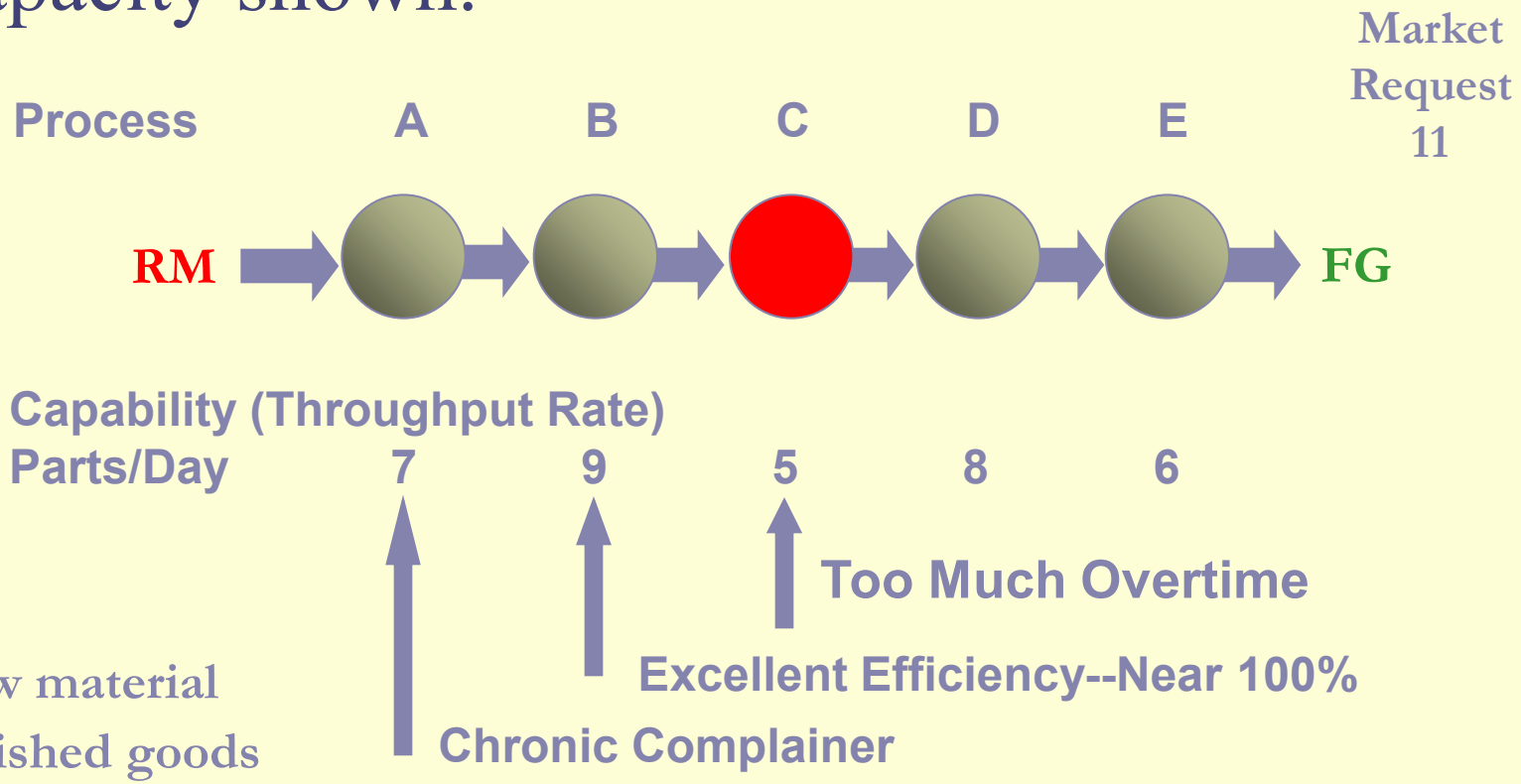
Drum –Buffer-Rope

Based on : R. Holt, Ph.D., PE

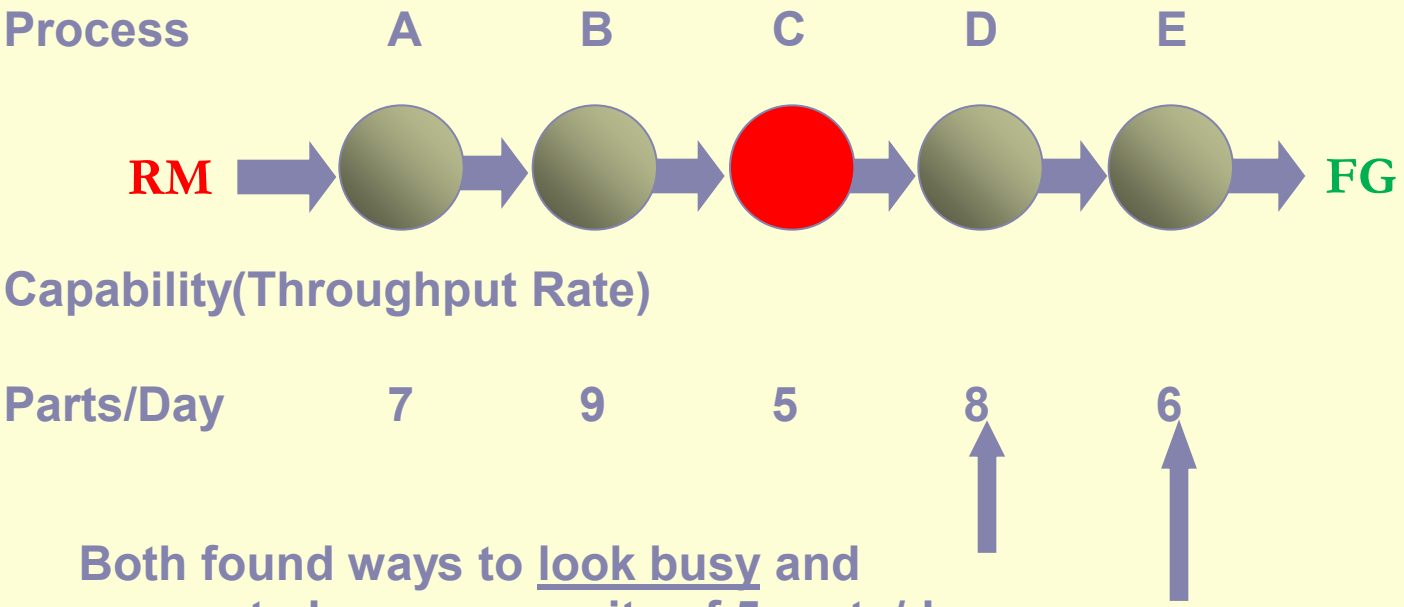
We Measure Operational Efficiency

- Work flows from left to right through processes with capacity shown.



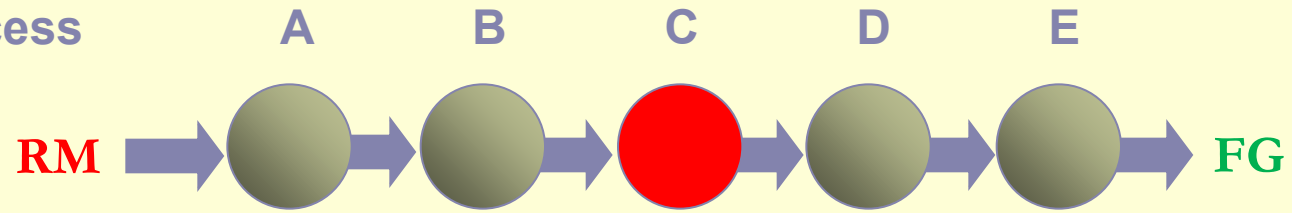
Reward Based on Efficiency

- Work flows from left to right.



In reality...

- Processes A and B won't produce more than Process C for long.

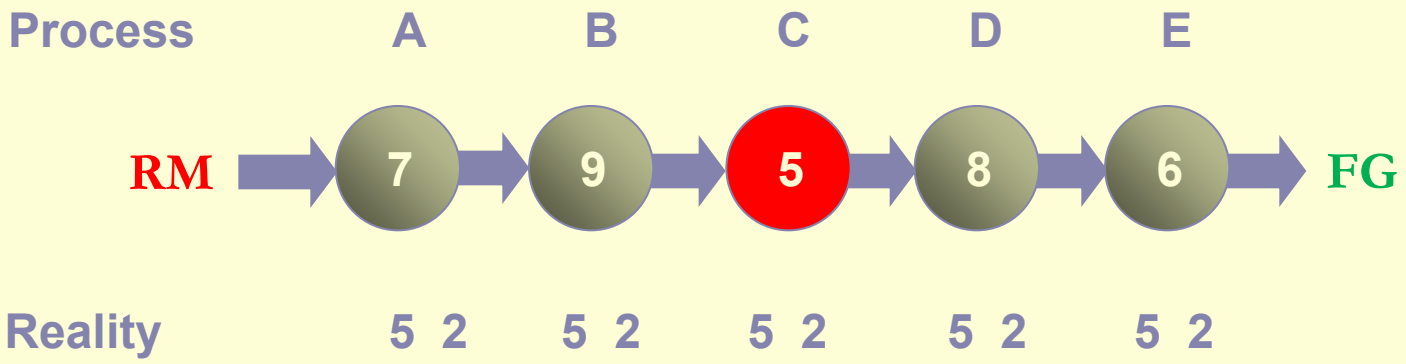


	A	B	C	D	E
Potential P/D	7	9	5	8	6
Reality	5	5	5	5	5

P/D=parts/day

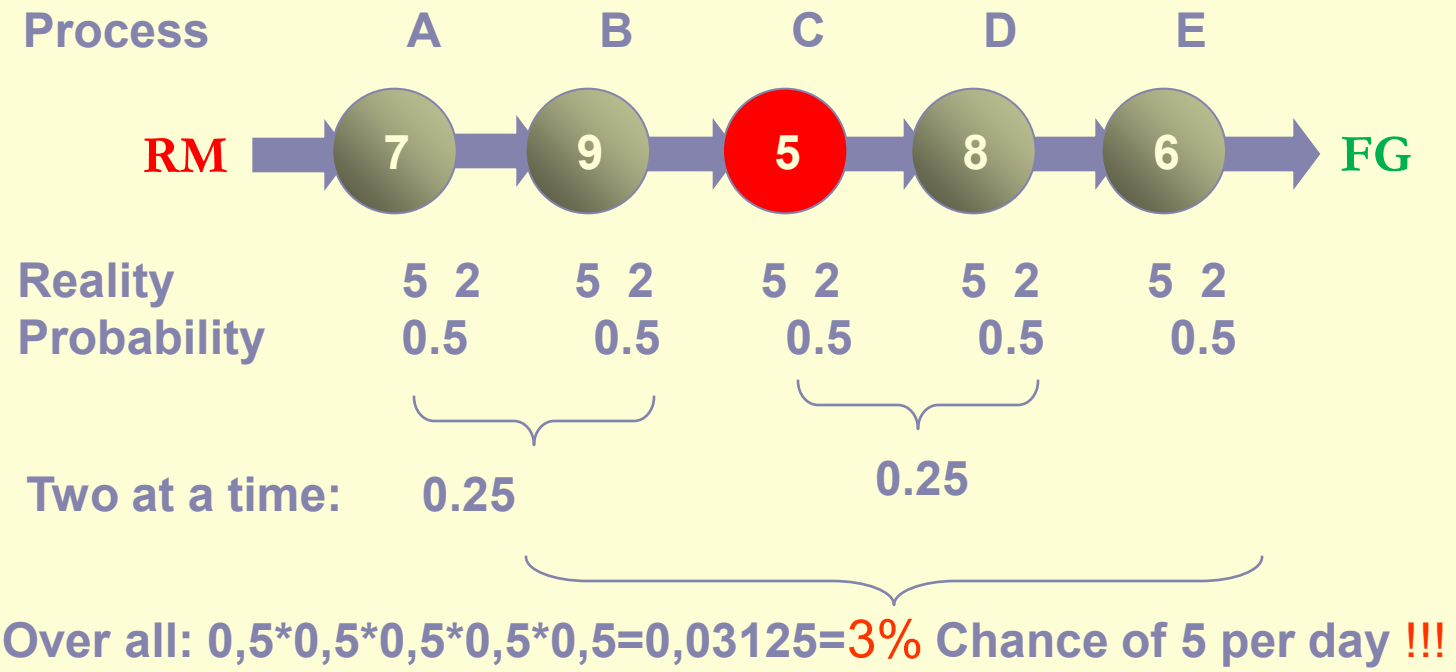
Then Variability Sets In

- Processing times are just AVERAGE Estimates



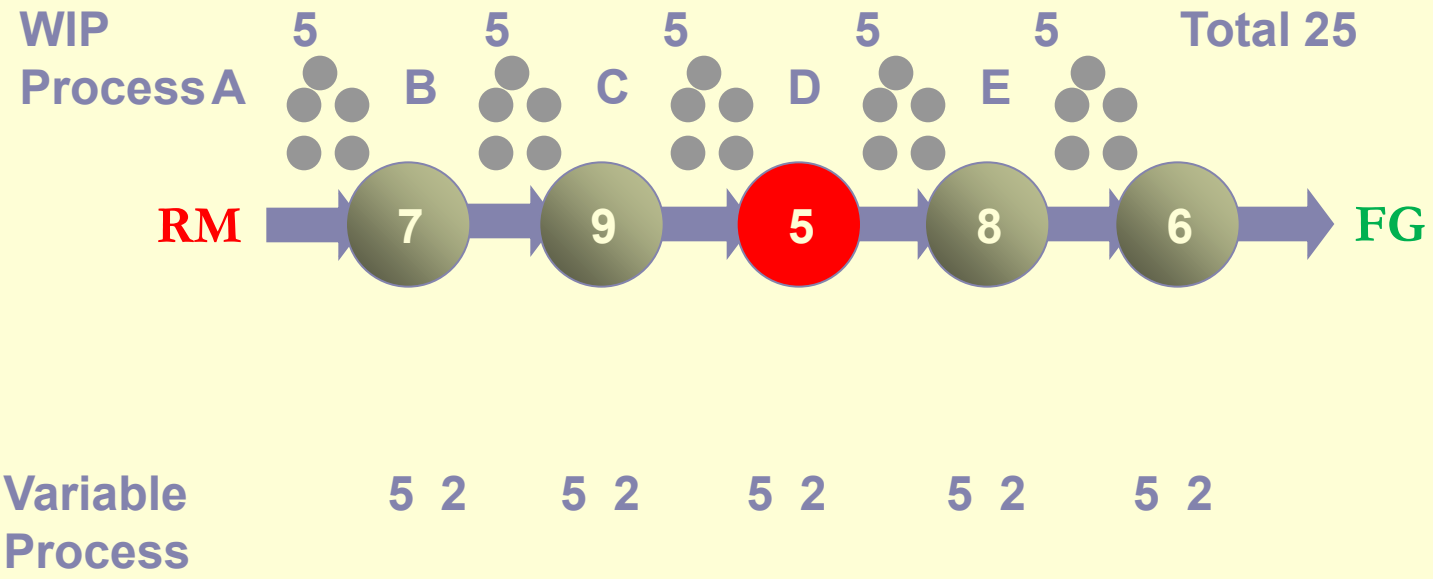
What's an Average? 50%

- Half the time there are 5 or more per day at each process--Half the time less



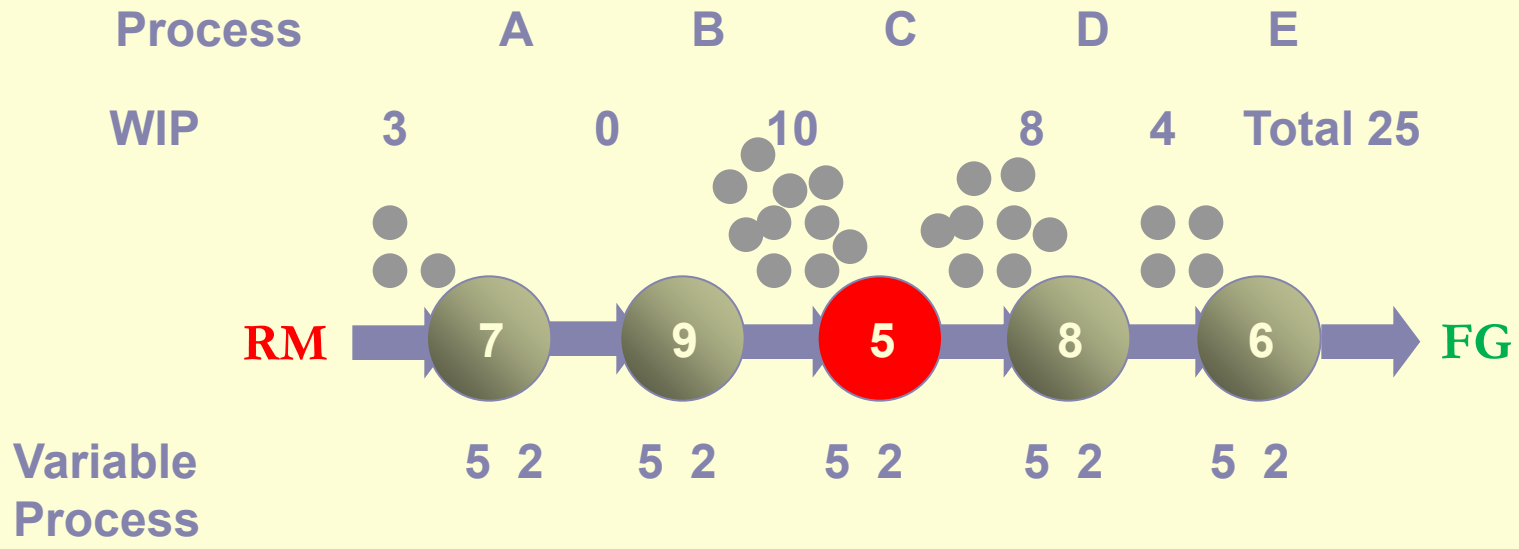
Previous Solution: Inventory

- Put a day of inventory (WIP) at each process!



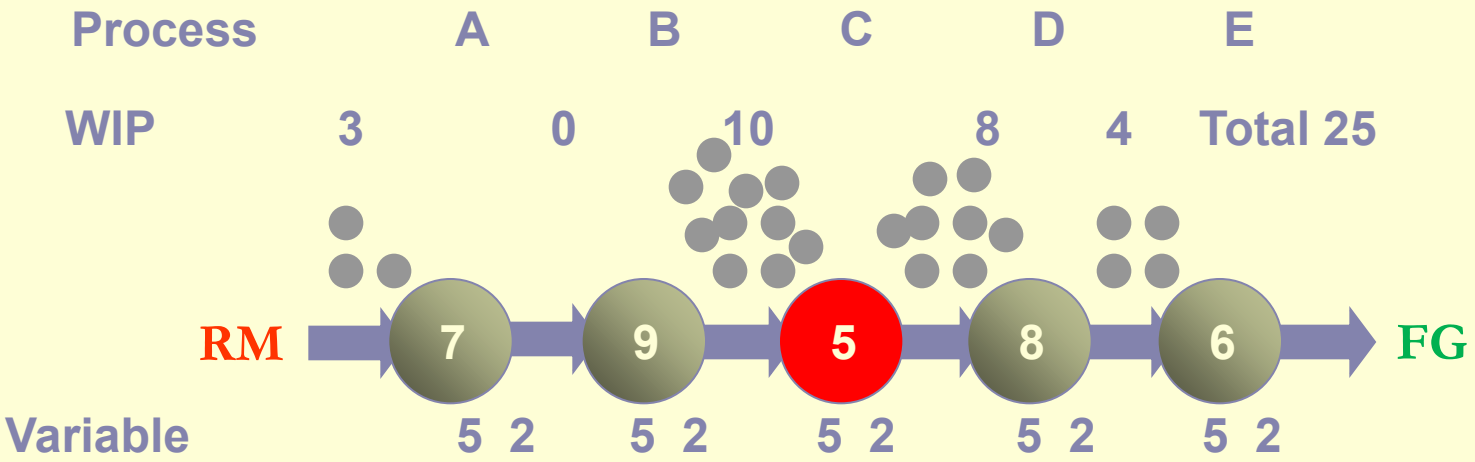
System Variability Takes Over--Chaos

Inventory (WIP) quickly shifts position.
Inventory manager tries to smooth it out.
Distribution problems result. Costs go up !!!



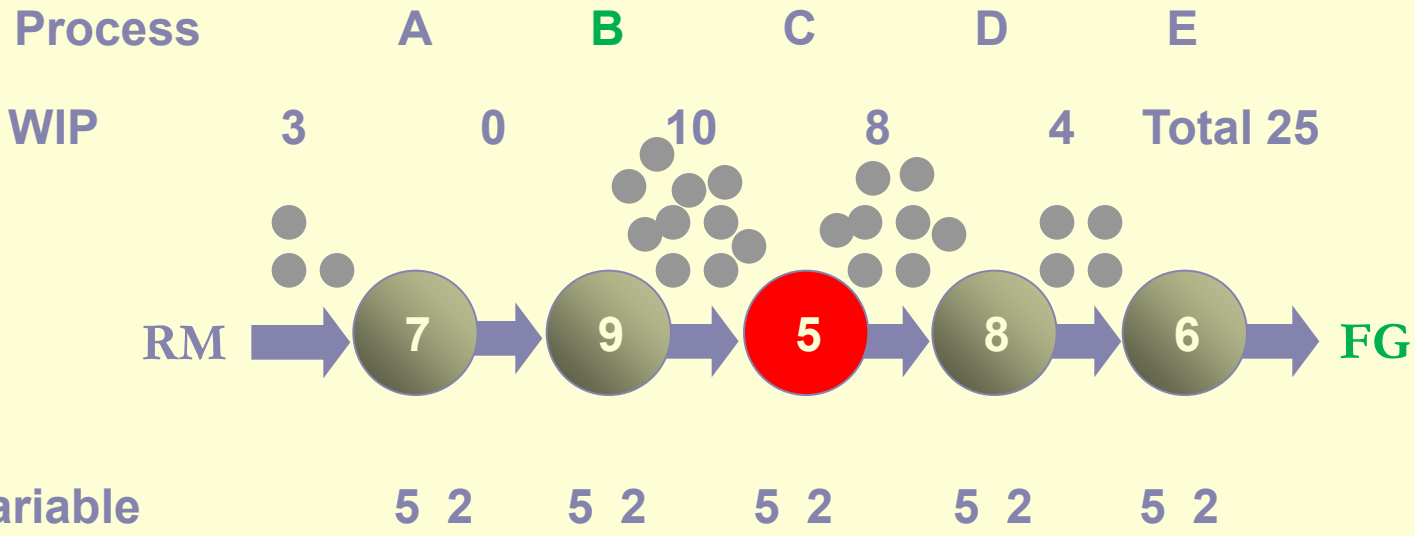
System Variability Takes Over--Chaos

An Average of 5 means sometimes 3 and some times 7



Shifting work-in-process creates **large queues** at some locations. This makes work wait longer to be processed. (based on Little s law)

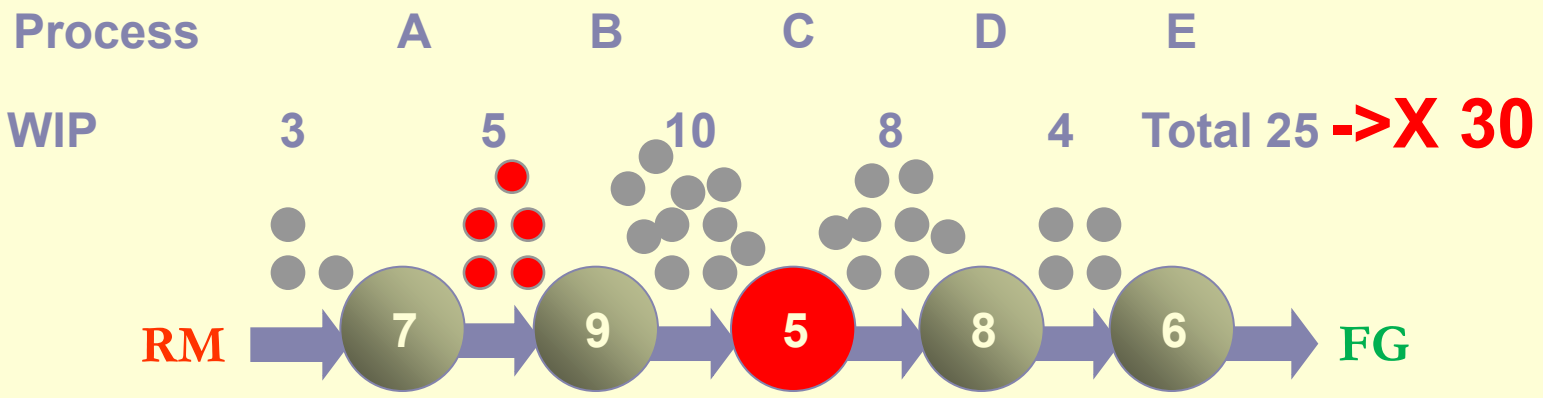
System Variability Takes Over--Chaos



Shifting work-in-process creates **large queues** at some locations. This makes work wait longer to be processed.

Other workstations are starving for work (**B**) The work they could do is delayed because they have no input material. They can't take advantage of their extra capability. So..... ?

System Variability Takes Over--Chaos



Variable Process 5 2 5 2 5 2 5 2 5 2

So… **Management Helps!** Management puts in more work (Inventory) (rate of input RM) to give everyone something to do (Cost world)!
Result: It takes longer and longer from time of release until final shipping. **More and more delay!!!!!!!!!!**

TOC Steps to Continuous Improvement

Step 1. ***Identify*** **the system's constraint.**

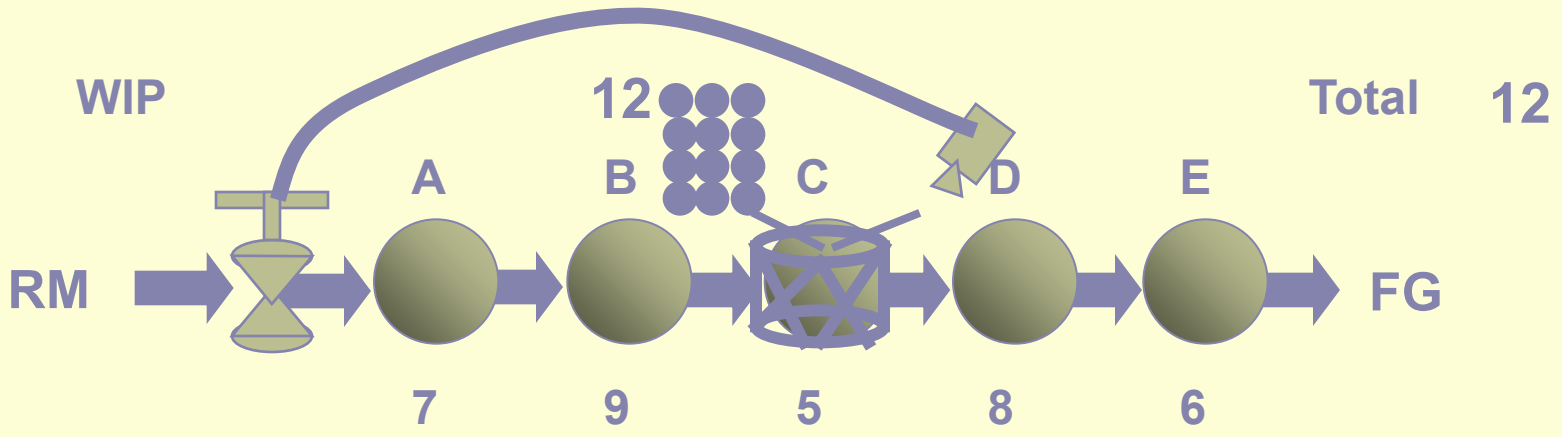
Step 2. ***Exploit*** **the system's constraint.**

Step 3. ***Subordinate*** **everything else to the above decision.**

Step 4. ***Elevate*** **the system's constraint.**

Step 5. If a constraint is broken (that is, relieved or improved), go back to Step 1. But don't allow ***inertia*** **to become a constraint.**

Five Steps Applied to Flow Operations



Five Focusing Steps

Step 1. Identify the Constraint (The Drum) - **CRT**

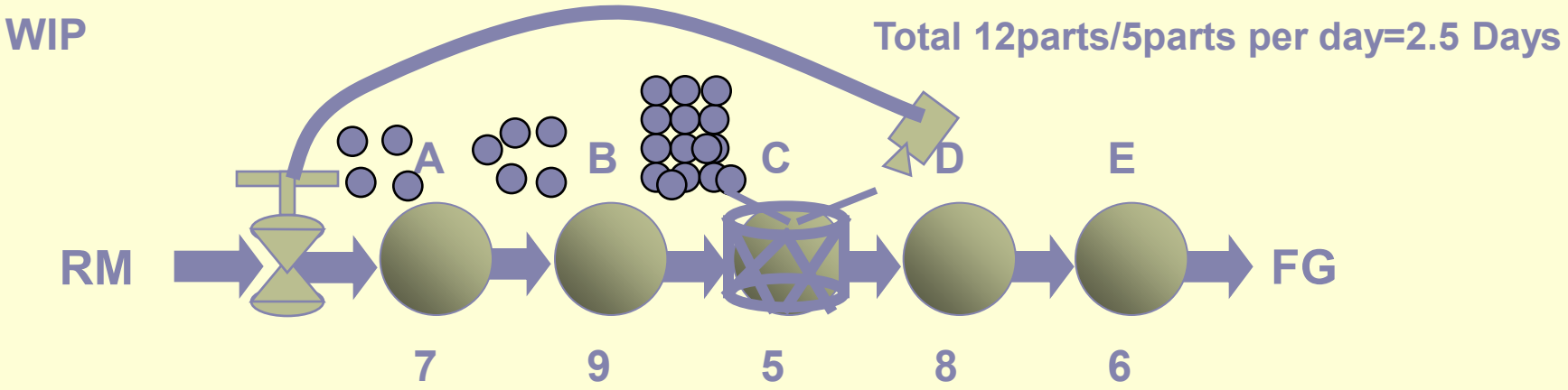
Step 2. Exploit the Constraint (Buffer the Drum) – **time reserve**

Step 3. Subordinate Everything Else (Rope) - **feedback**

Step 4. Elevate the Constraint ($?)

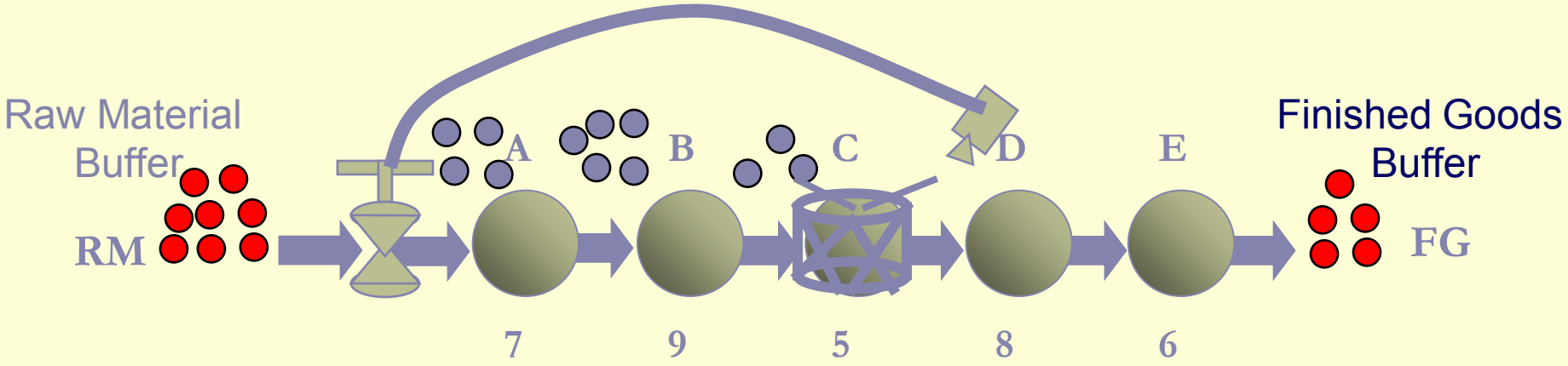
Step 5. If the Constraint Moves, Start Over

Understanding Buffers



- The "Buffer" is Time!
- In general, the buffer is the total time from work release until the work arrives at the constraint.
- Contents of the buffer alters (see below)
- If different items spend different time at the constraint, then number of items in the buffer changes
- but **Time in the buffer remains constant**.

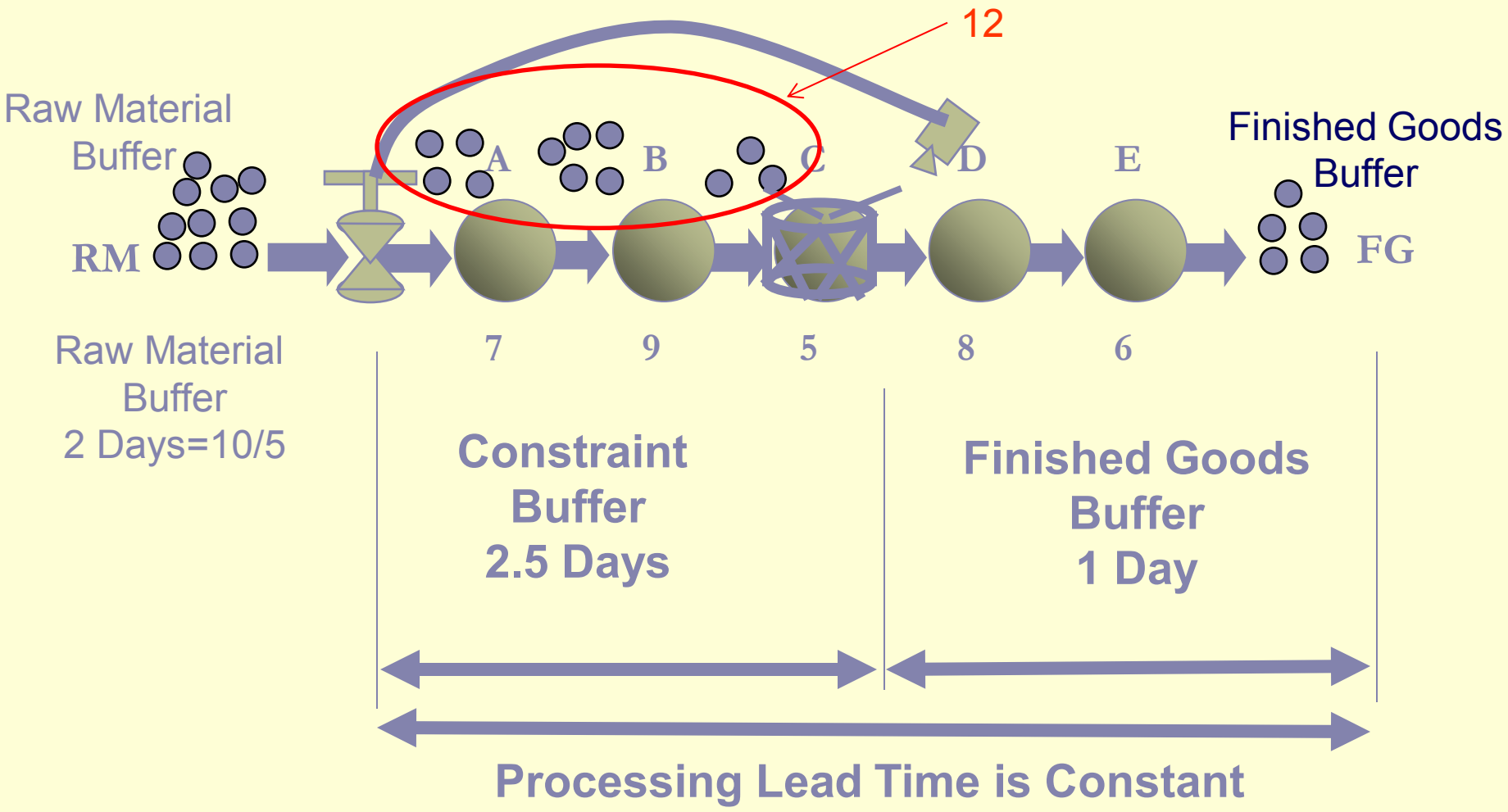
We need more than one Buffer



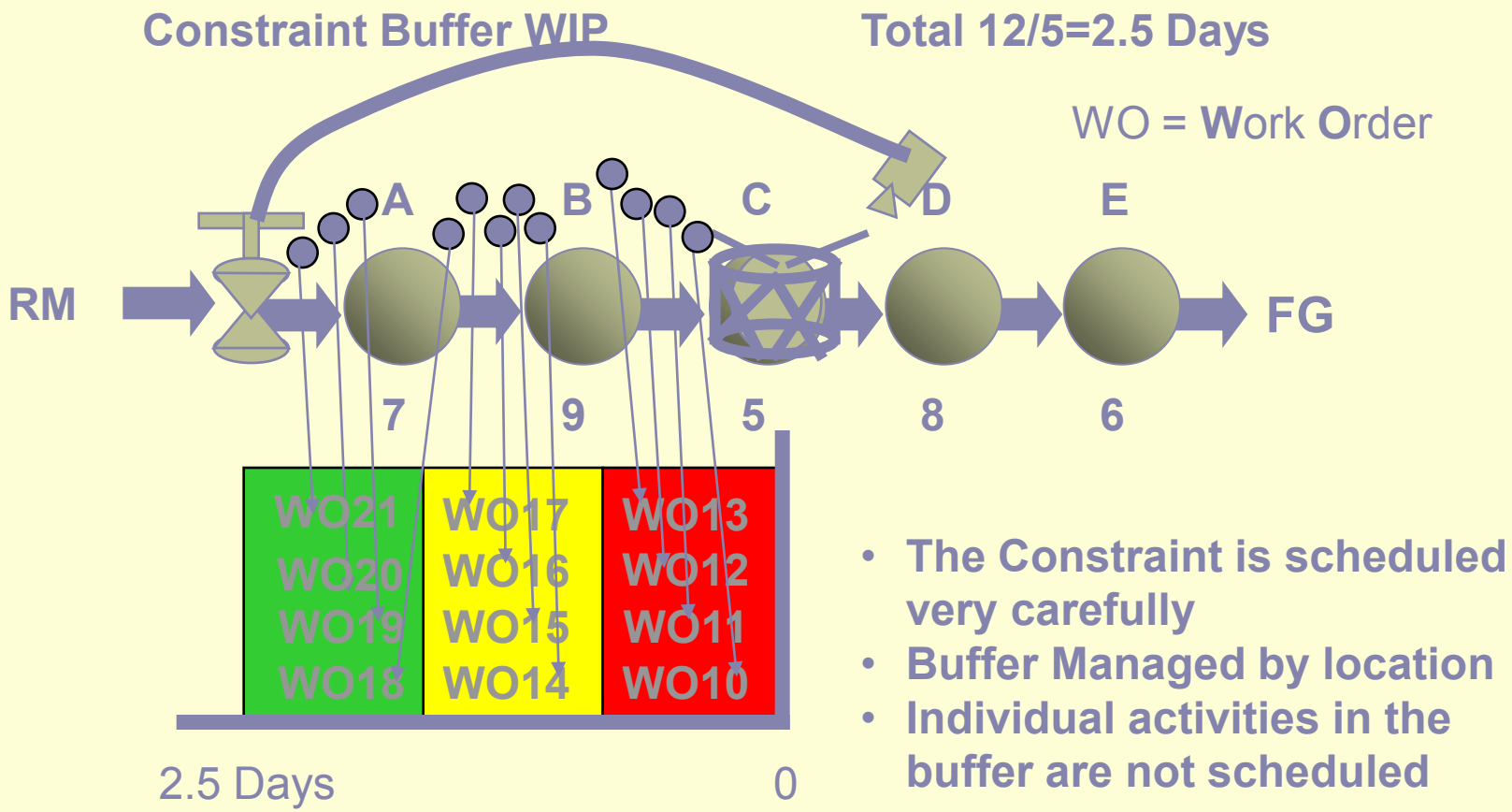
There is variability in the Constraint.
To protect our delivery to our customer we need a finished goods buffer.

There is variability in our suppliers.
We need to protect ourselves from unreliable delivery.

Buffer Time is Constant-Predictable

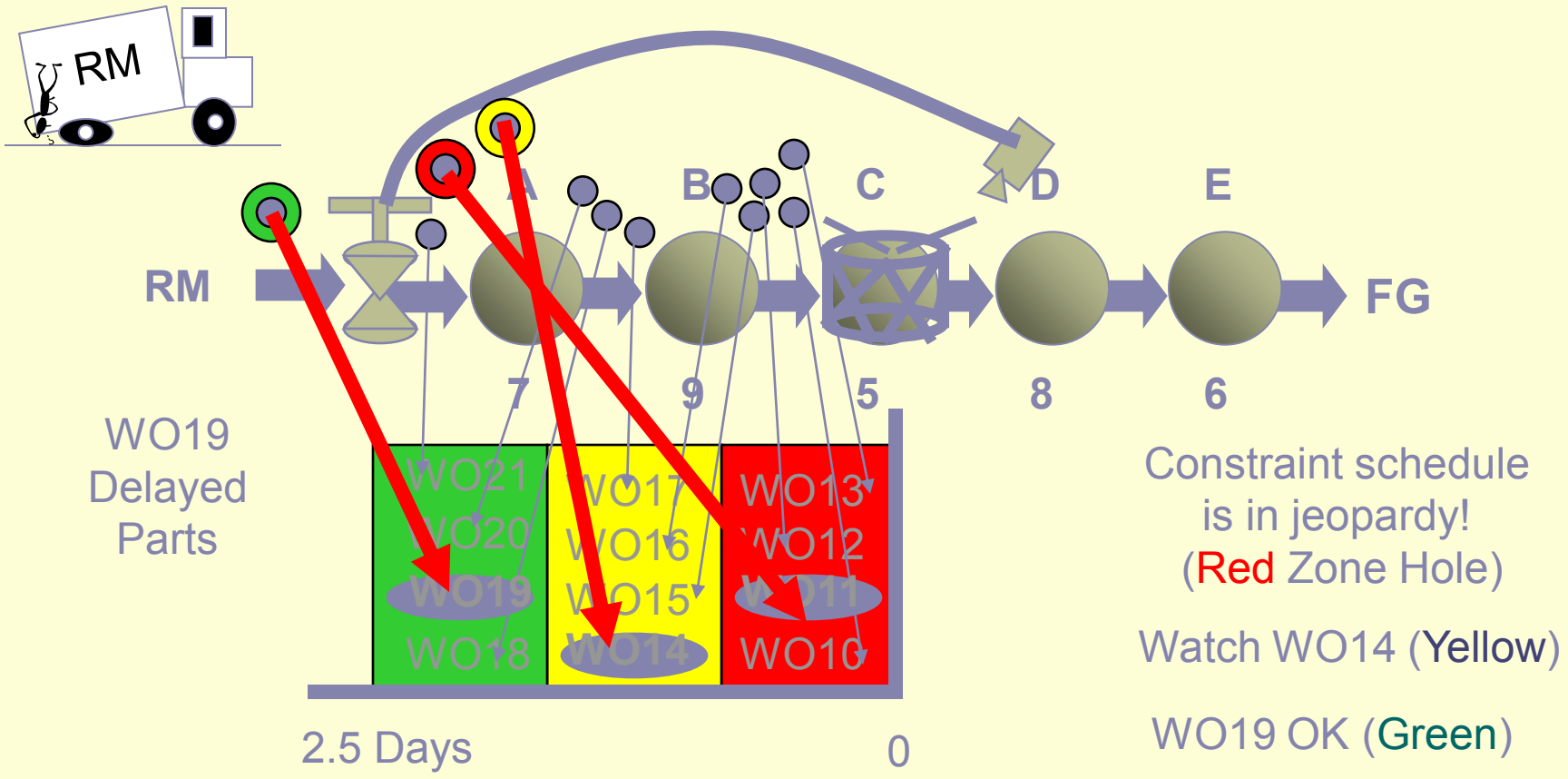


Buffer Management



- The Constraint is scheduled very carefully
- Buffer Managed by location
- Individual activities in the buffer are not scheduled

Problem Identification



Additional Buffers

- Constraint Buffer (as we discussed)
  - Protects the Constraint from running out of work
- Finished Goods Buffer
  - Protects customer delivery from Constraint variation
- Raw Material Buffer
  - Protects the Release of material from suppliers
- Assembly Buffer
  - Facilitates speedy flow of products