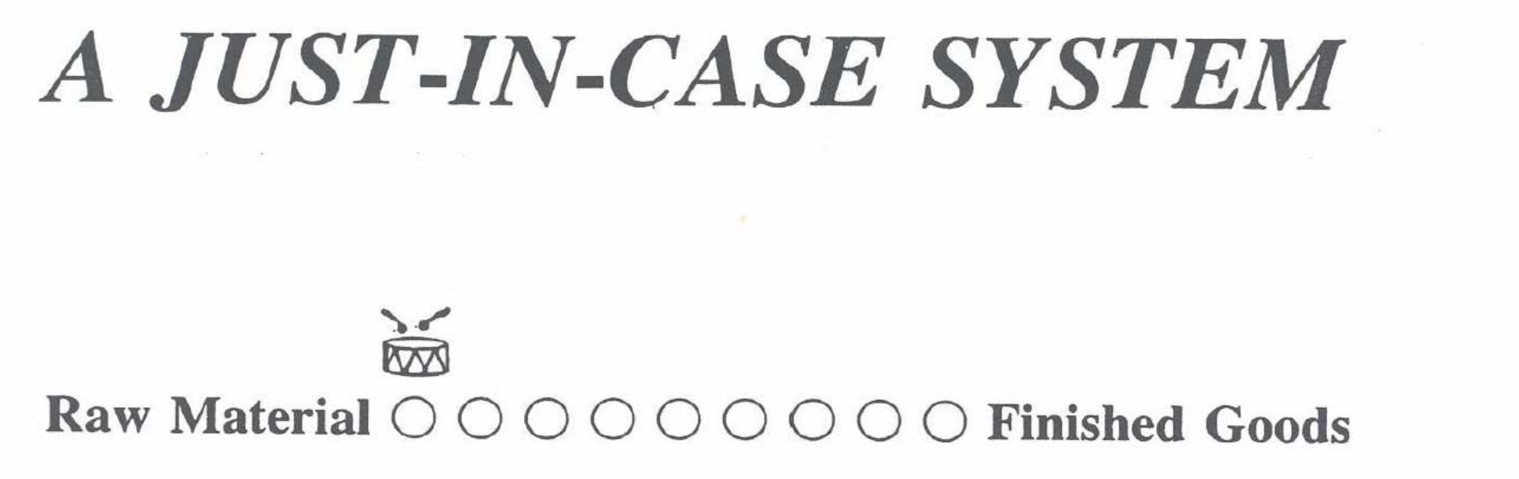


- Tie the rows of soldiers together to limit the spreading of the inventories.
  - The Invention of Henry Ford –The assembly line
  - Dr. Ohno from Toyota – The Kanban system

Troops Analogy (VIII)

- Synchronized manufacturing assembly lines and kanbans.
  – Predetermined inventory buffers (either limited by space or number of cards) regulate the rate of production for assembly lines and kanban system.
  – "**Stop working when the buffer is filled!**"
  – *The work is synchronized, inventory is low. But any significant disruption will cause the entire system to stop.*

Troops Analogy (IX)

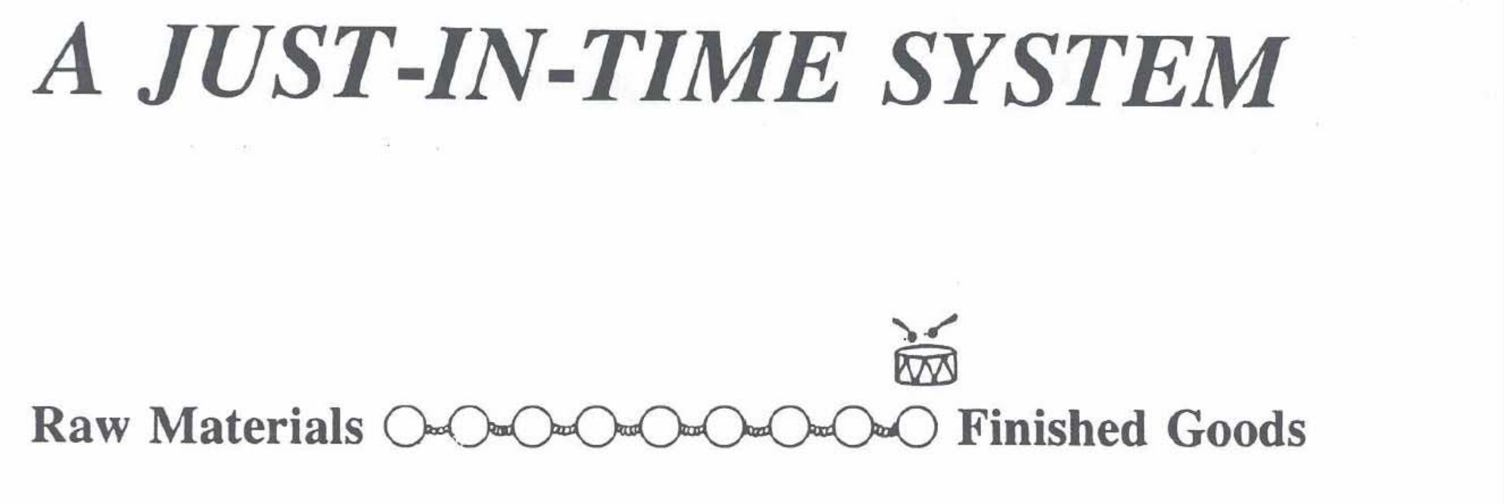


The drum is held by the excess capacity of the gating operations

Result:

- Inventory is high
- Current throughput is protected
- Future throughput is in danger

Troops Analogy (X)

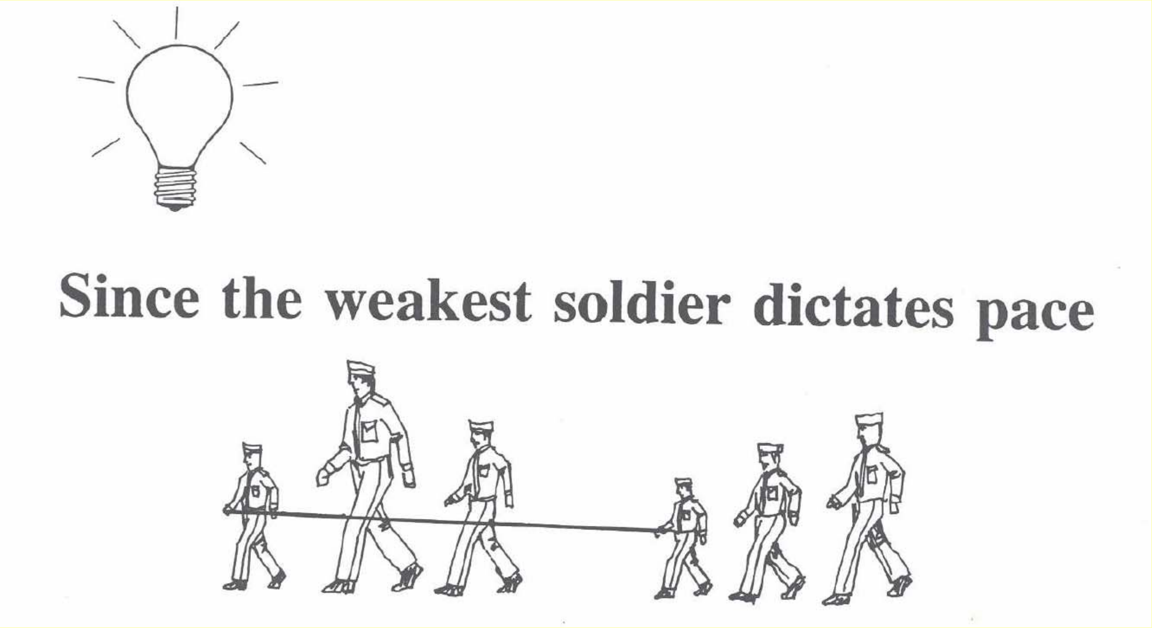


The drum is held by marketing demands

Result:

- Inventory is low
- Current throughput is in danger
- Future throughput is increased

Troops Analogy (XI)



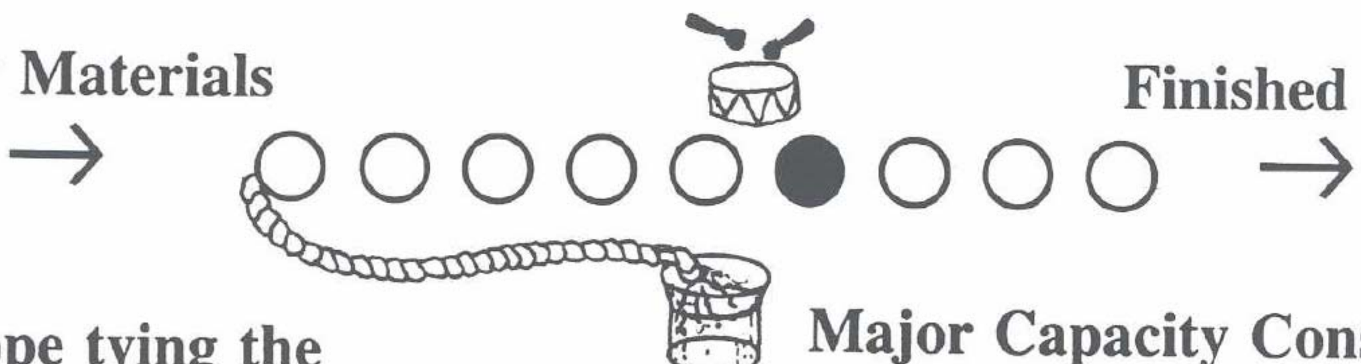
- To prevent spreading, tie weakest soldier to the front row.
- To protect overall pace, provide some slack in the rope

SYNCHRONIZED MANUFACTURING

THE DRUM-BUFFER-ROPE WAY

Raw Materials

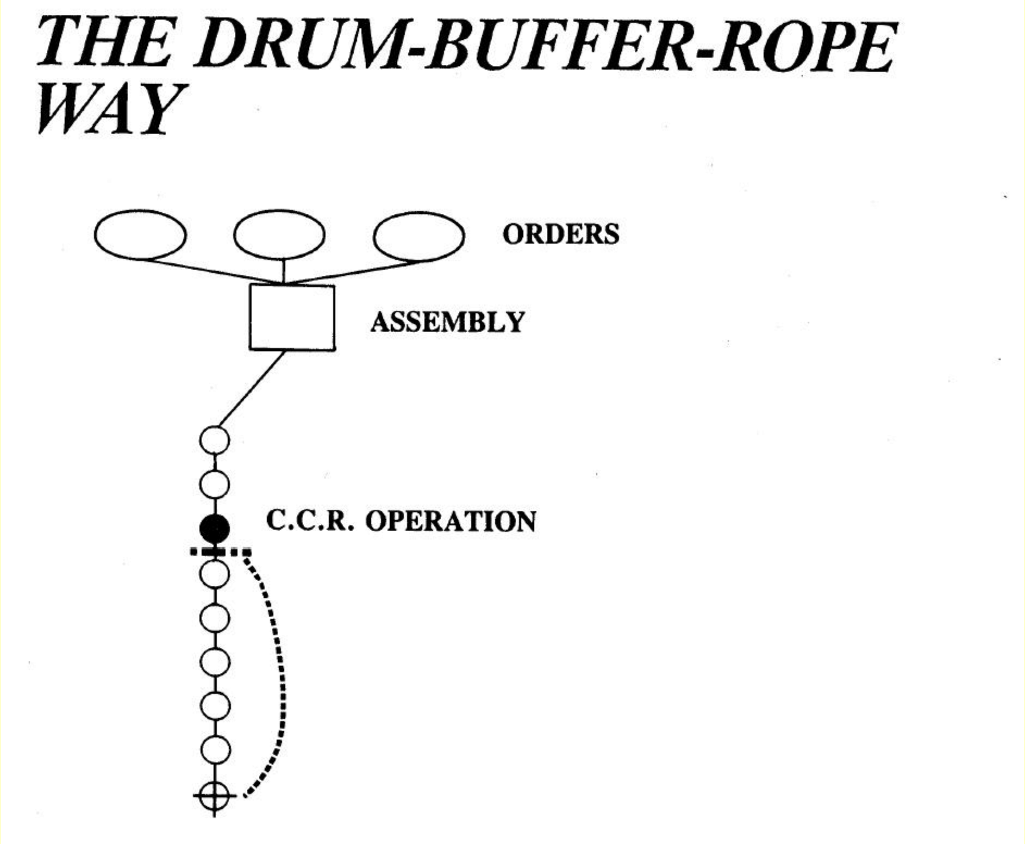
Finished Goods



Major Capacity Constraint

A rope tying the gating operation to the buffer

Time Buffer



- The Capacity Constraint Resource (C.C.R) should dictate the schedule based on market demand and its own potential.
- The schedule for succeeding operations (including assembly) should be derived accordingly.
- The schedule of preceding operations should support the time buffer and thus be derived backwards in time from the C.C.R schedule

Synchronized Manufacturing – Locating the Constraints

First step toward synchronized manufacturing is to identify the constraints.

A Capacity Constraint manifests itself in all of the major business issues.

An analysis of the major business issues can be used to identify the capacity constraint resource (CCR’s)

Synchronized Manufacturing – Beating the Drum

Ensure maximum throughput through forward scheduling of the C.C.R.'s.

Due dates give us the first, rough sequence, but the sequence must be modified under any one of four conditions…

Synchronized Manufacturing – Four Complicating Conditions

- Different lead times from capacity constraint resources to due dates
- One capacity constraint resource feeding another one
- Set up at a capacity constraint resource
- A capacity constraint resource feeding more than one part to the same product

Synchronized Manufacturing – Locating the Time Buffer

- Concentrate protection not at the origin of a disturbance, but before critical operations
- Inventory of the right parts in the right quantities at the right times in front of the right operations give high protection
- Inventory anywhere else is destructive

Ten Rules of OPT

1. Utilization and activation of a resource are not the same –

   Activation is what should be done

   Utilization is what can be done

   "100% utilization of a non-bottleneck is wasteful."

2. The level of utilization of a non-bottleneck is determined not by its own potential but by some other constraint in the system.

Ten Rules of OPT (Cont.)

3. An hour lost at a bottleneck is an hour lost for the total system.
4. An hour saved at a non-bottleneck is just a mirage.
5. Bottlenecks govern both the throughput and inventory in the system.
6. The transfer batch may not and often should not be equal to the process batch.
7. The process batch should be variable, not fixed.

Ten Rules of OPT (Cont.)

8. Capacity and priority should be considered simultaneously, not sequentially.
9. Balance flow, not capacity.
10. The sum of local optima is not equal to the global optimum.