

Packaging Line Design

Bob Seaman

Packaging – Welcome
to the dark side

Discussion points

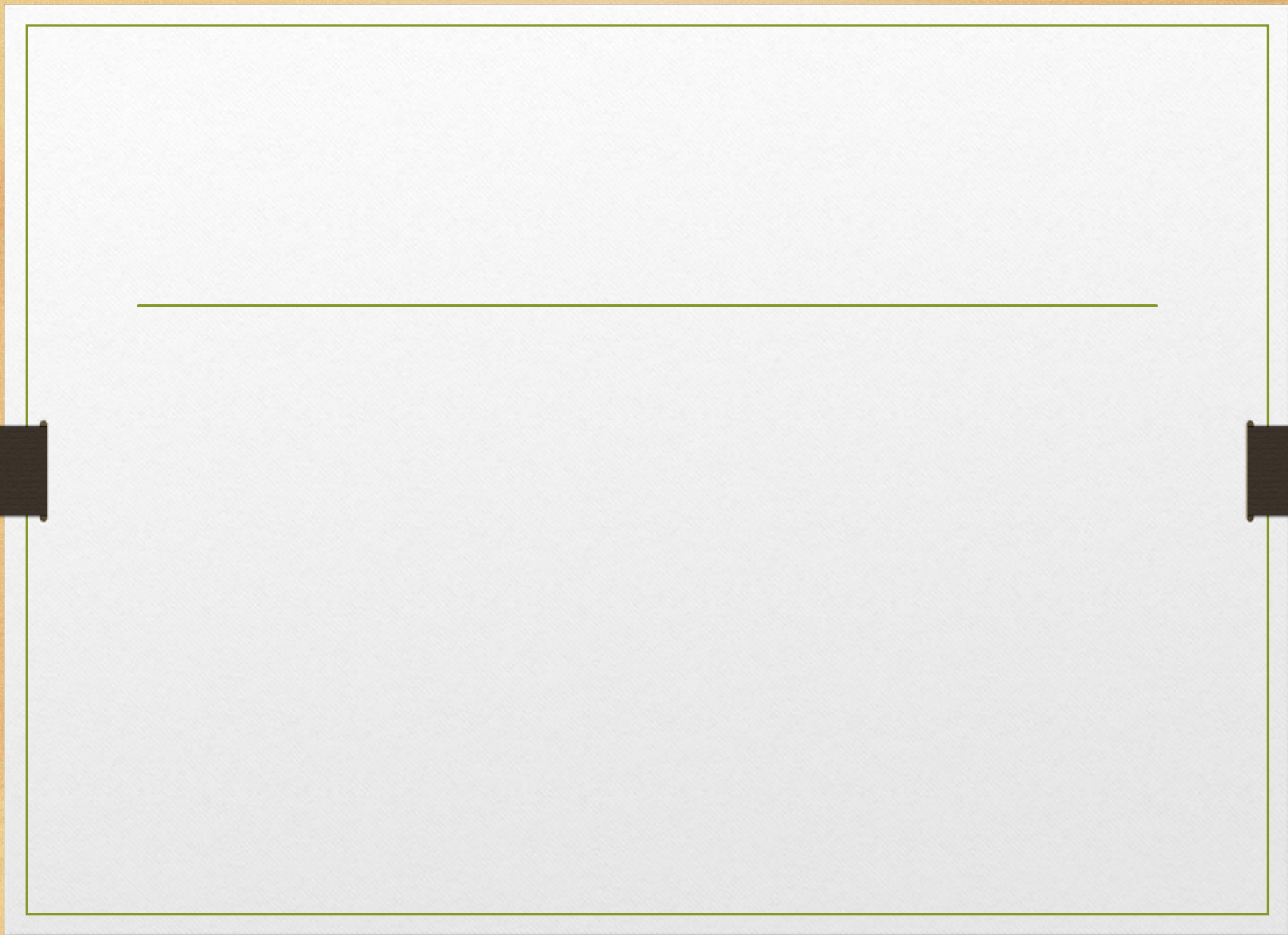
- Packaging line design considerations
- Packaging Line efficiency
- Packaging modulation speeds
- General Maintenance concerns

Your Boss asks you to shop for a Packaging Line, What is expected?

- 100% packaging efficiency
- 0% losses
- Highest speed possible
- Minimum manpower
- Quick changeovers
- Minimum maintenance manpower and cost
- Low capital expenditure

General Packaging Line Design Considerations

- What product will be run?
- What volume of output is required?
- What container will be run?
- What packages will be run?



Why do we care about packaging Efficiency?

- Service to our customers
- Labor costs – Packaging is where there is generally the most labor costs
- Motivation/goal -Chest pounding/bragging rights
- Care enough to cheat – a sign your employers are motivated

What is simple packaging Efficiency?

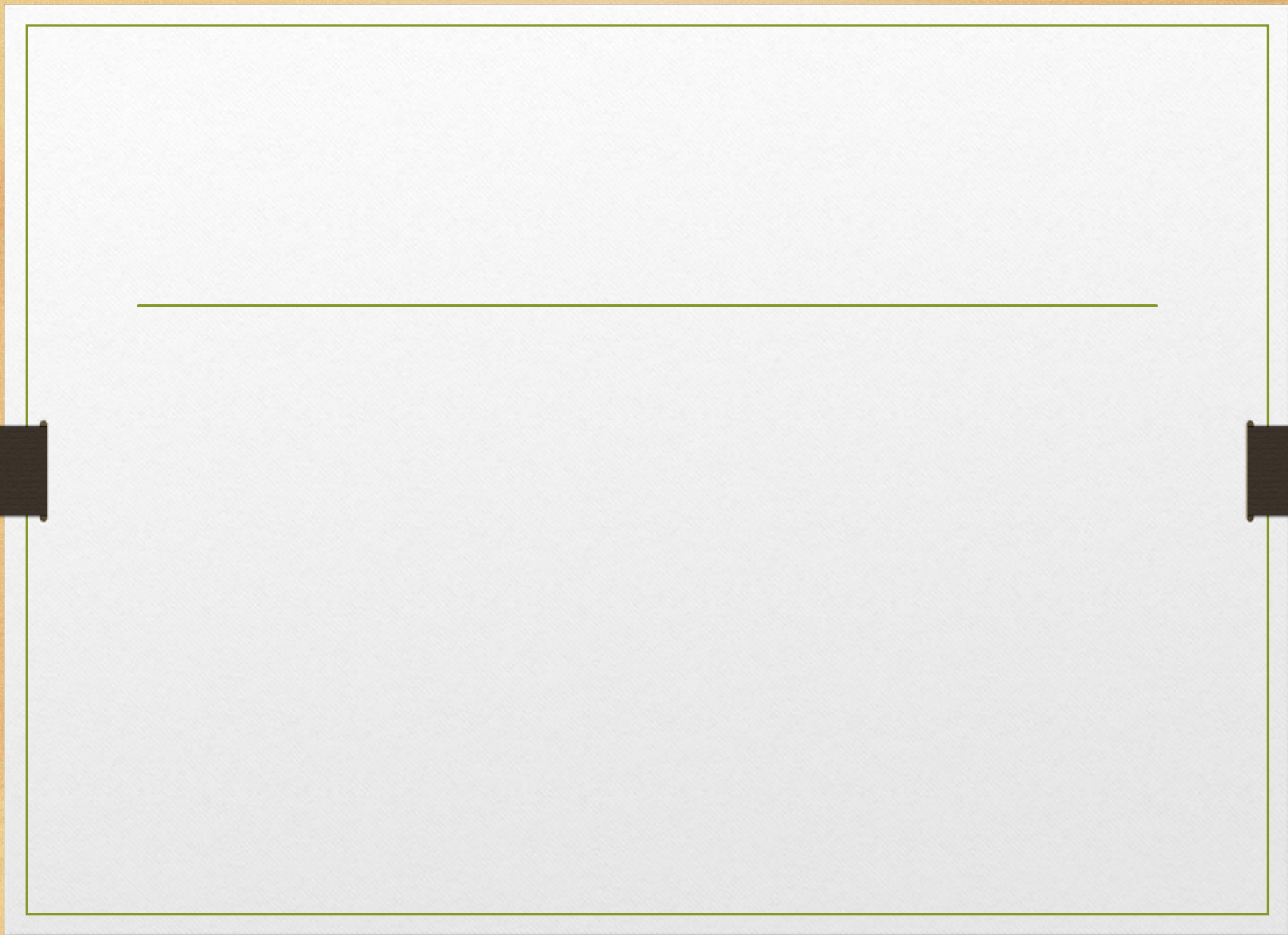
- Packaging Line Efficiency = ((Total containers run on filler) / (scheduled run time X filler speed)) X100

- Example:

Packaging Line Efficiency = (210000 bottles)/(480 min X 500 bottles/min) X 100 = 87.5% efficiency

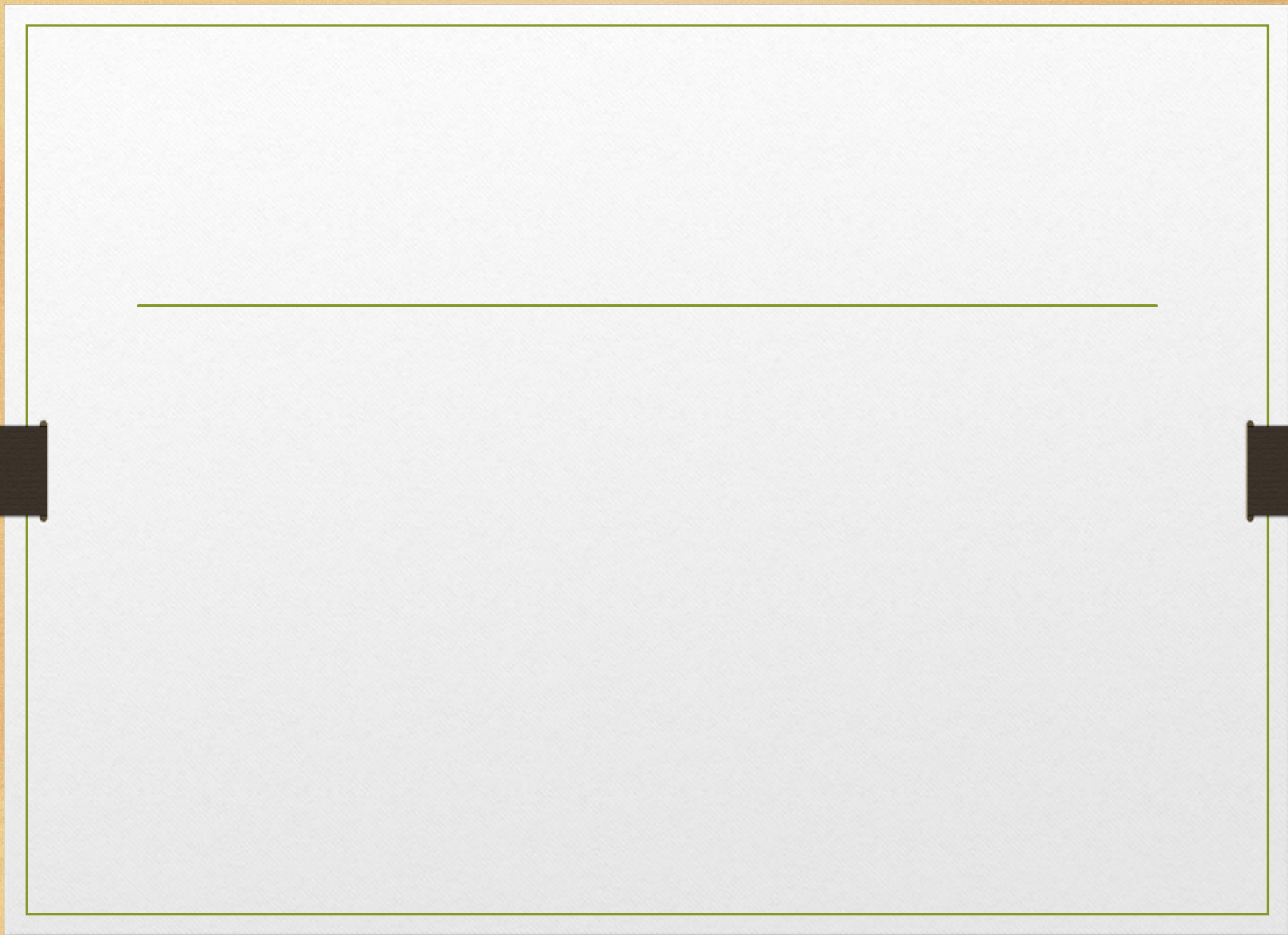
How do we design excellent Packaging Efficiencies into a line?

- Specify, verify and maintain high machine availability
 - Specify, verify and maintain correct machine speed capability and settings
 - Specify, verify and maintain the correct amount of accumulation
 - Specify, verify and maintain correct conveyor speed capability and settings
-
- The name of the game is to keep the filler running as much as possible!



“We would have had a great run today but”

- The conveyor bearing failed
- A filler valve fell off
- Someone hit the stop button on the pasteurizer by mistake
- The brewhouse ran out of beer
- The palletizer dumped a pallet of beer
- John did not show up for work
- Dah!!!!!!!!!!!!!! Really????????????!!!!!!!



Line Efficiency: What is machine availability?

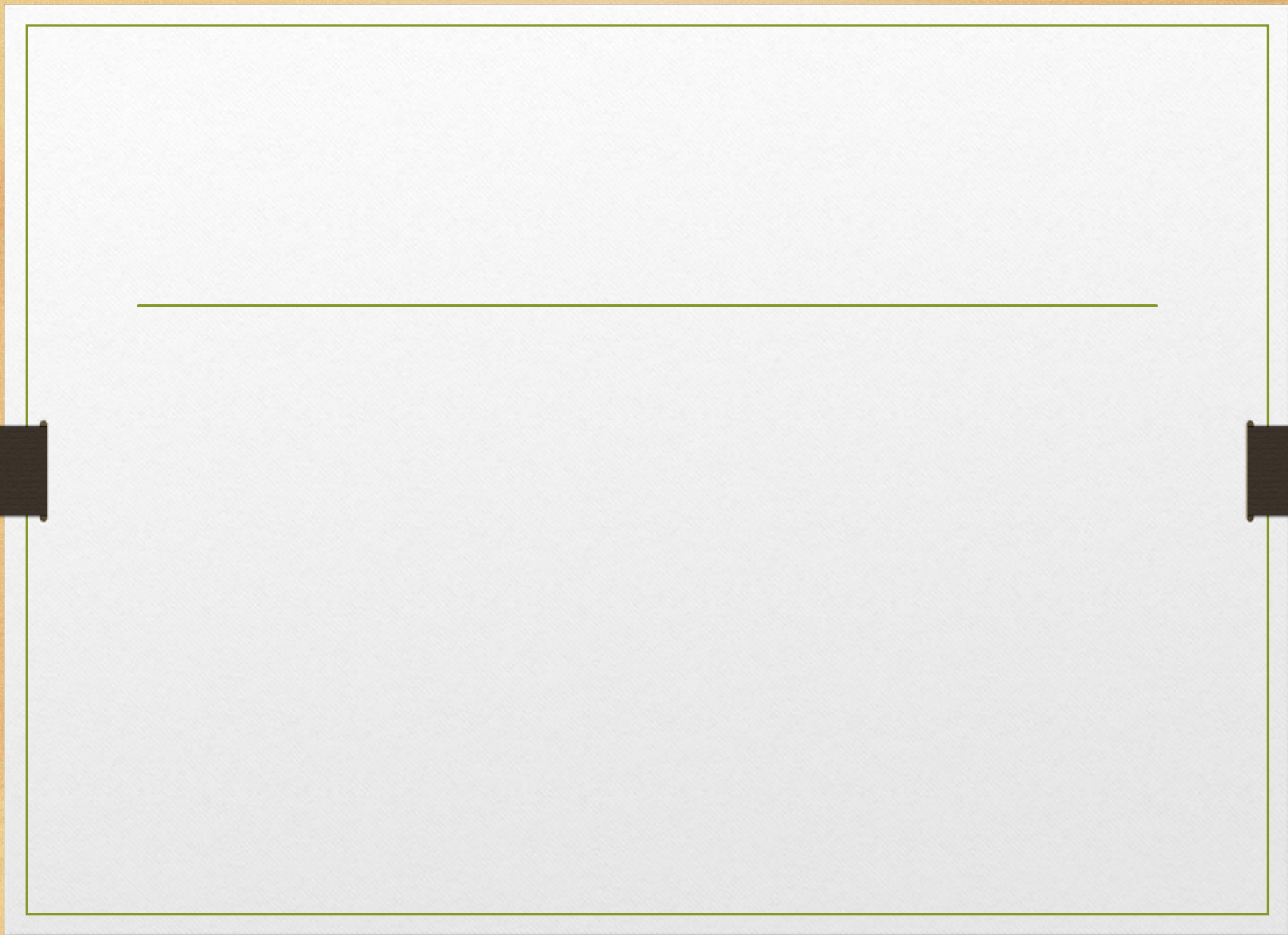
- $\% \text{ Availability} = (\text{MTBF} / (\text{MTTR} + \text{MTBF})) \times 100$
- MTBF – The average time between machine failures
- MTTR – the average time to get the machine running again
- In simple terms it is the percentage of time that we need the equipment to run and compared to how it actually will run.
- If the machine availability is 92%, then the machine is available 92% of the time that you need it to run
- Make MTBF as long as possible
- Make MTTR as short as possible

Efficiency: Machine Availability is the key to high Packaging Efficiency!

- Never accept less than a 98% machine availability guarantee from an equipment supplier
- Insure that each piece of equipment on the Packaging line is very reliable (available to run)
- $75\% \times 75\% \times 75\% = 42\%$ packaging efficiency
- $99\% \times 98\% \times 98\% = 95\%$ packaging efficiency
- In both of the above scenarios these are the best that you will be able to do from a packaging efficiency point of view without accumulation added to the line.

Efficiency: Typical Machine failure times

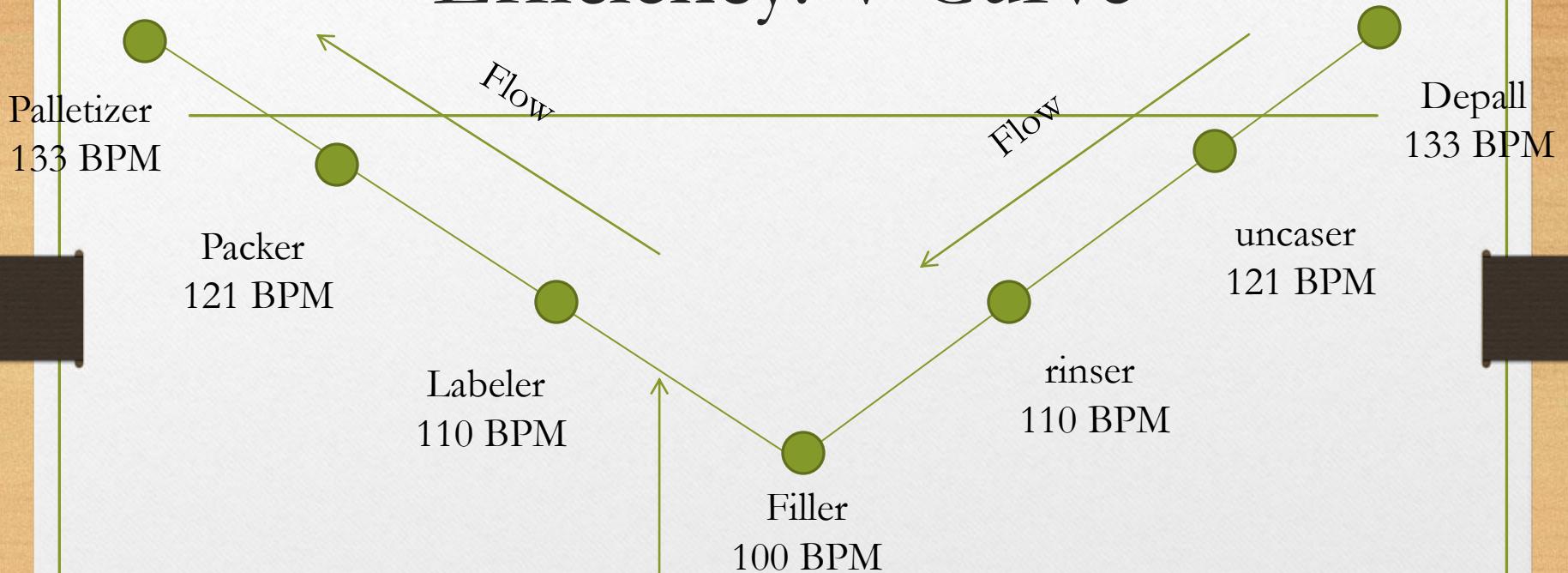
- Microstops – any machine downtime that is 3 minutes or less
- Macrostop – any machine downtime that is 3 minutes or more
- 70% of all machine downtime comes from microstops
- Most macrostops are less than 15 minutes



Efficiency: Machine Speed

- The primary machine is normally the filler
- The filler's rated speed is the speed in which the remainder of the line is typically designed around
- The way in which the machines on the line are designed from a speed capability point of view is typically done using a v-curve scheme
- Typically the farther you get from the filler the faster the machines are capable of and need to be running

Efficiency: V Curve



Each line between machines
represents conveyor and therefore
accumulation

Efficiency: Why the V curve

- Keep the filler running!
- The v-curve gives the ability for each machine upstream of the filler to speed up after they have been unavailable (stopped). The objective is to make sure that the filler always has bottles at its infeed.
- The v-curve gives each machine downstream of the filler the ability to speed up after they have been unavailable(stopped). The objective is to make sure that the filler never has bottles backed up to its discharge.

Efficiency: What if machine availability is 100%?

Palletizer
100 BPM

Packer
100 BPM

Labeler
100 BPM

Filler
100 BPM

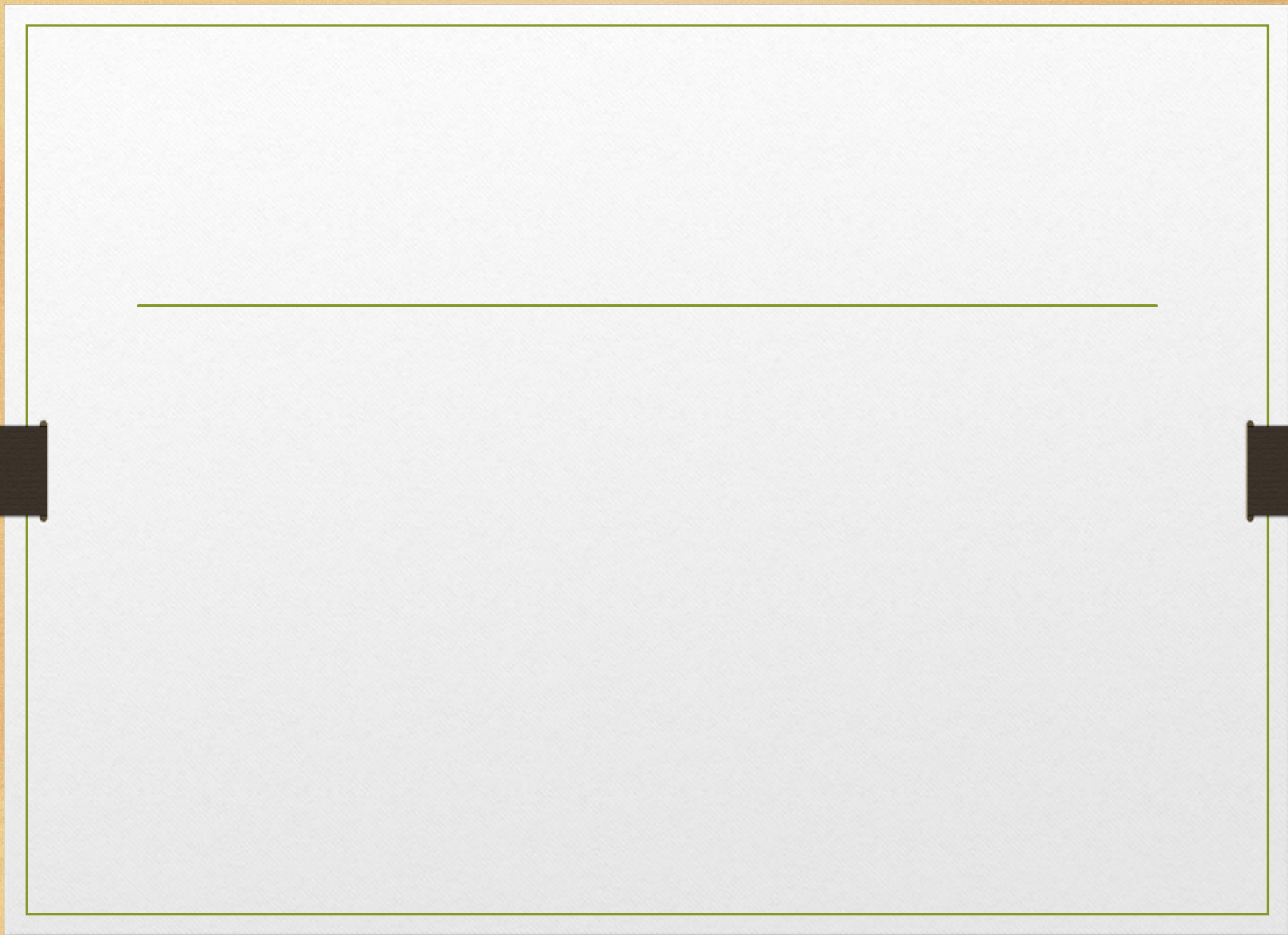
rinser
100 BPM

uncaser
100 BPM

Depall
100 BPM

Efficiency: What if machine availability is 100%?

- Less capital expenditure as all machines only have to be capable of running at filler speed.



Efficiency: Machine Speed modulation

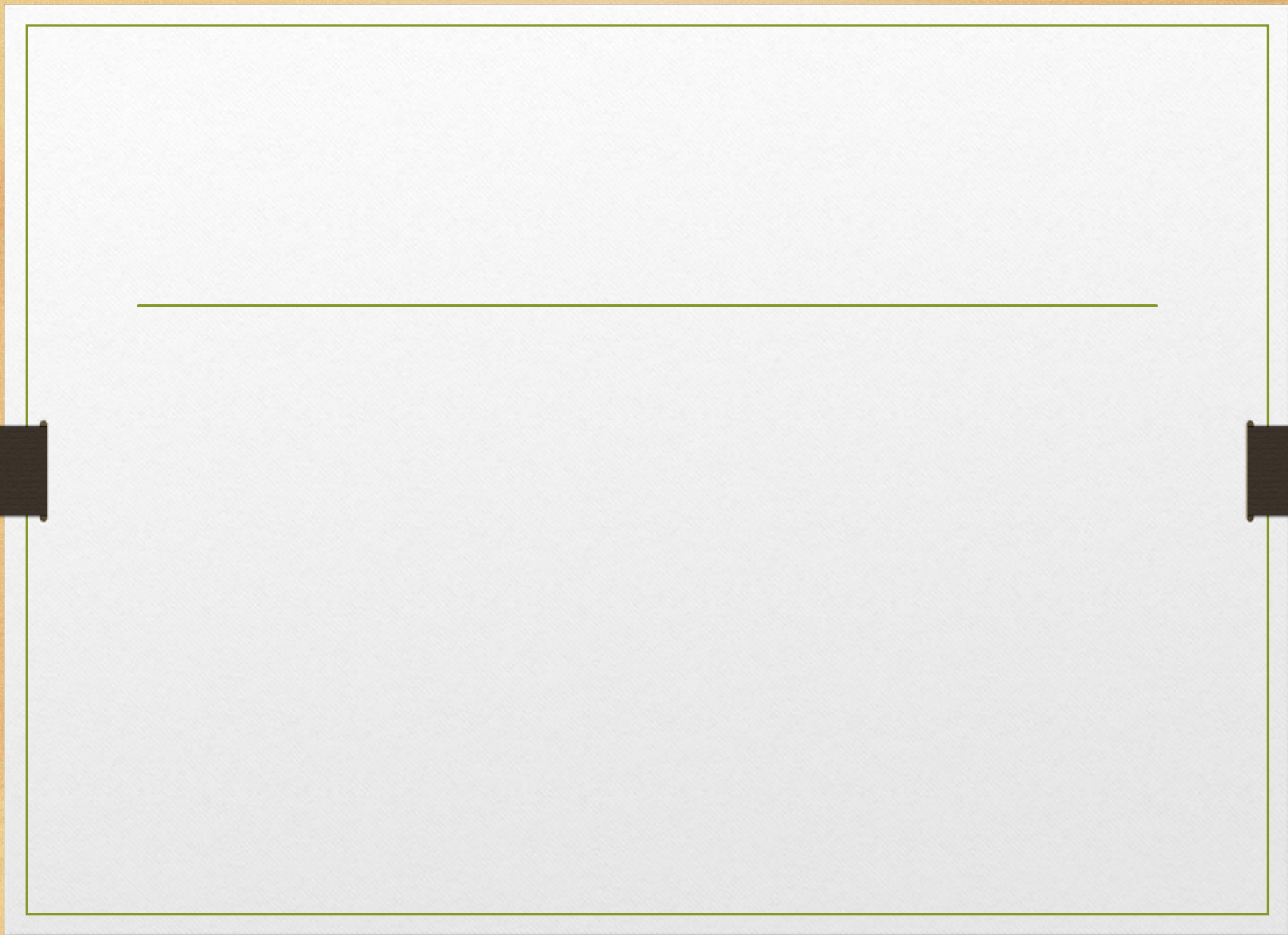
- Speed modulation means that the machine can typically run at 3 different speeds:
 - Normal speed – essentially filler speed when the line is in normal condition
 - High speed when the machine needs to catch up or pull away after an upset
 - Slow speed when the machine is running low on containers on the infeed or its discharge is backing up after an upset
 - Typically done today with VFD(variable frequency drives)

Efficiency: Why is speed modulation important?

- It keeps the machine running – when a machine stops, bad things happen.
- It keeps machines around it running
- It allows the line to return to a normal state
- A normal line state means that all machines are running the same speed as the filler.

Efficiency: What if machine availability is 100%?

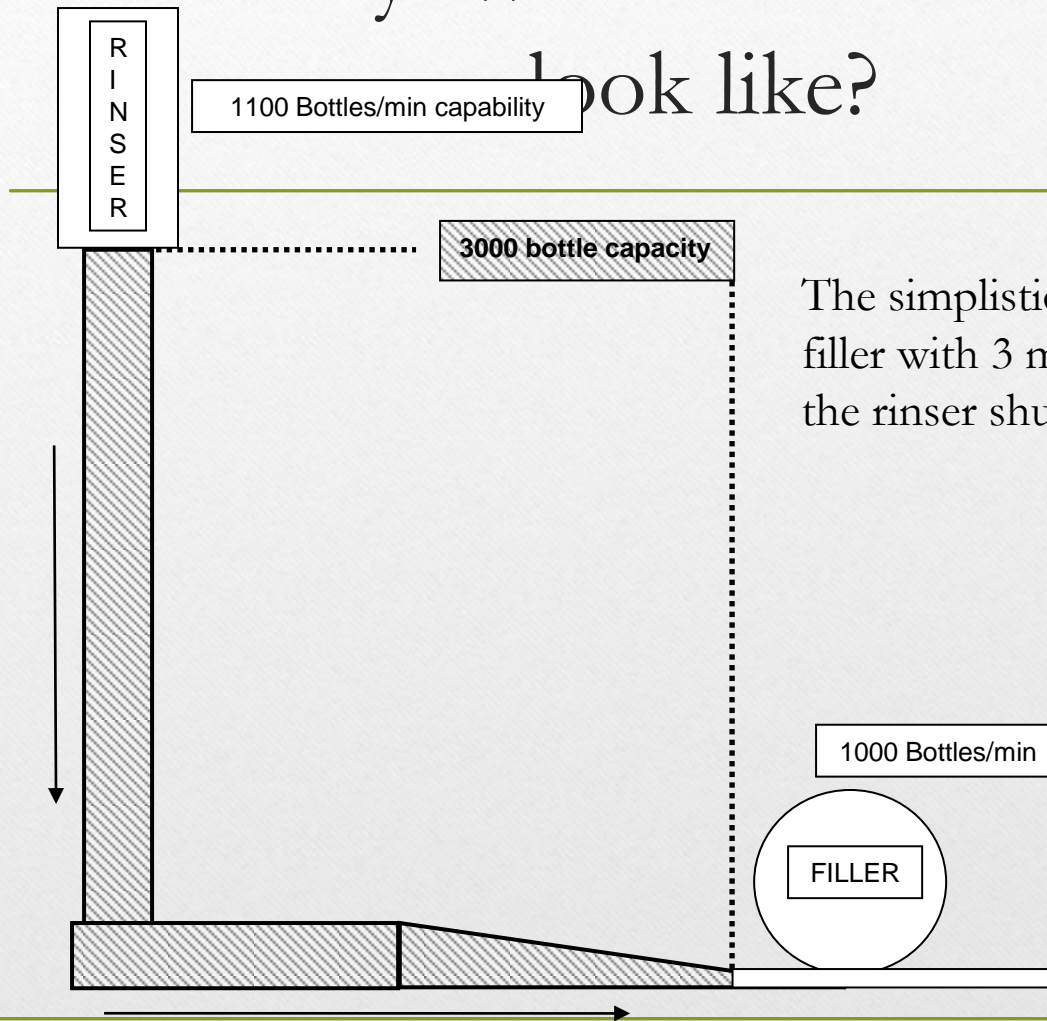
- No speed modulation required, much less capital expenditure



Efficiency: Line accumulation

- Line accumulation is basically time installed between each machine
 - Allows downstream machines to continue to run for a predetermined time when upstream machines have stopped
 - Allows upstream machines to continue to run for a predetermined time when downstream machines have stopped

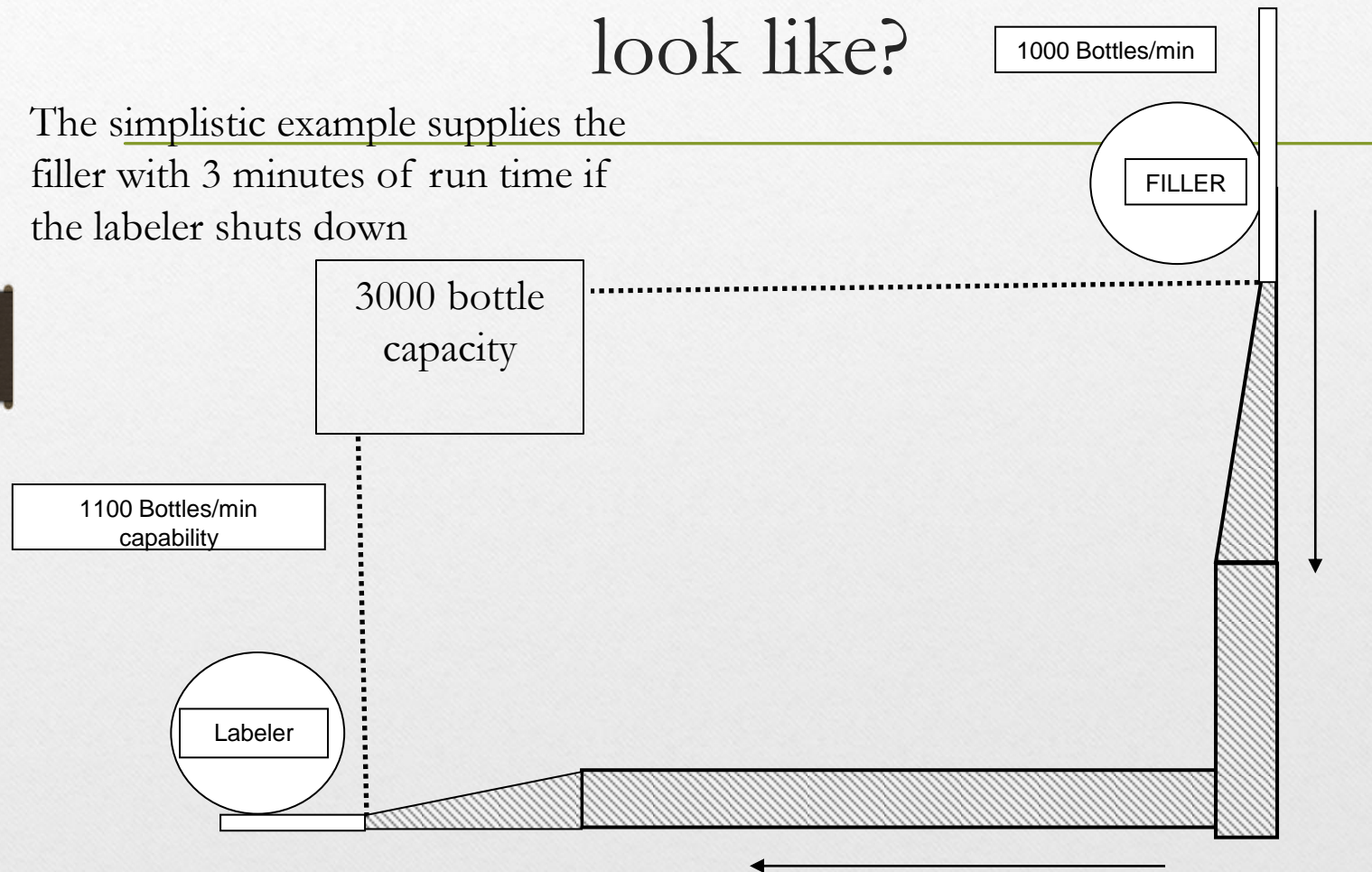
Efficiency: What does accumulation look like?



The simplistic example supplies the filler with 3 minutes of run time if the rinser shuts down

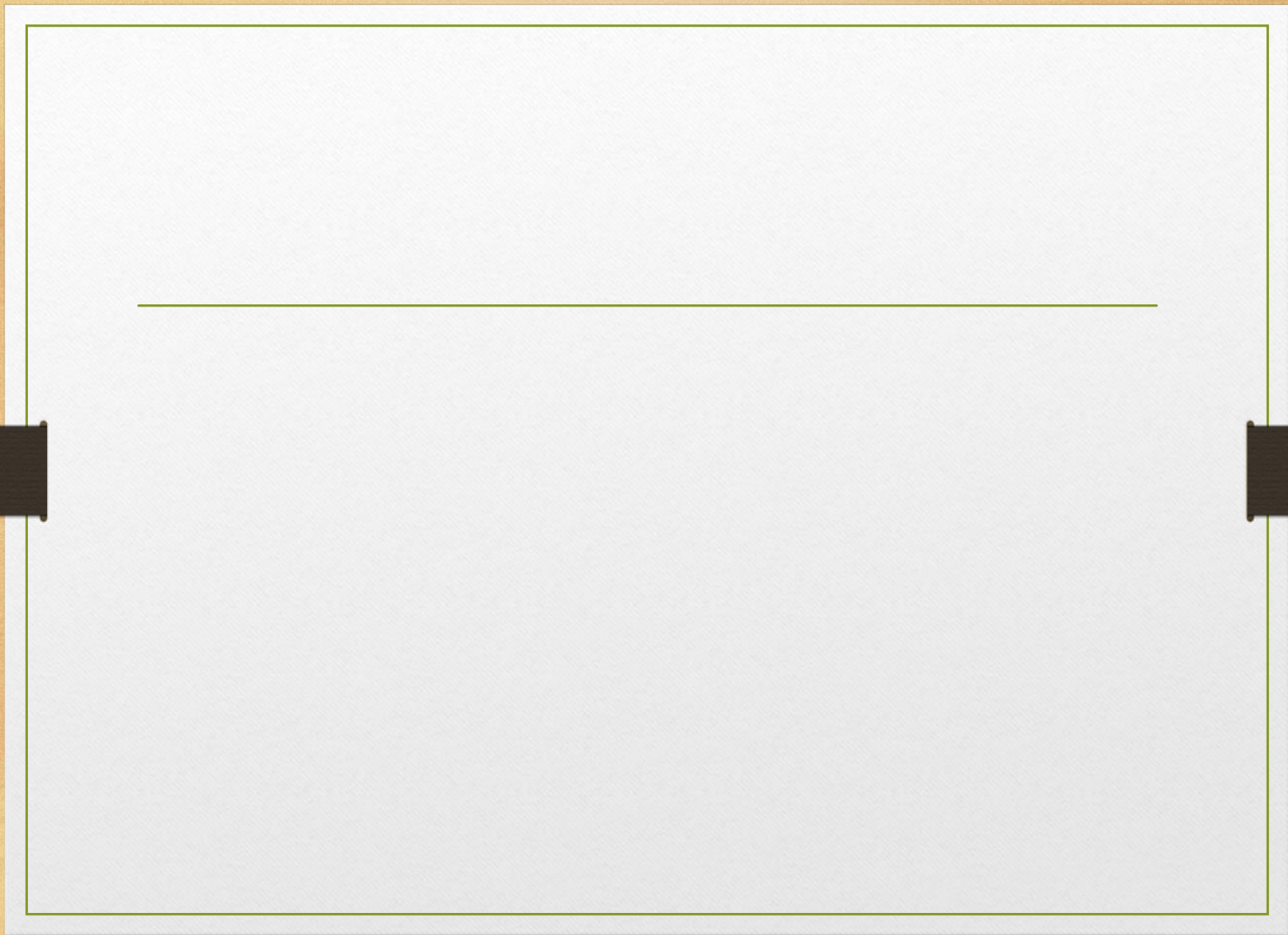
Efficiency: What does Accumulation look like?

The simplistic example supplies the filler with 3 minutes of run time if the labeler shuts down



Efficiency: What if machine availability is 100%

- No accumulation required
- All machines can be close coupled and only single file conveyor needed

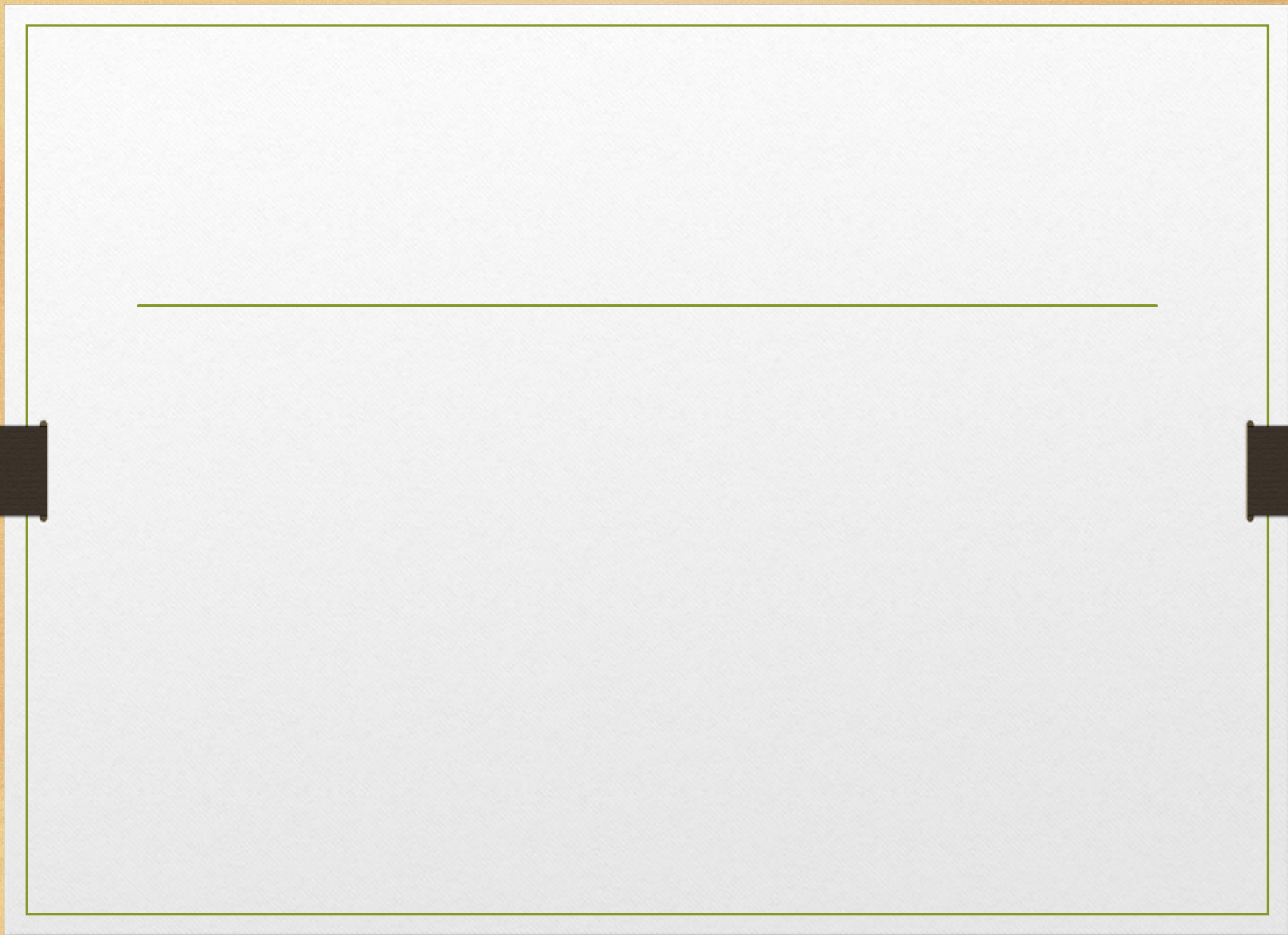


Efficiency: Conveyor speeds

- Much like machine modulation, conveyor speed modulation is required so that the conveyors are able to supply containers to the infeed of a machine and take them away from the machine discharge at the correct speeds to keep the machine running.
- Typically done today with VFD (Variable frequency drives)

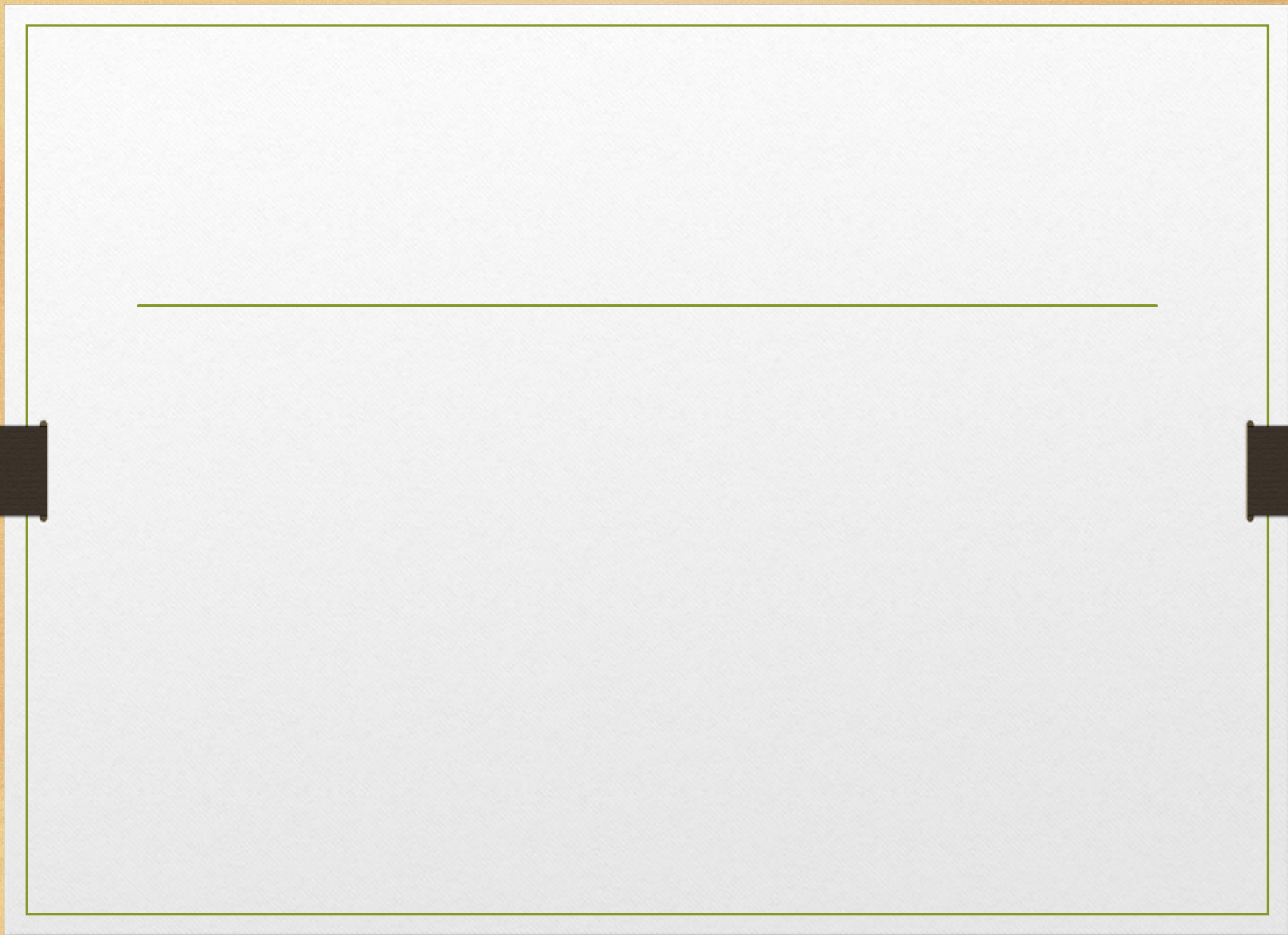
Efficiency: What if machine availability is 100%?

- No conveyor speed modulation required
- All machines only run at filler speed and therefore conveyors only have to run at one speed



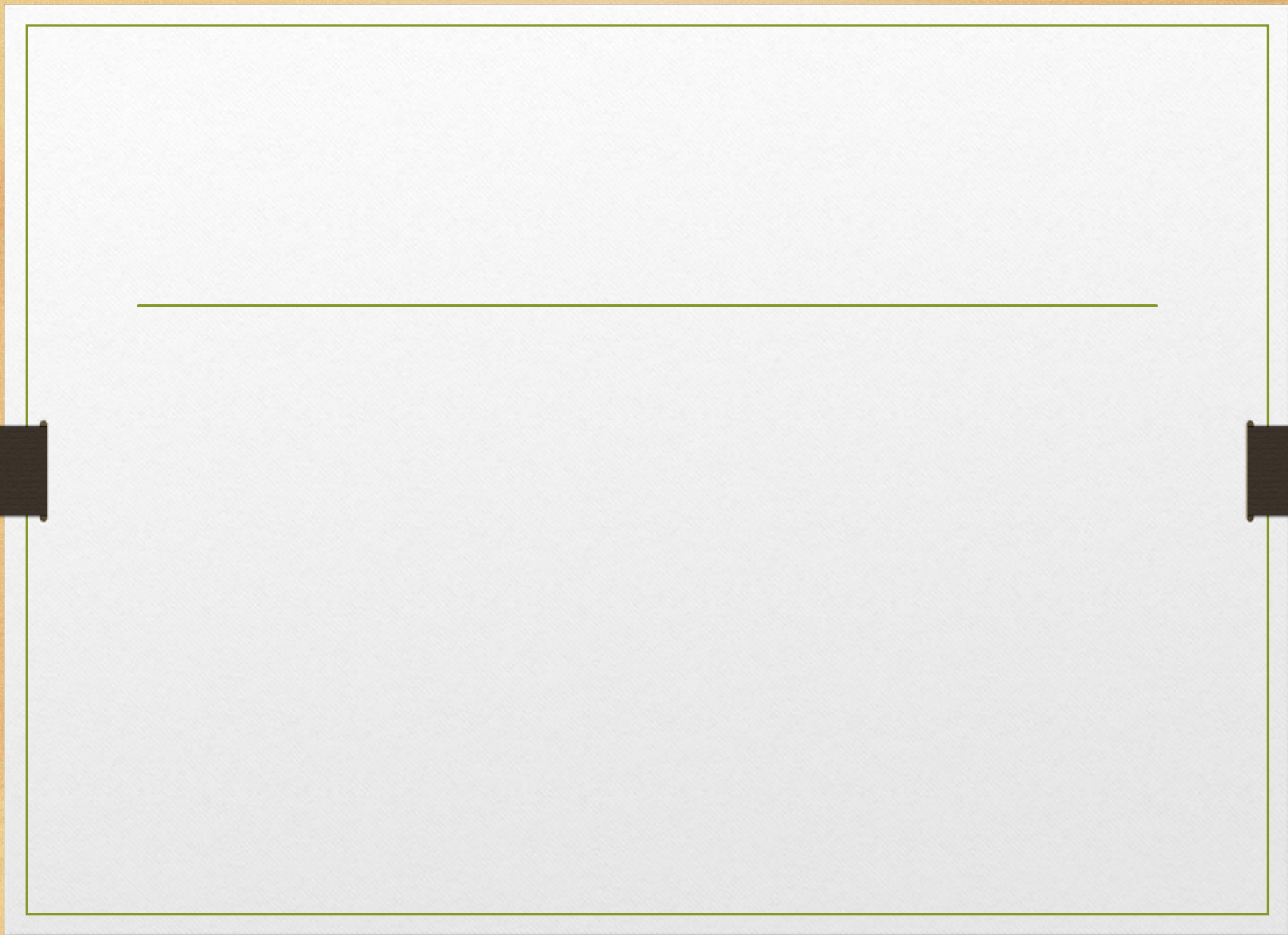
Beer/Material Line Losses

- Insure and verify that a maximum loss is specified with the equipment suppliers
- Filler should be a serious focal point of what beer losses should be
- Max down bottles or broken bottles/hour rating
 - Tunnel pasteurizers
 - Conveyors
 - Packers
 - palletizers



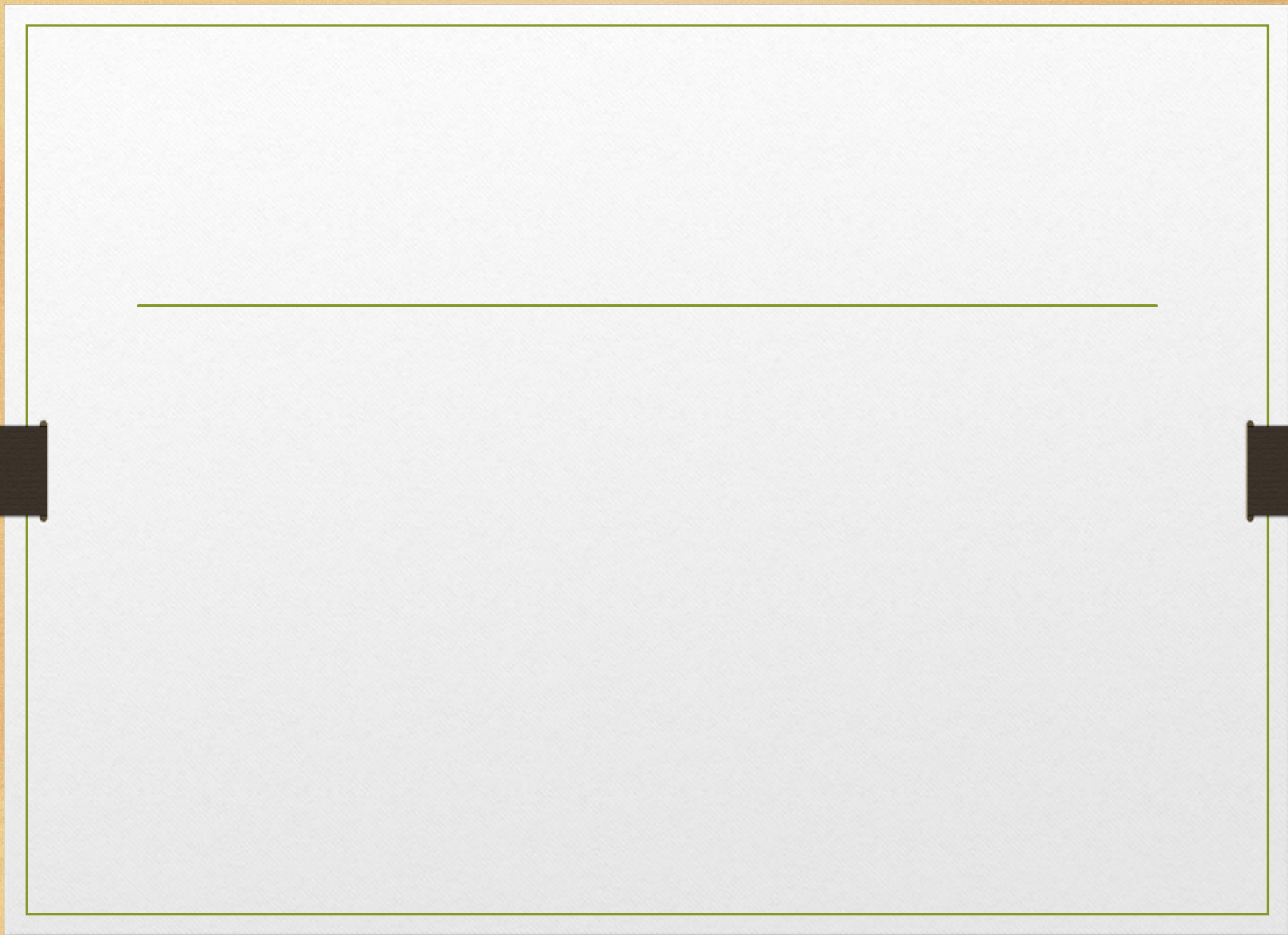
Packaging Line Production speed

- The faster the line design speed the closer to perfect you must be in all aspects
- As packaging line design speeds increase, the need for quality conveying becomes incredibly important.
- The design of quality conveying is only the beginning. The maintenance of it and all equipment on the line becomes more critical and complex.



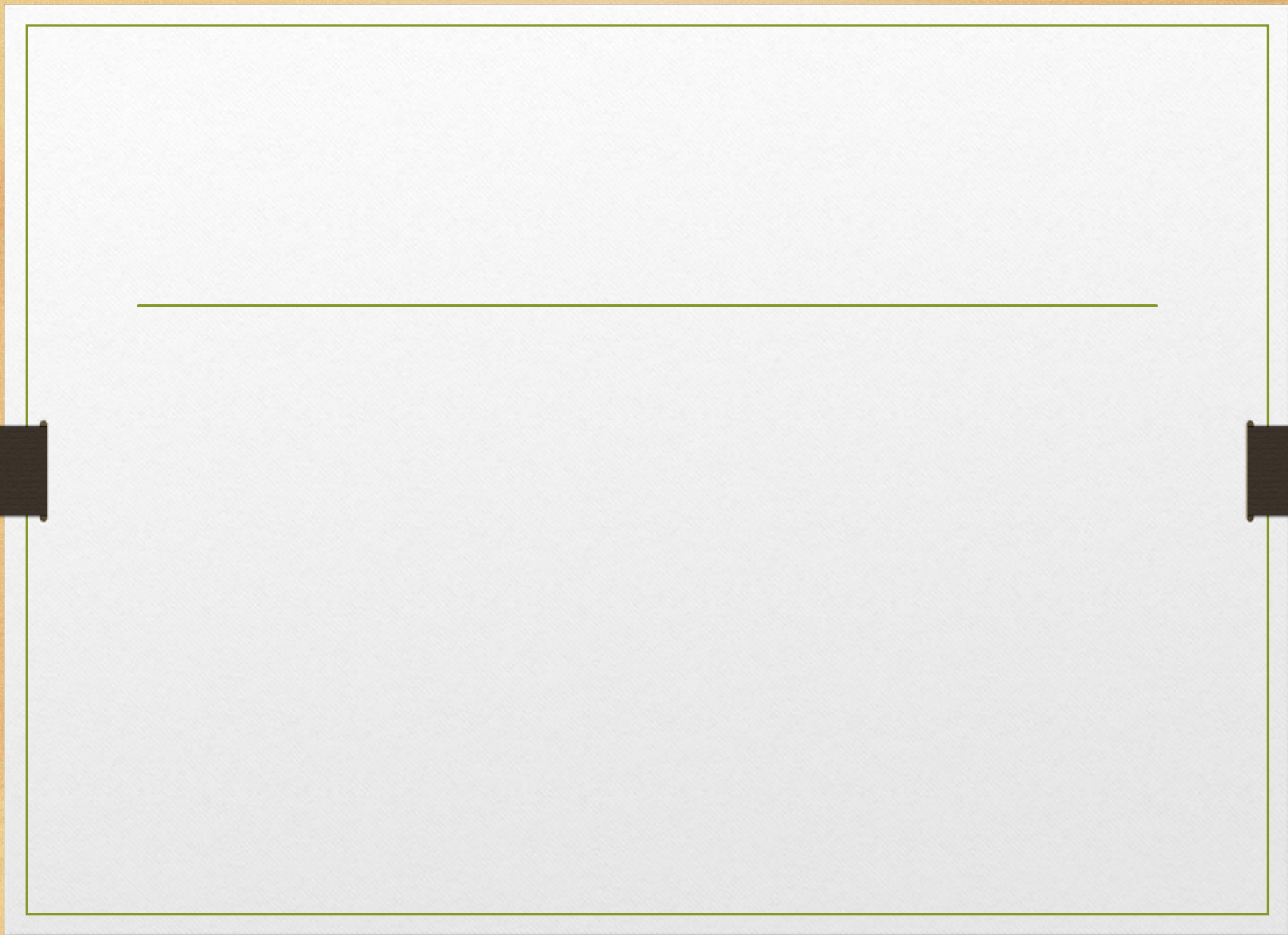
Manpower

- Line layout is critical
- The line must be laid out to minimize manpower requirements.
- The plant needs to know what their people are presently capable of and what they are capable of in the future.
- A great line layout that only needs two operators but the people are not capable of performing the job is not a bargain



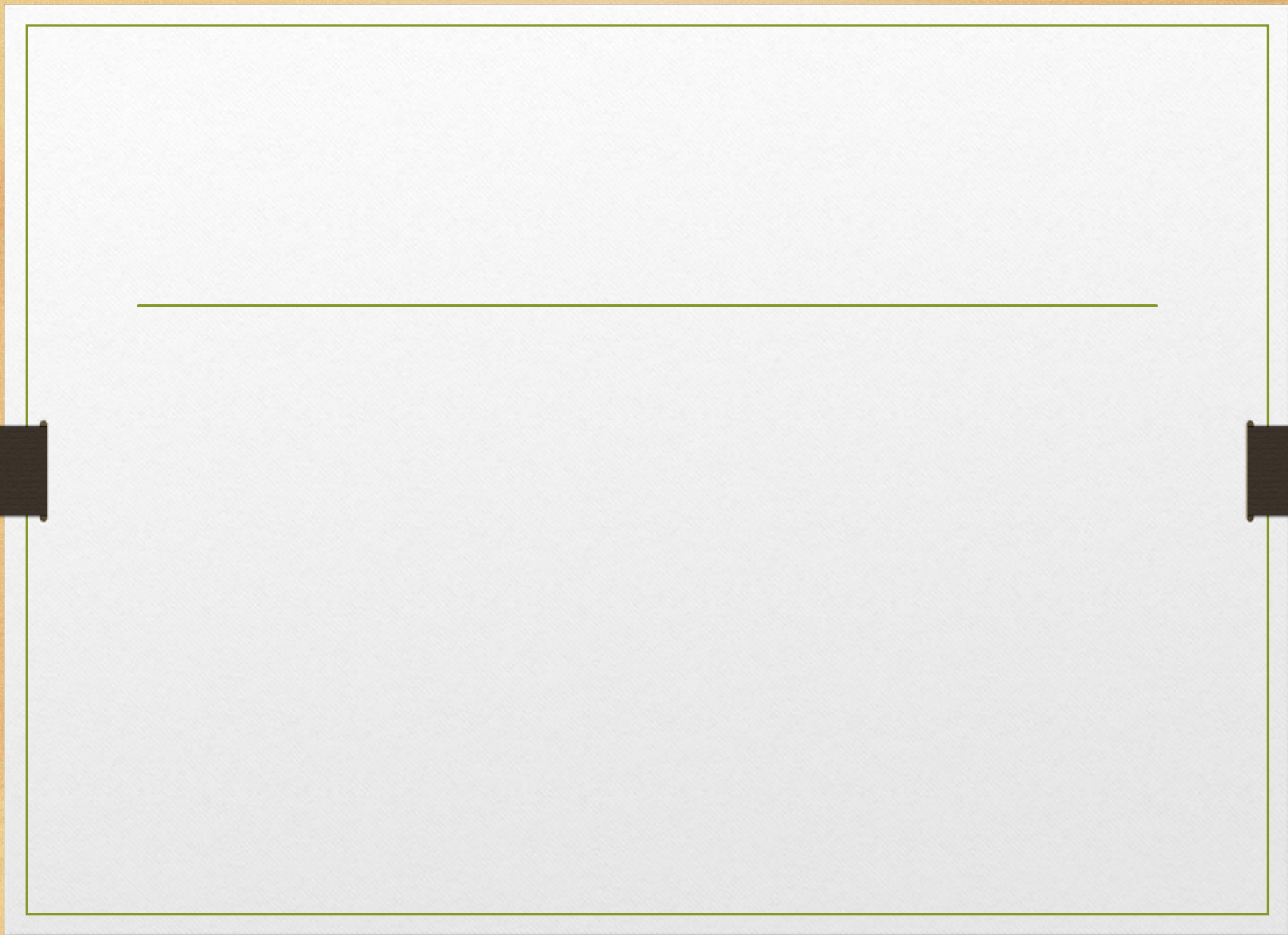
Changeovers

- If changeovers are required they must be quick
- Simplicity is the key
 - Kiplocks – no tools required
 - Repeatability is attainable every time



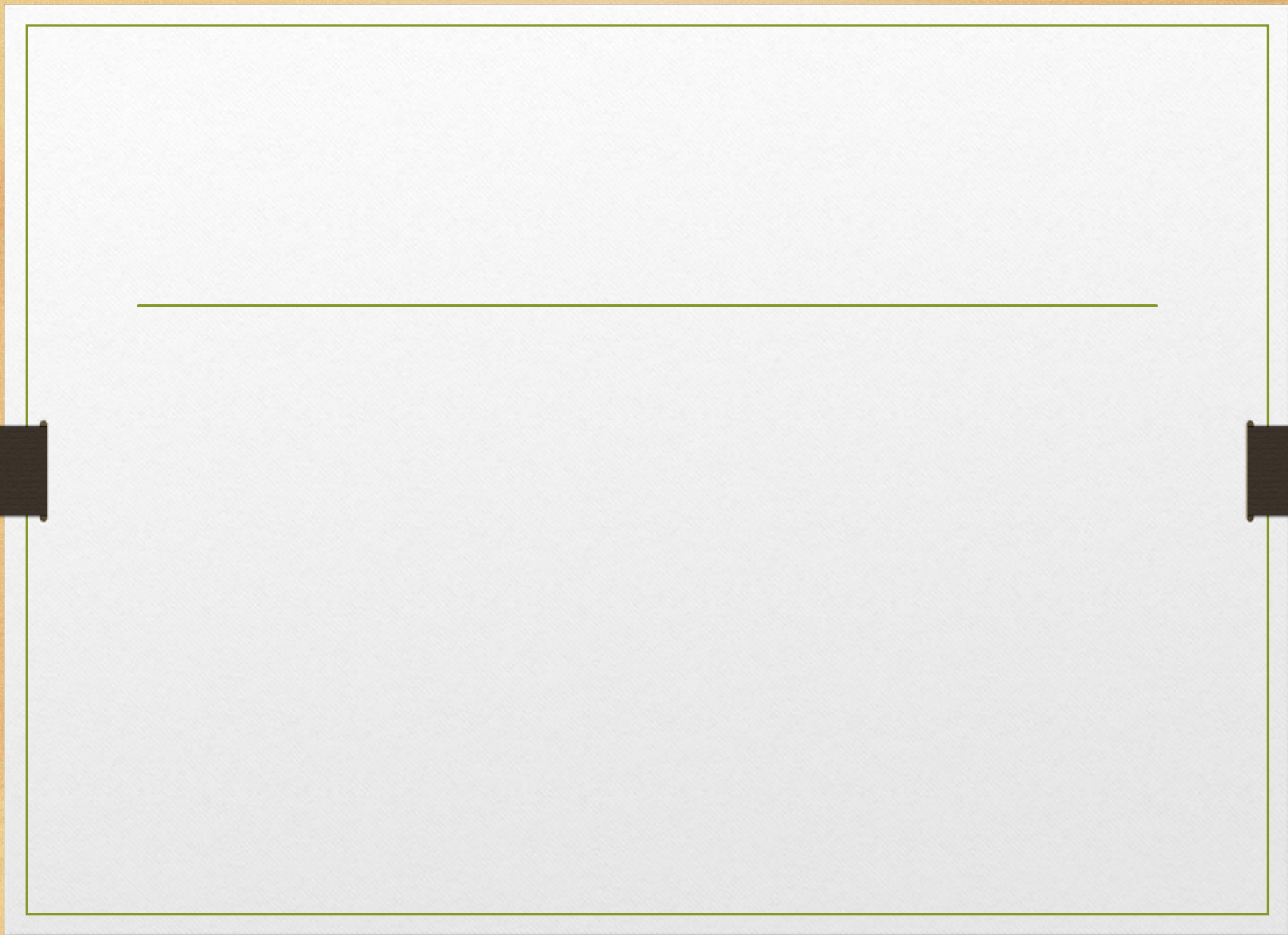
Maintenance

- Make sure that the majority of maintenance is able to be performed by the operators
- Standardize on equipment components whenever possible
- Conveyors are the biggest opportunity:
 - Gear boxes
 - Sprockets
 - VFDs
 - Table top chain
 - Motors
 - Siderails
 - Drive chain
 - Wear strips
- Keep it simple!!!!!!!!!!!!!!



Low Capital Cost

- Keep it simple
 - Minimize bells and whistles
 - Good operators are worth their weight in gold, know their capabilities and use them
 - It does not have to be new equipment if you know what you are looking for

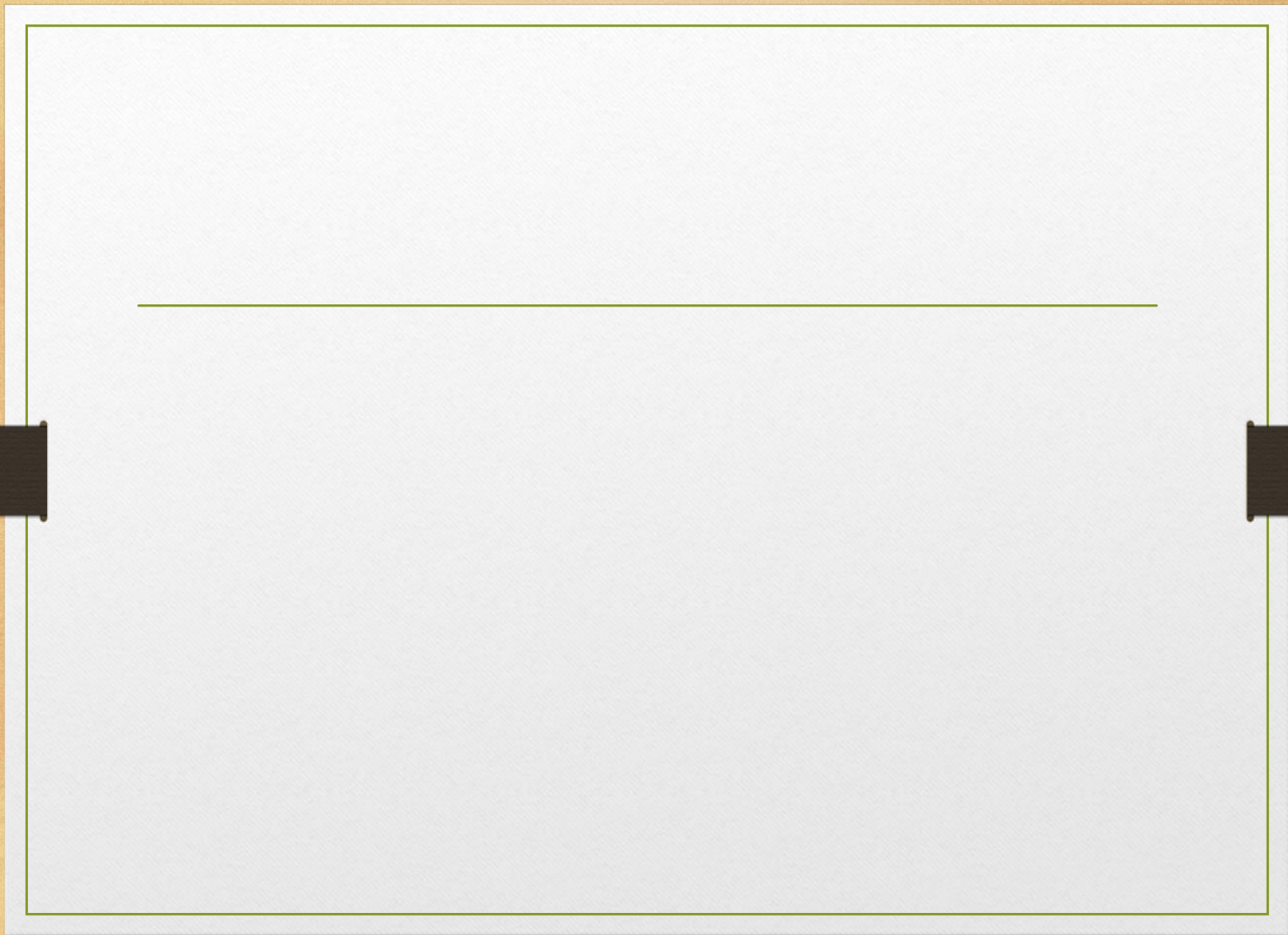


Minimum Packaging Supervisor/lead person Requirements

- Psychology Degree
- Day care license
- Great Motivational Speaker
- Treat others how you want to be treated(Unless it is the brewing dept)
- Skin like an alligator
- Memory like a defensive back
- Able to walk twice as fast any other employee in the building
- Enjoys being the company piñata at meetings

Packaging Manager's primary concern

- Keep the 50% of people that hate you away from the 50% who are not sure.



What can reduce simple packaging efficiency?

- Equipment breaking
 - Microstops – 3 minutes or less, 70% of all downtime
 - Macrostops – 3 minutes or more, random or run to failure items, most of these are probably less than 15 minutes
- Equipment adjustments/setup
- Equipments container jams
- Bad packaging material/no packaging material
 - How do we stop this?
- Morale
- No beer
- Changeovers
- Speeds
 - Equipment
 - Conveyors
- Conveyors
- Bad schedules
- Thieves from the previous shift ☺
- ***People***

Broomsticks

- Packaging Line Efficiency is inversely proportional to the amount of broomsticks on the packaging line.

Jim Helmke

People

- Never forget that *People* are the key to your operation!

Contact Information

- Bob Seaman
- rseaman@yuengling.com