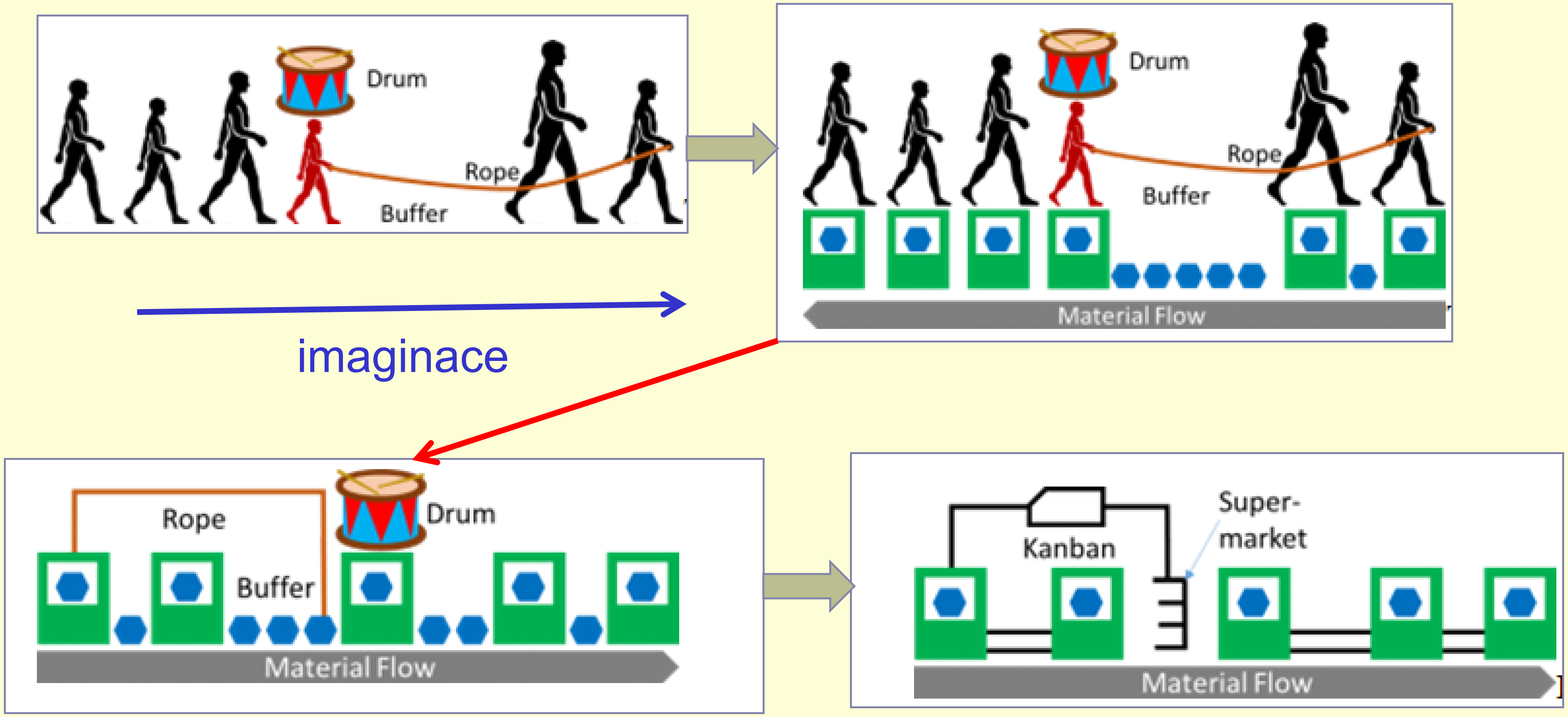
Drum –Buffer-Rope

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

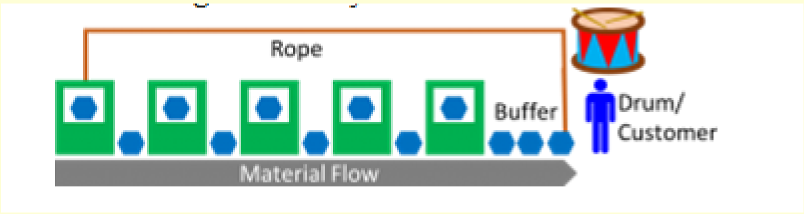
Principy



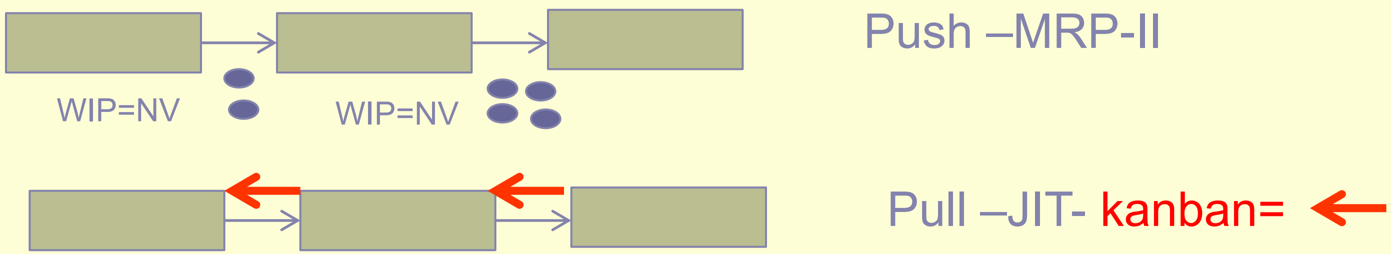
Resource : http://www.allaboutlean.com/drum-buffer-rope/

Simplified Drum Buffer Rope (S-DBR)

Principy

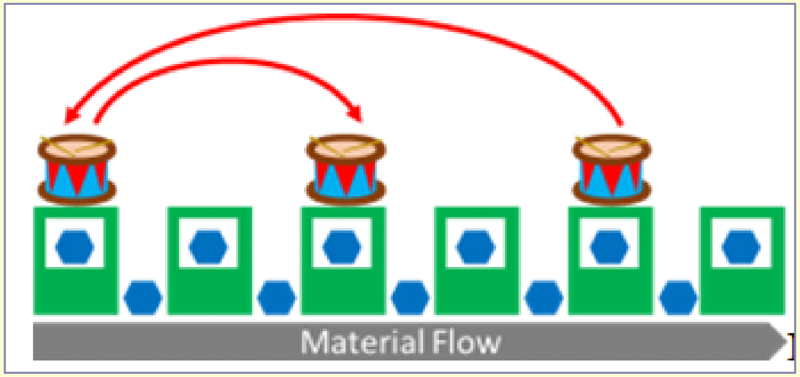


Most importantly, it does try to constrain the work-in-progress and aims to prevent an overloading of the system. As such it can be considered sort of a pull system like Kanban or CONWIP, and hence Drum-Buffer-Rope is superior to the traditional **push systems**.

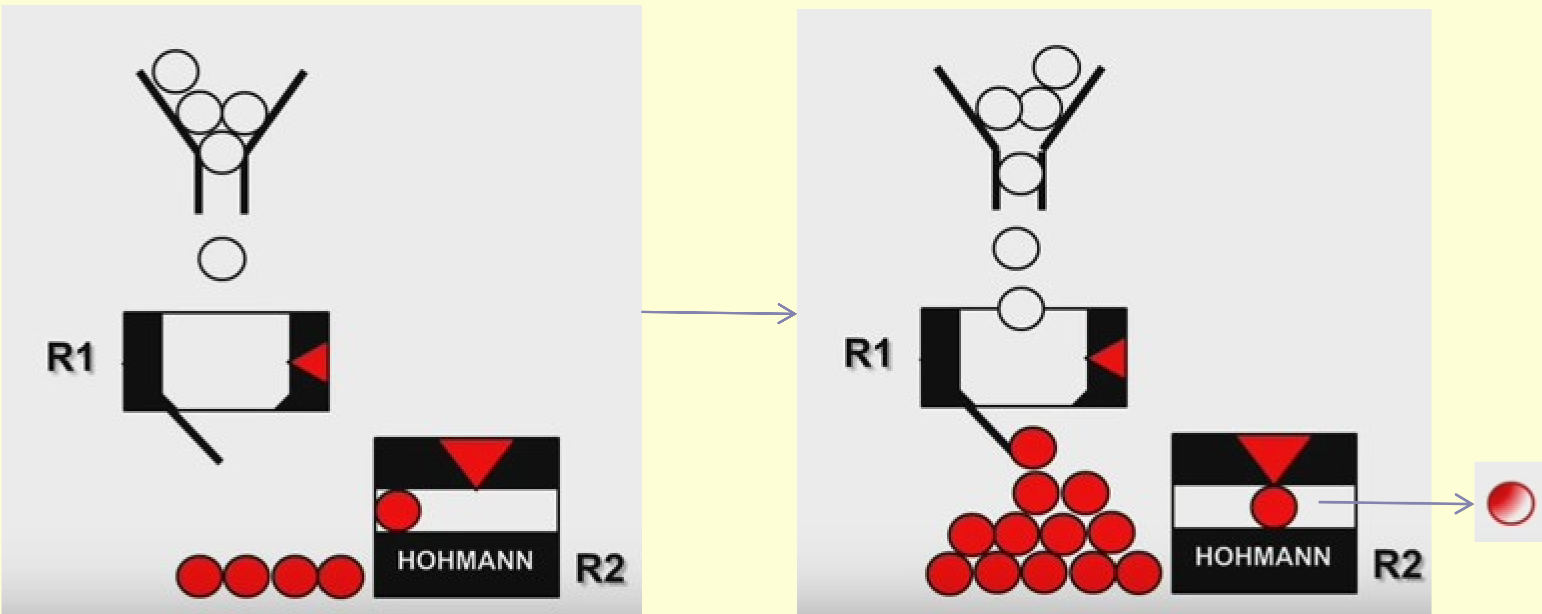


Nejdůležitější je omezení rozpracovanosti a díky tomu zabránit přetížení systému.
Jako takový to může být považován Kanban nebo CONWIP, které jsou postaveny na principu PULL.
Metoda Drum-Buffer-Rope, je mixem obou systémů a o mnoho lepší než tradiční PUSH systém.

Při řízení a kontrole toku se musí brát do úvahy to, že se pozice úzké místa může měnit.



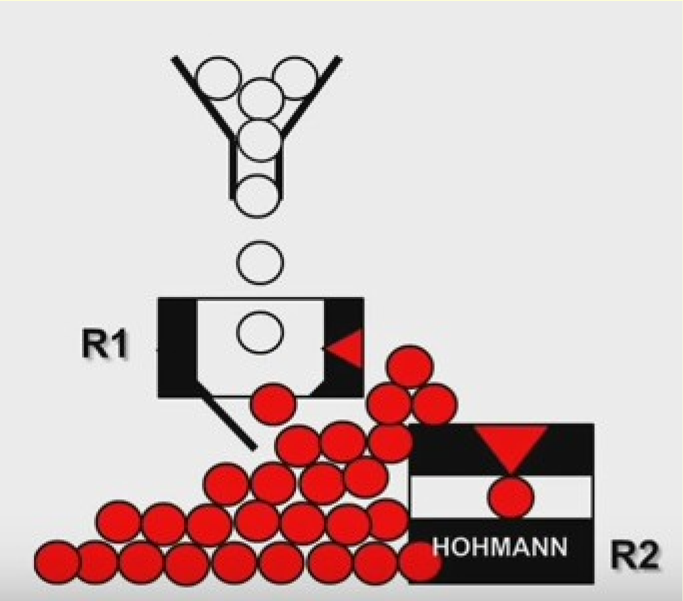
System not controlled (neregulovaný systém)

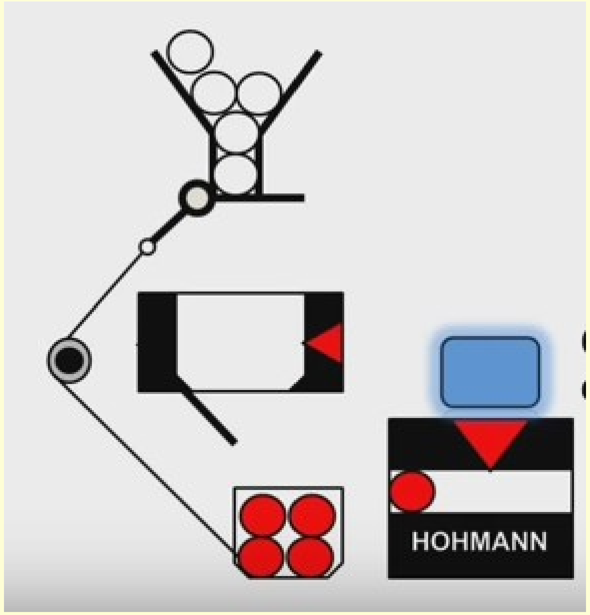


Based on pictures taken from CH.Hohman show

System not controlled and modification DBR

Systém, který není řízený a modifikace takového systému na principu DBR.

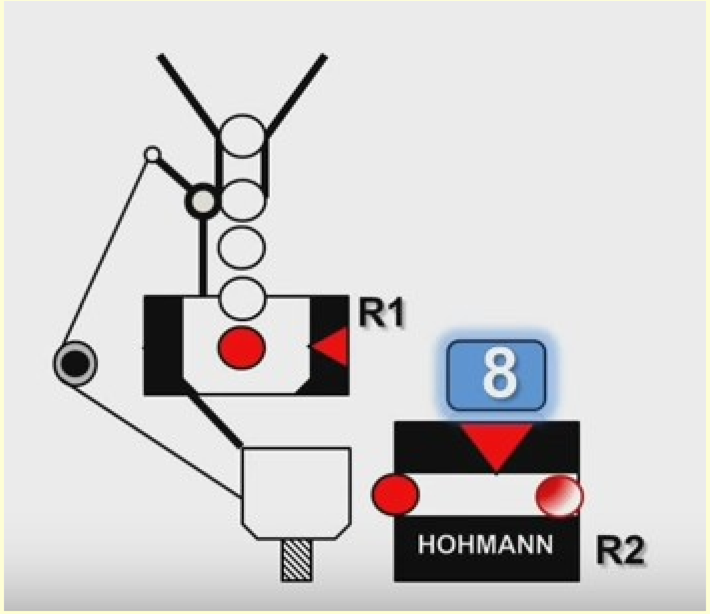


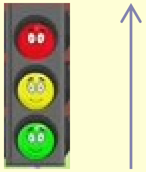


Based on pictures taken from CH.Hohman show

Rope opened raw material valve

Zpětná vazba pro kontrolu množství vstupujícího materiálu na vstupu sysému - LANO

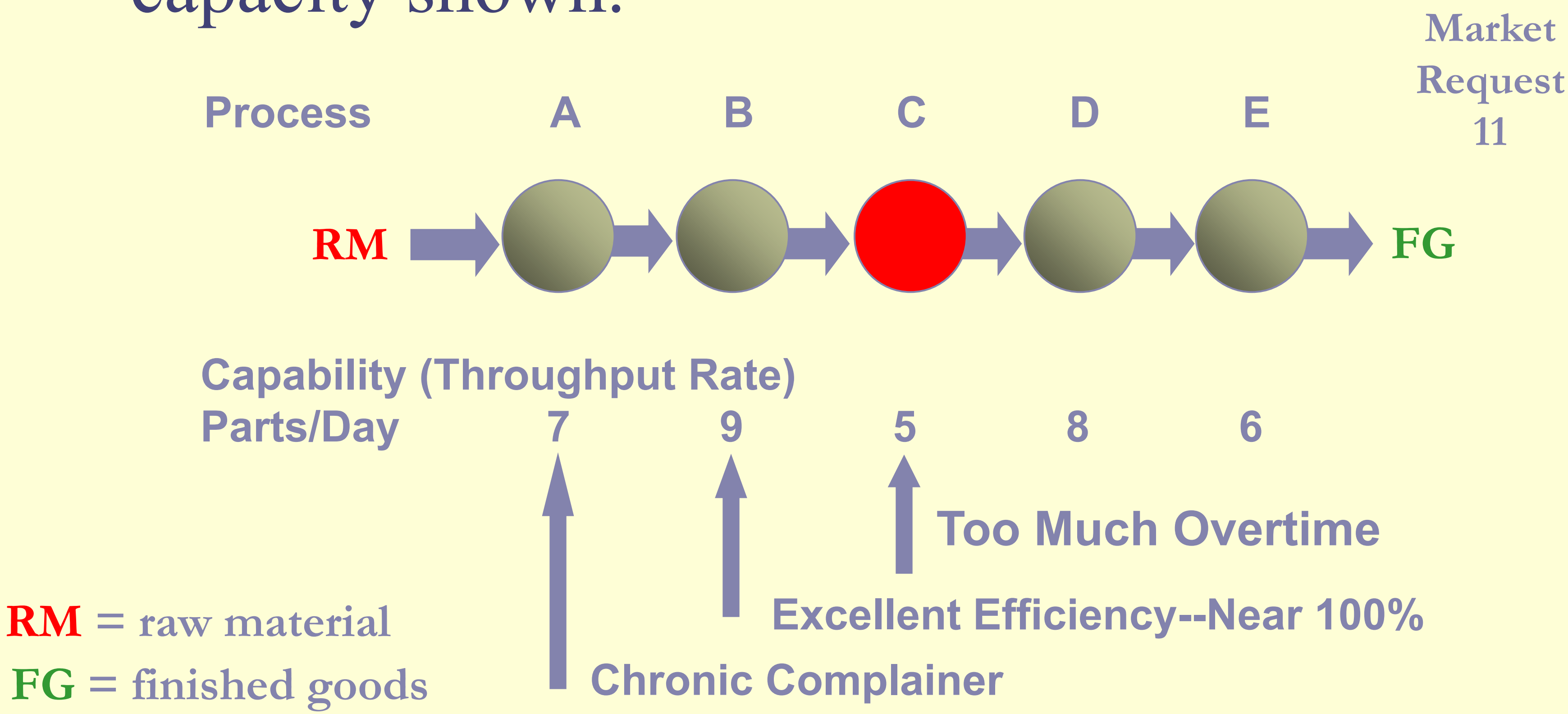




Based on pictures taken from CH.Hohman show

We Measure Operational Efficiency

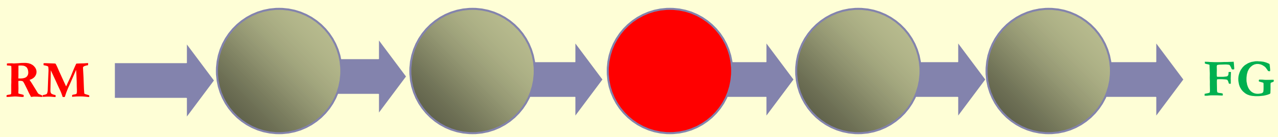
- Work flows from left to right through processes with capacity shown.



Reward Based on Efficiency

- Work flows from left to right.

Process	A	B	C	D	E



Capability(Throughput Rate)

Parts/Day	7	9	5	8	6

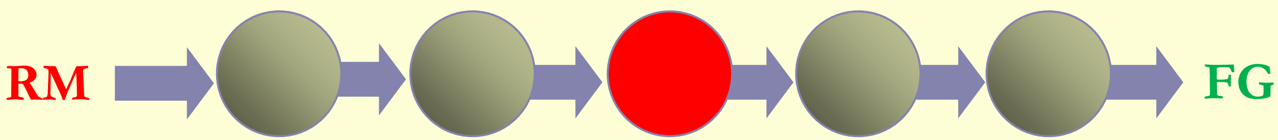
Both found ways to look busy and appear to have a capacity of 5 parts/day.

„horní tok“

„dolní tok“

In reality...

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

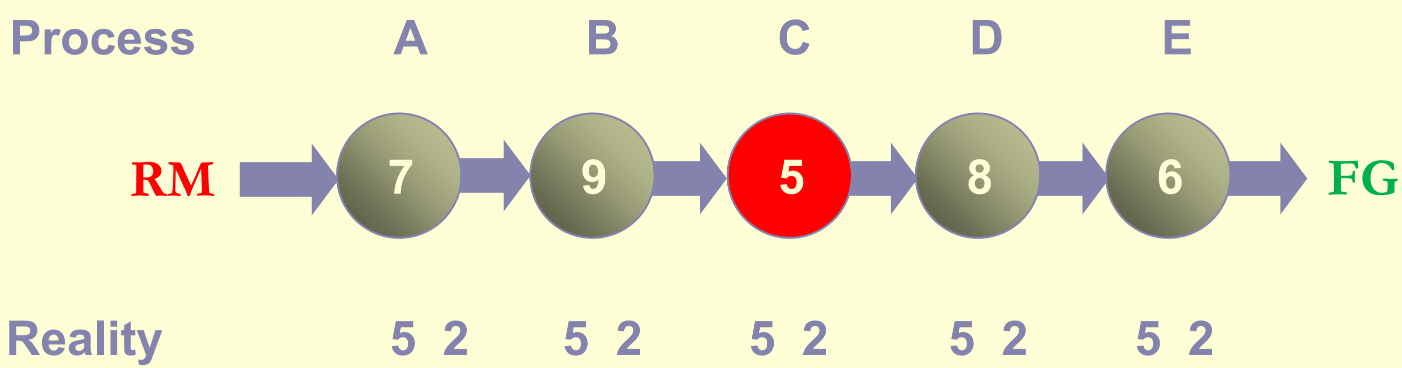


Process	A	B	C	D	E
Potential P/D	7	9	5	8	6
Reality	5	5	5	5	5

P/D=parts/day

Then Variability Sets In

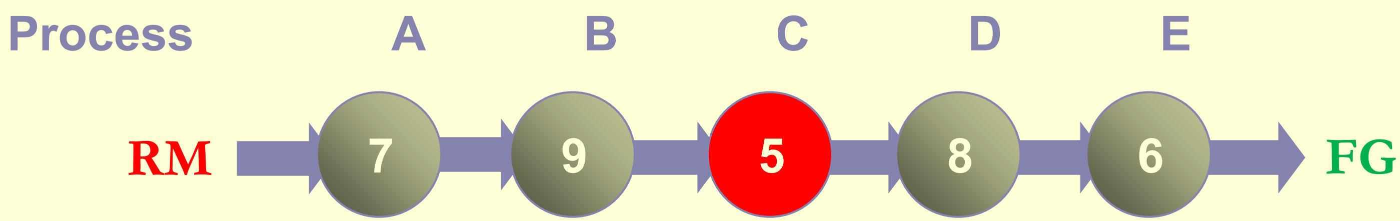
- Processing times are just AVERAGE Estimates (procesní časy jsou pouze průměrné odhady)



What's an Average? 50%

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

RM=Raw Material ->komponenty, FG=Finished Goods->výrobky



	A	B	C	D	E
Reality	5 2	5 2	5 2	5 2	5 2
Probability	0.5	0.5	0.5	0.5	0.5

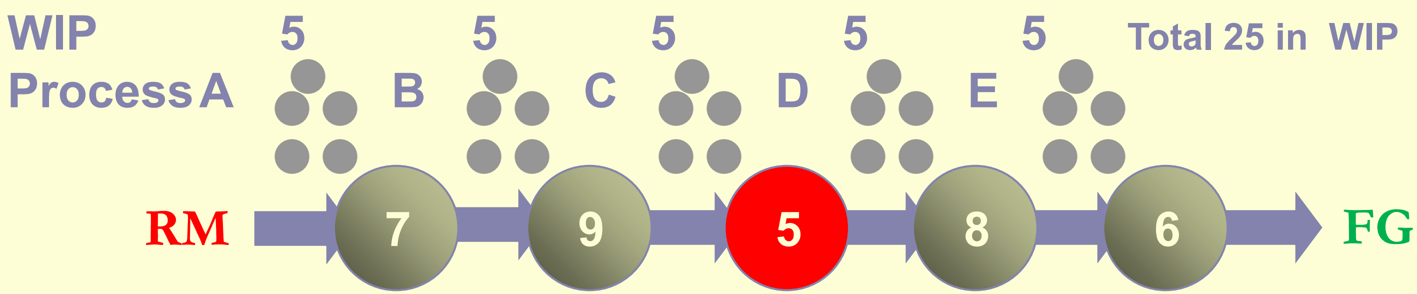
Two at a time: 0.25 0.25

Over all: 0,5*0,5*0,5*0,5*0,5=0,03125=3% Chance of 5 per day !!!

Previous Solution (not good one !): Inventory

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

  Před každý stroj dáme rezervu jednoho dne, což je reprezentováno maximálním průtokem úzkého místa za jeden den



RM=Raw Material ->komponenty, FG=Finished Goods->výrobky

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

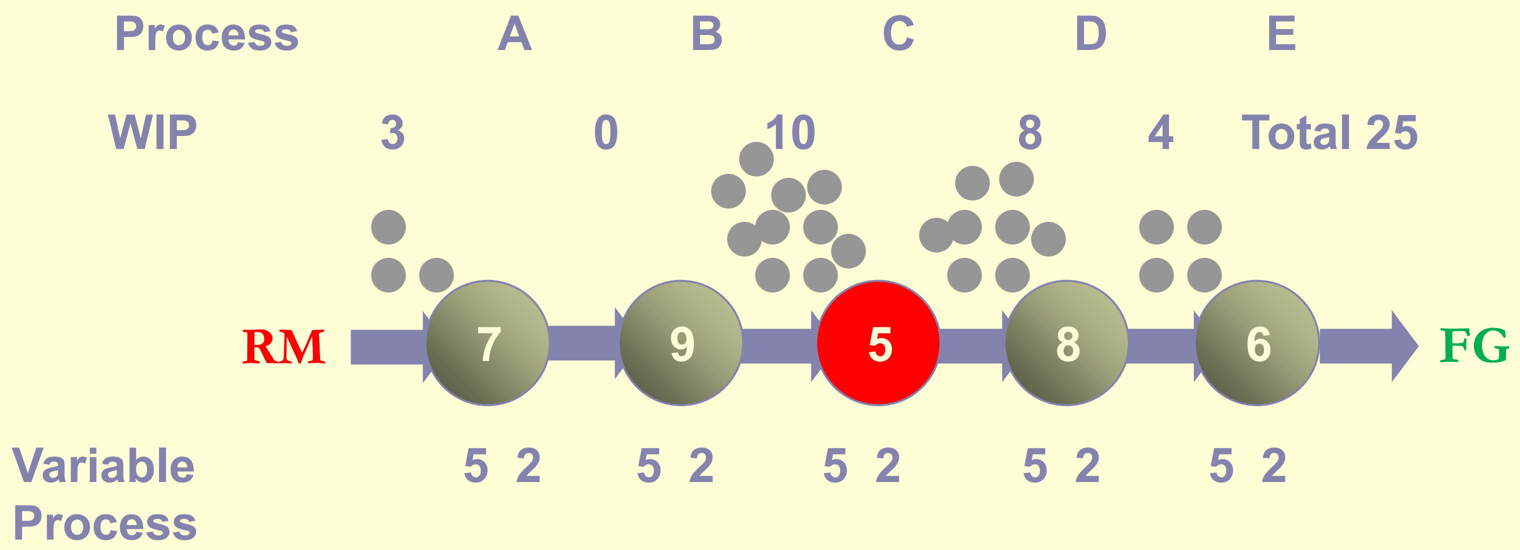
WIP= Work in Progress = NV=Nedokončená výroba

System Variability Takes Over→Chaos

Inventory (WIP) quickly shifts position. **(Velikost NV před každým strojem mění svou velikost)**

Inventory manager tries to smooth it out. **(Manažer skladu se to snaží tuto situaci vylepšit)**

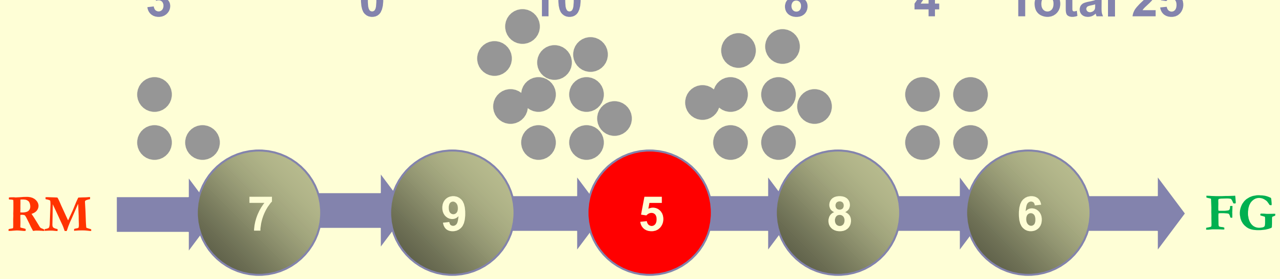
Distribution problems result. Costs go up! **(Větší problémy v distribuci, náklady stoupají)**



System Variability Takes Over--Chaos

An Average of 5 means sometimes 3 and some times 7

Process		A		B		C		D		E
WIP	3		0		10		8		4	Total 25



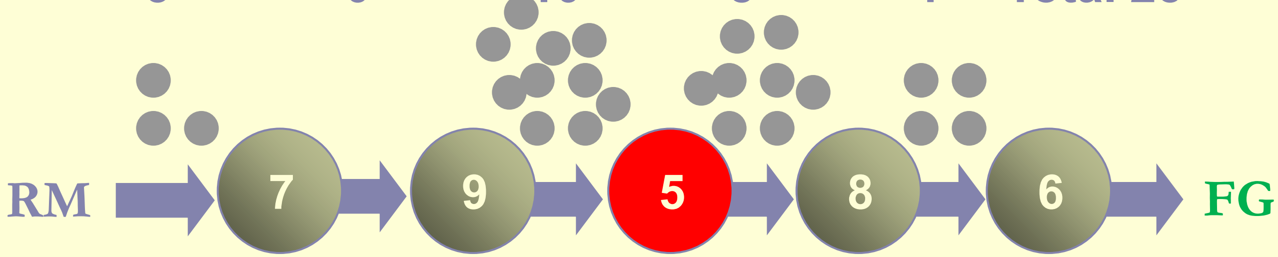
Variable	A	B	C	D	E
	5 2	5 2	5 2	5 2	5 2

Process

Shifting work-in-process creates **large queues** at some locations. This makes work wait longer to be processed.
(based on Little s law ->**WIP=TH x CT) – Littlův zákon bude probírán v kurzu RIOP i PIS1**
TH= průtok , CT = Cycle Time=CT=average time from when the job is released into station (machine or line) to when it exits

System Variability Takes Over--Chaos

Process	A	B	C	D	E	
WIP	3	0	10	8	4	Total 25

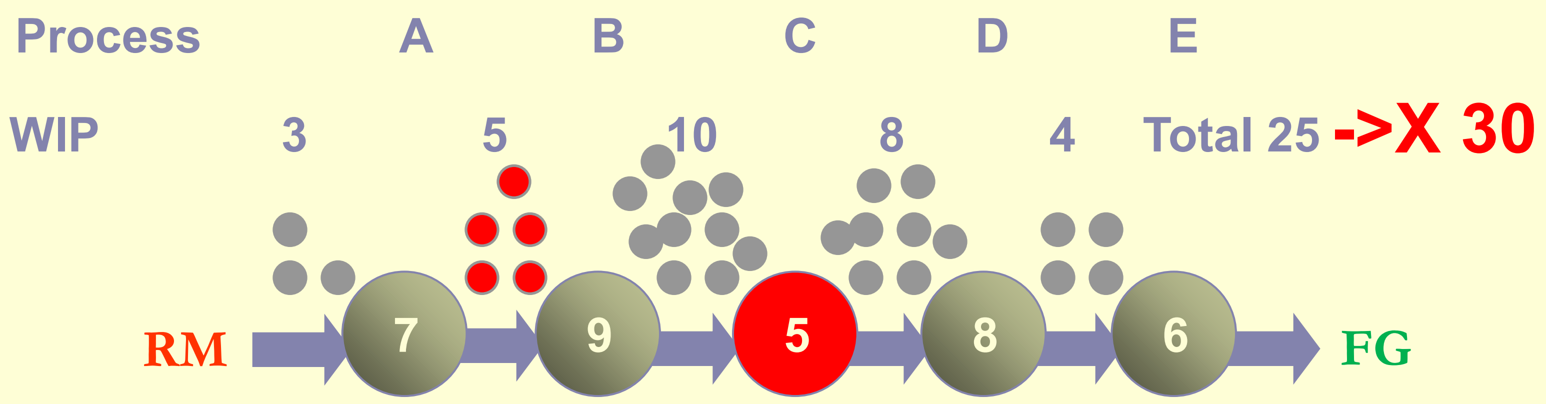


Variable Process	5 2	5 2	5 2	5 2	5 2

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 approach**)!

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.**

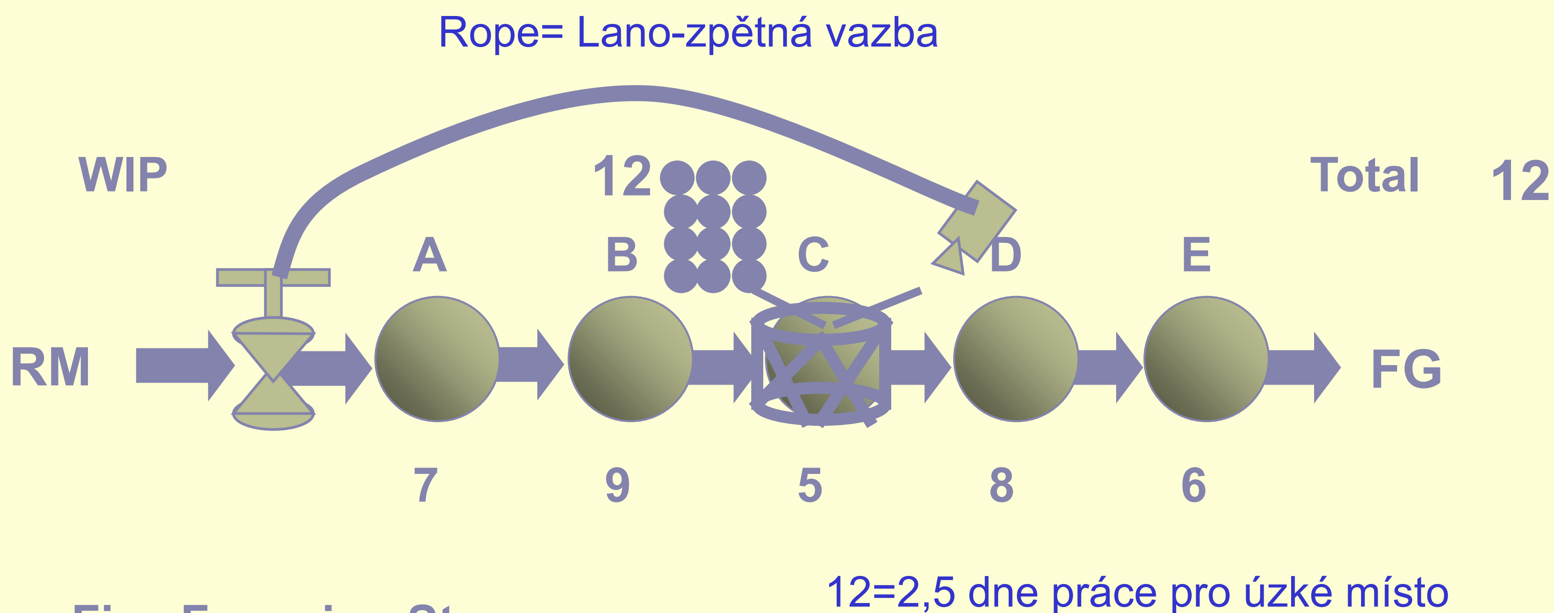
Step 2. ***Exploit*** **the system's constraint.**

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

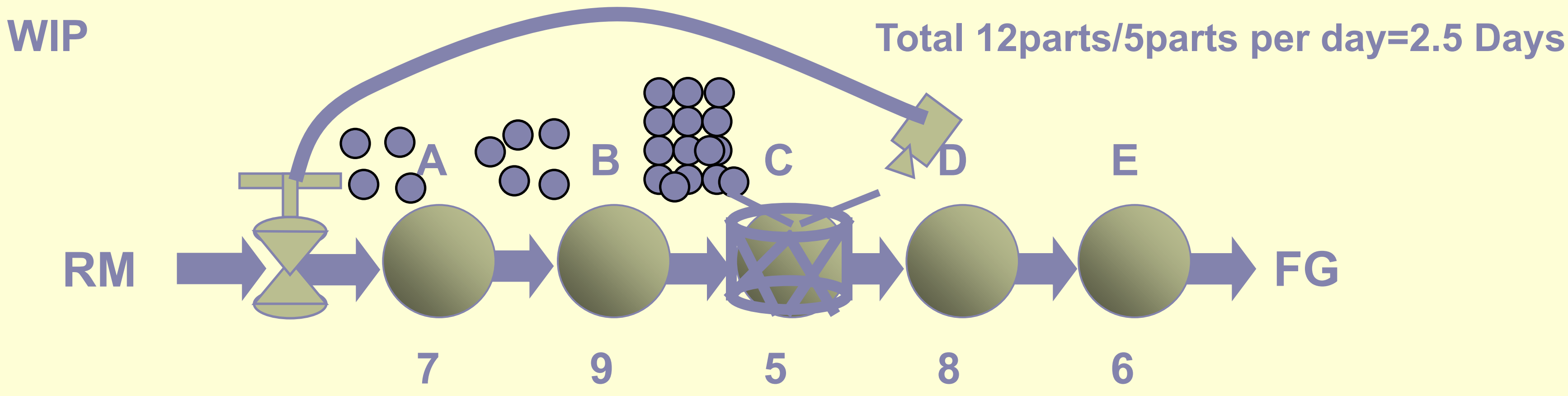
Step 2. Exploit the Constraint (Buffer the Drum) – time reserve

Step 3. Subordinate Everything Else (Rope) - feedback

Step 4. Elevate the Constraint ($?->extra costs,depreciation)

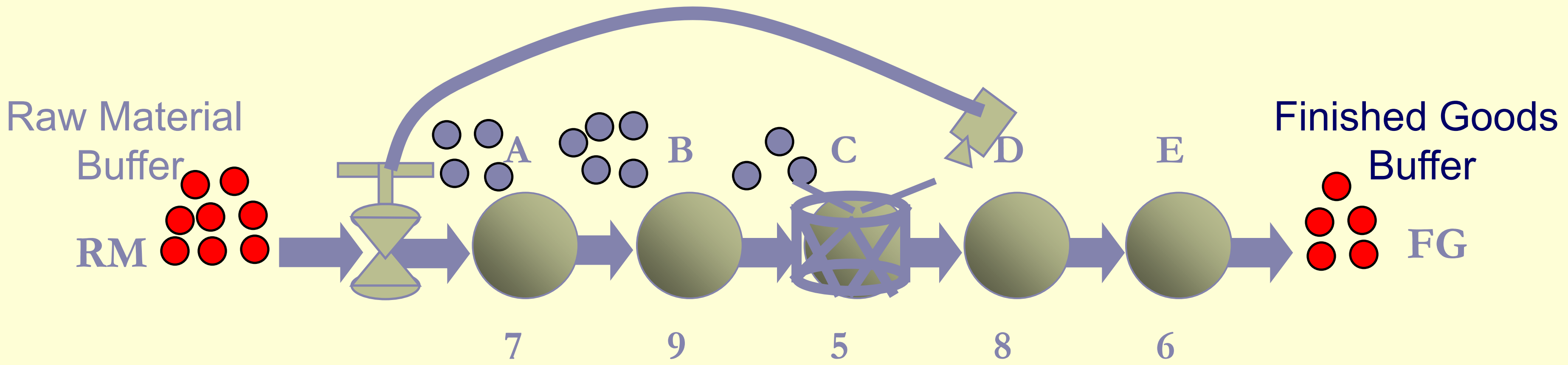
Step 5. If the Constraint Moves, Start Over

Understanding Buffers



- The "Buffer" is Time! **(Buffer=nárazník je čas!)**
- 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.**

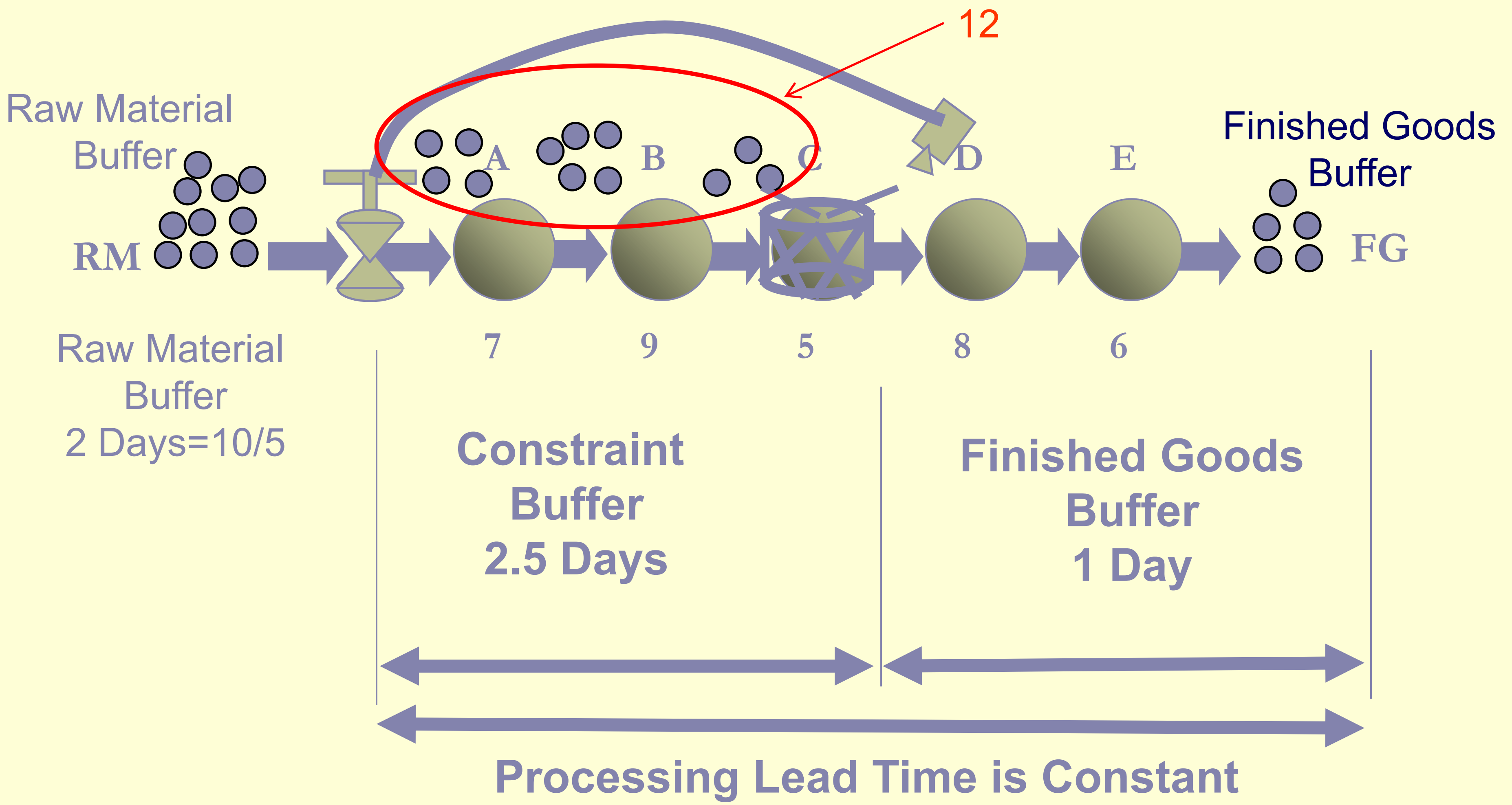
We need more than one Buffer



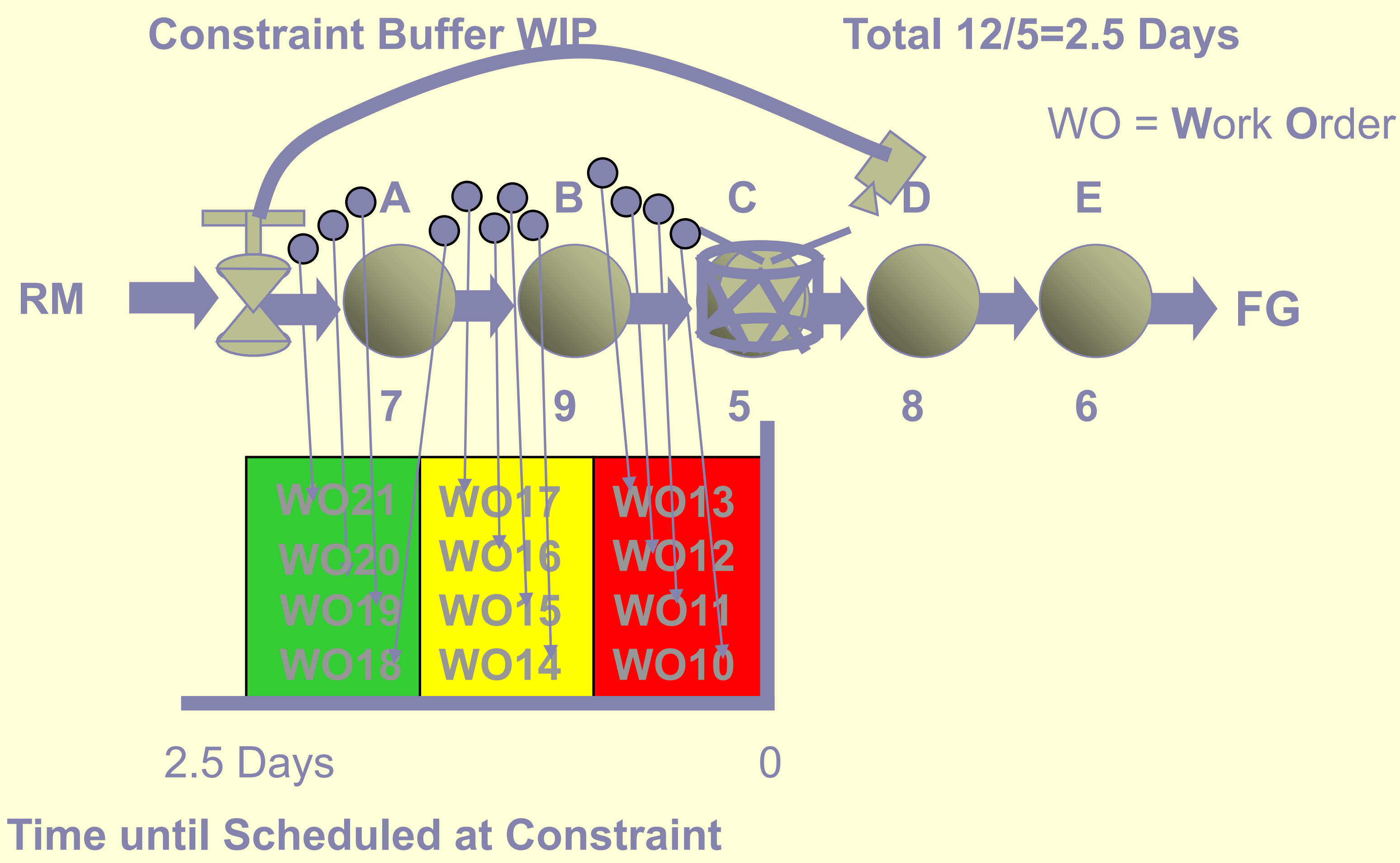
**There is variability in the Constraint.
To protect our delivery to our customer we need a finished goods buffer.**

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

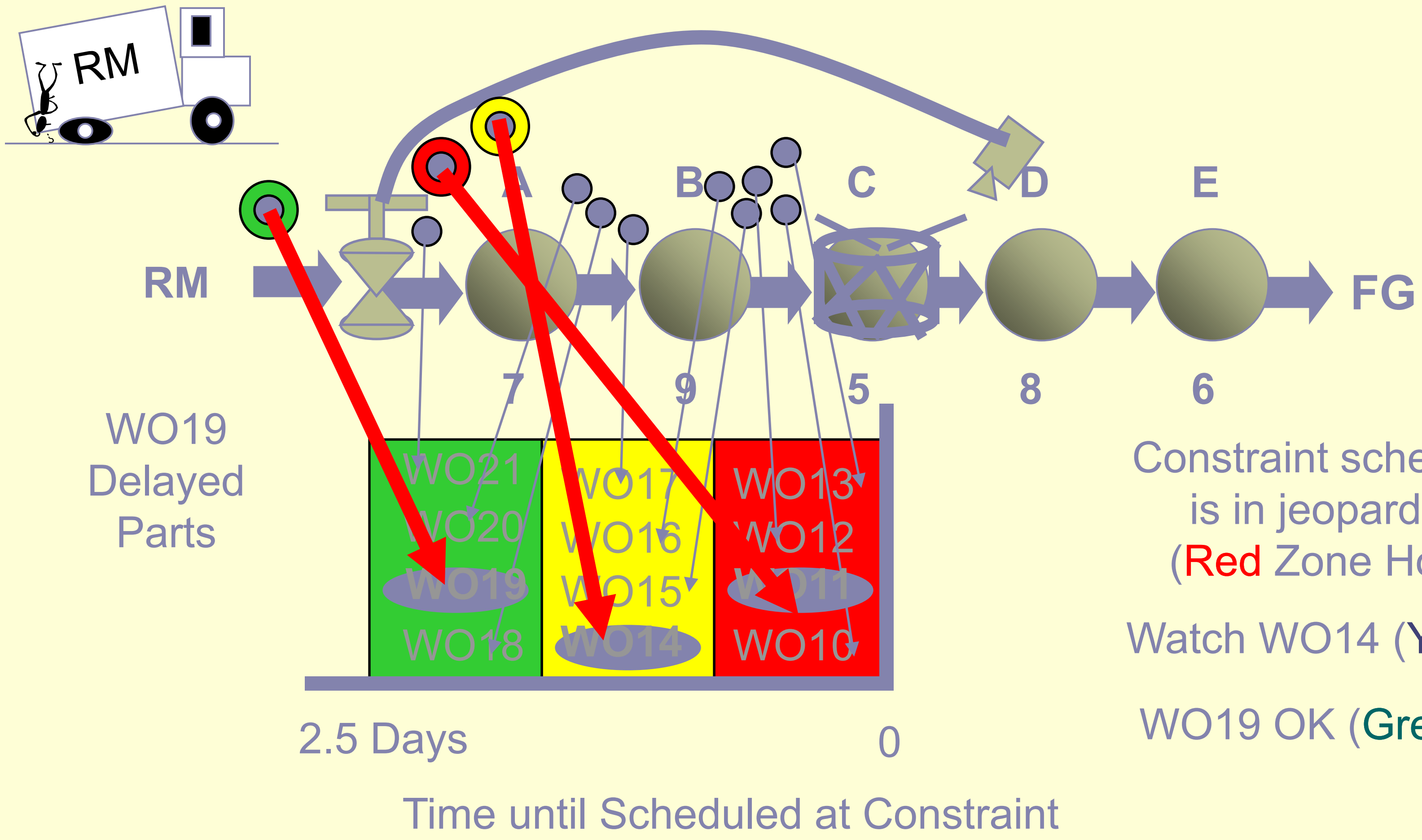
Buffer Time is Constant-Predictable



Buffer Management



Problem Identification



Constraint schedule is in jeopardy! (Red Zone Hole)

Watch WO14 (Yellow)

WO19 OK (Green)

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

See interesting video

https://www.youtube.com/watch?v=8yehd2ZsKH0