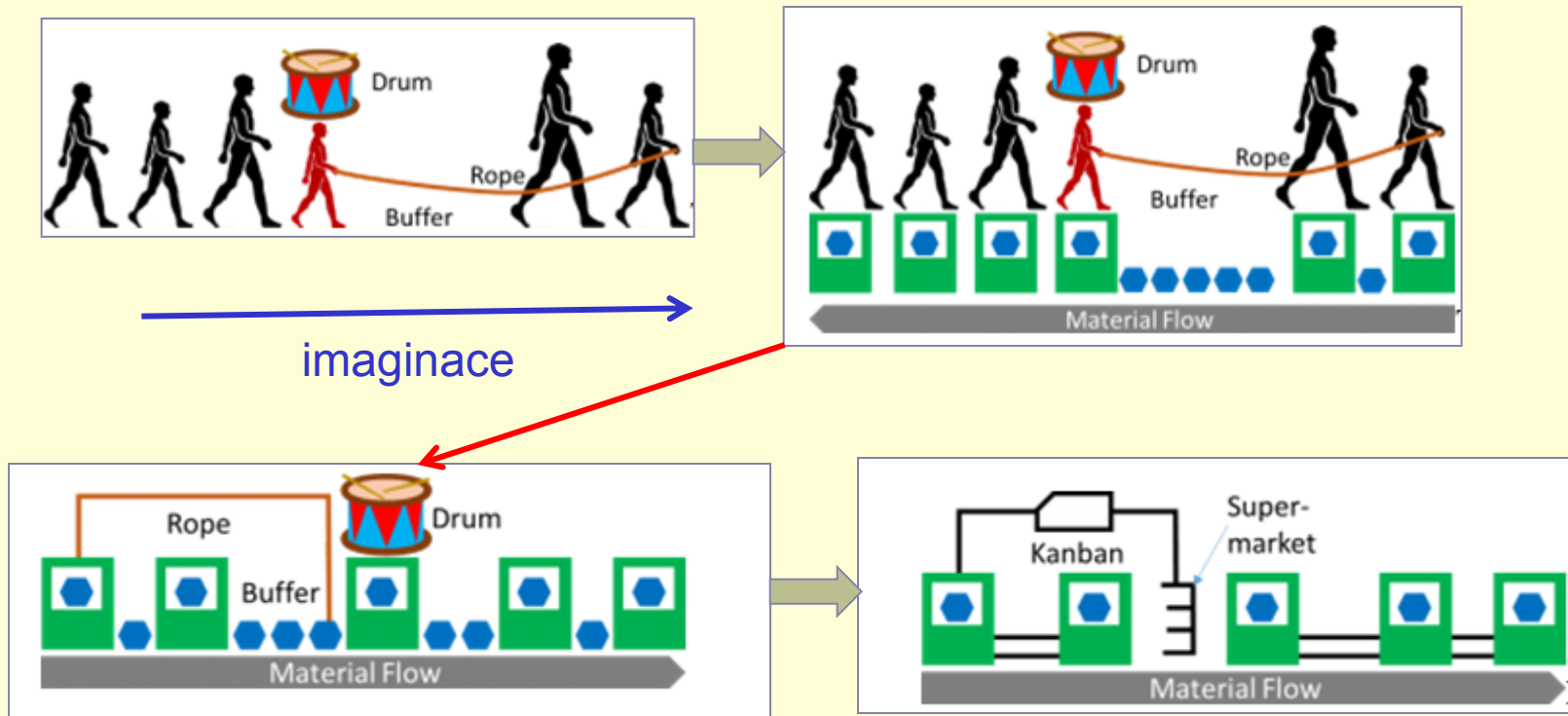


# Drum –Buffer-Rope

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

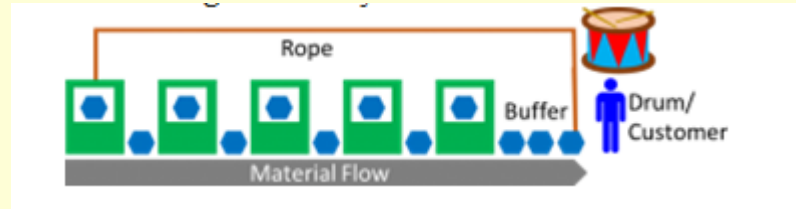
# Principy



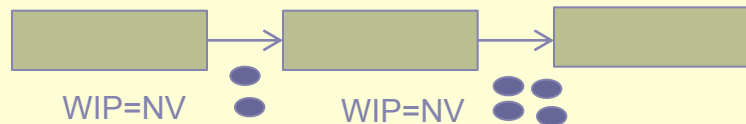
Resource : <http://www.allaboutlean.com/drum-buffer-rope/>

## 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**.



Push –MRP-II

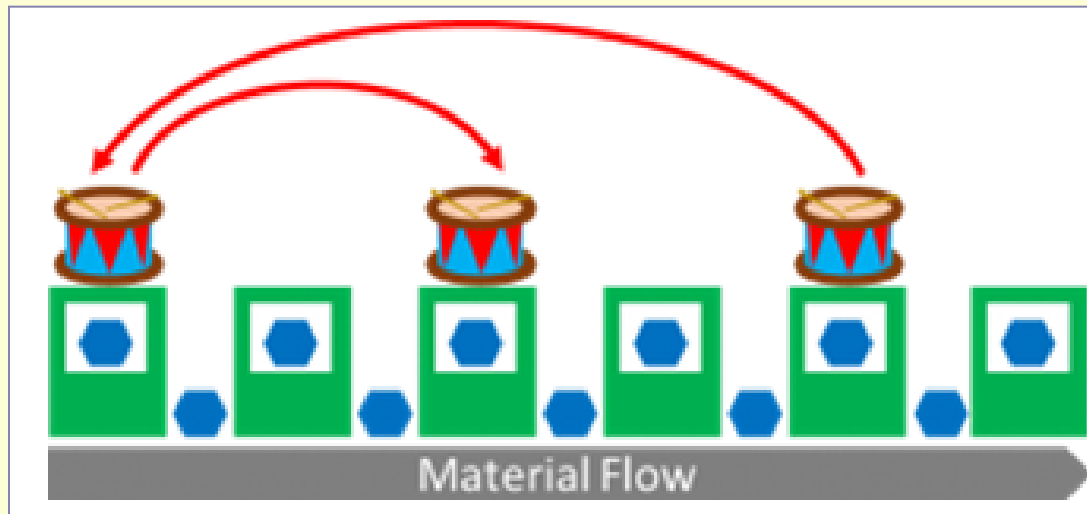


Pull –JIT- kanban= ←

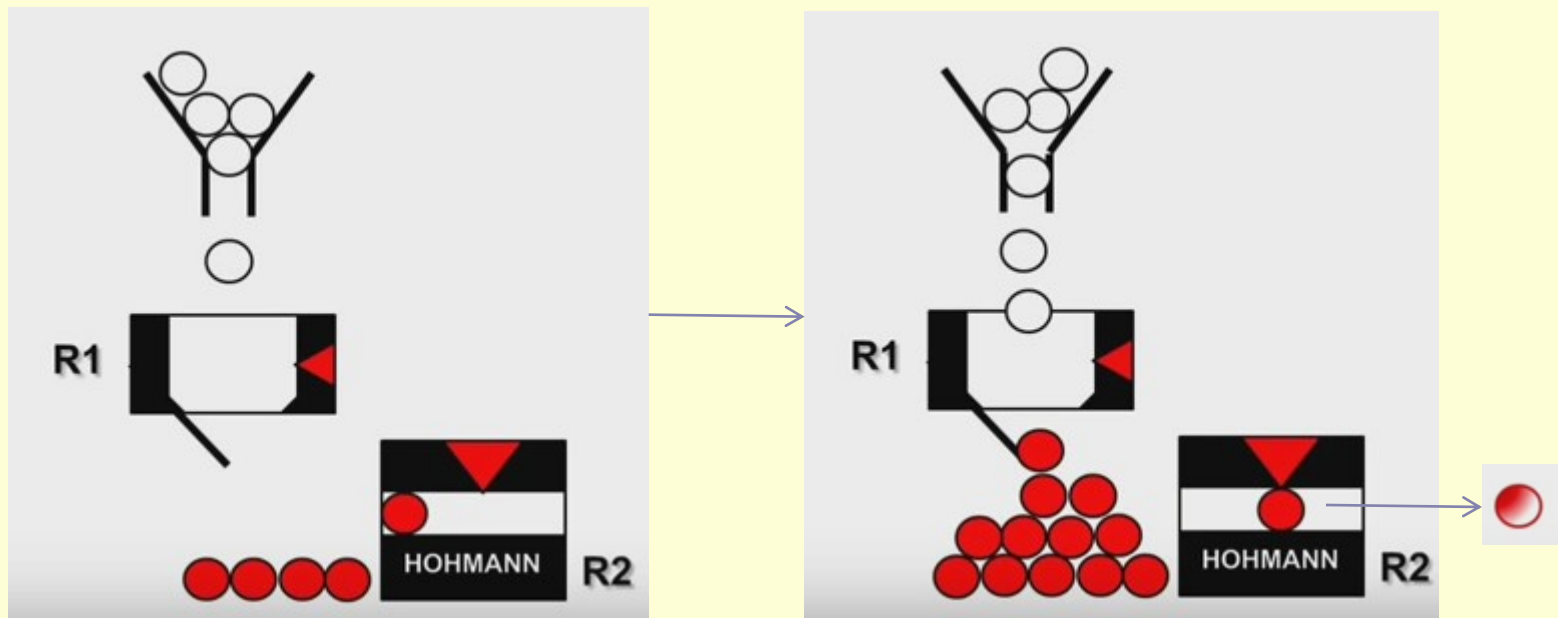
WIP=Nv->0

# No Consideration for Shifting Bottlenecks

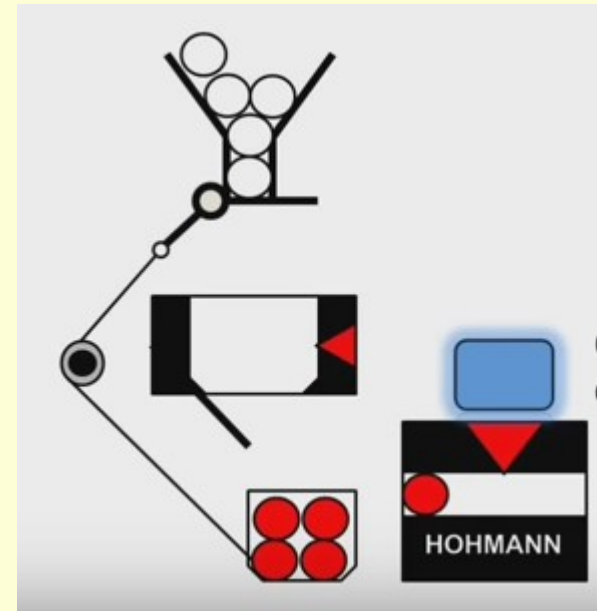
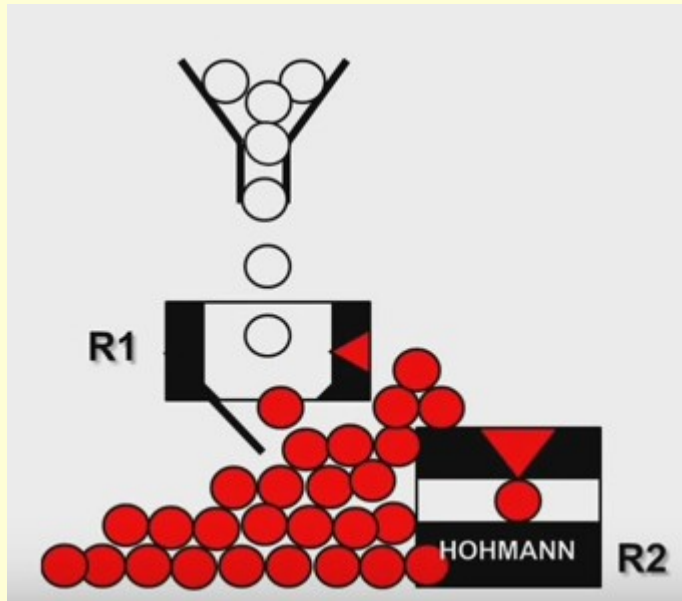
Nevýhoda DBR->nebereg do úvahy posuny úzkého místa



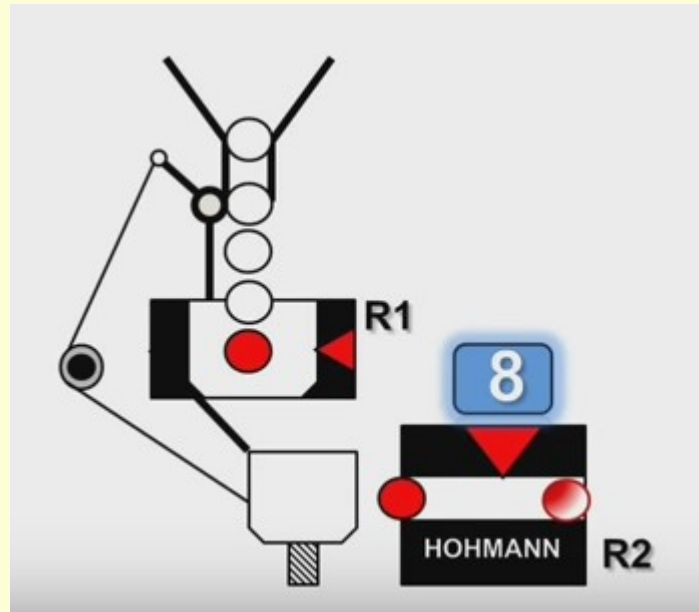
# System not controlled (Neregulovaný systém)



# System not controlled and modification DBR

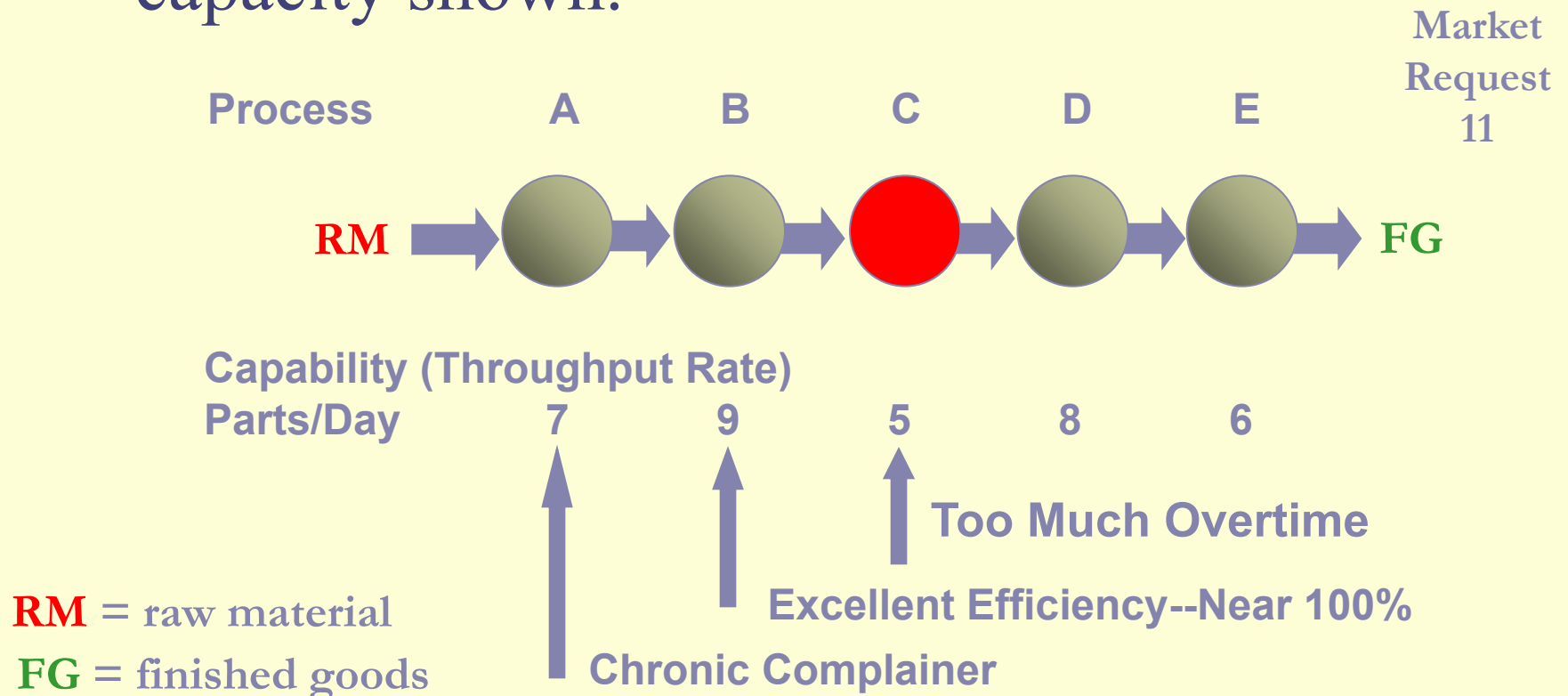


# Rope opened raw material valve



# We Measure Operational Efficiency

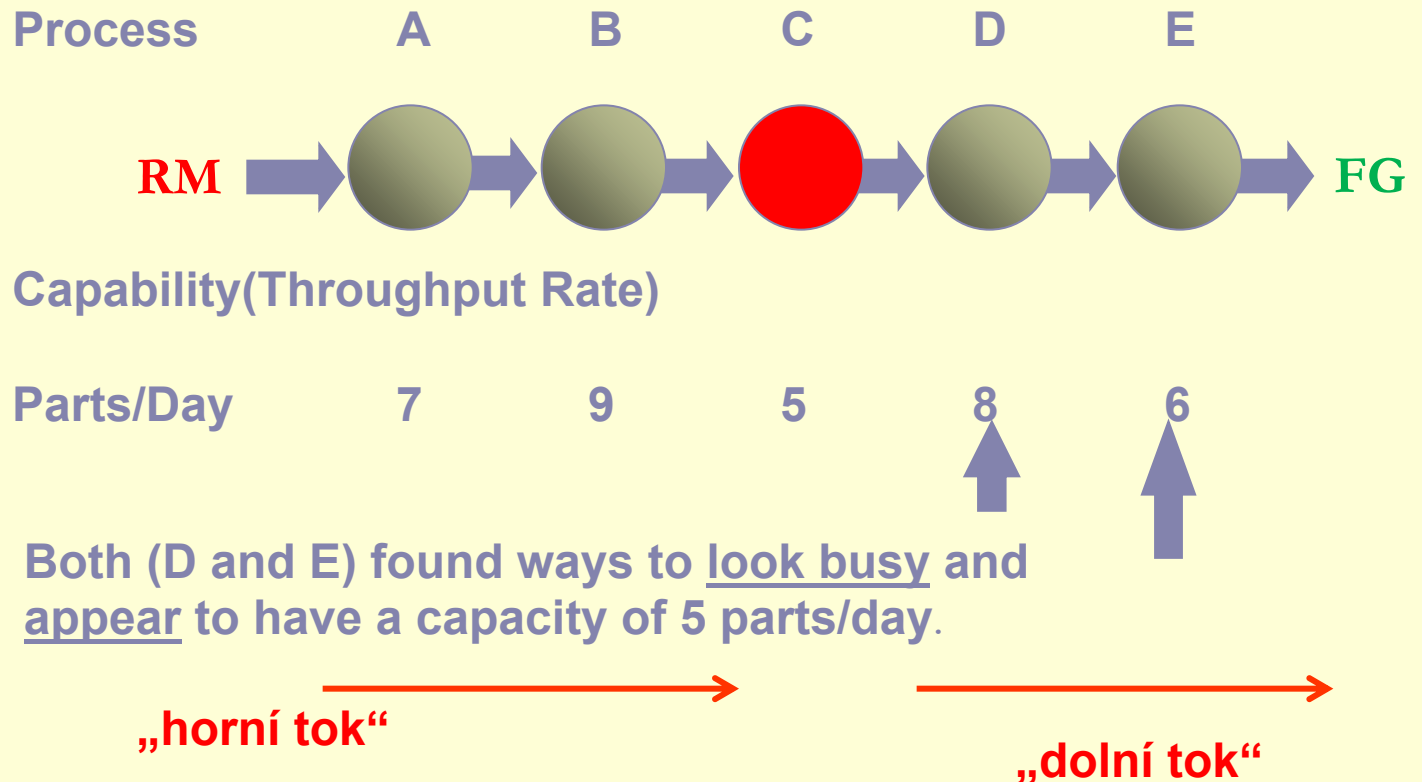
- Work flows from left to right through processes with capacity shown.





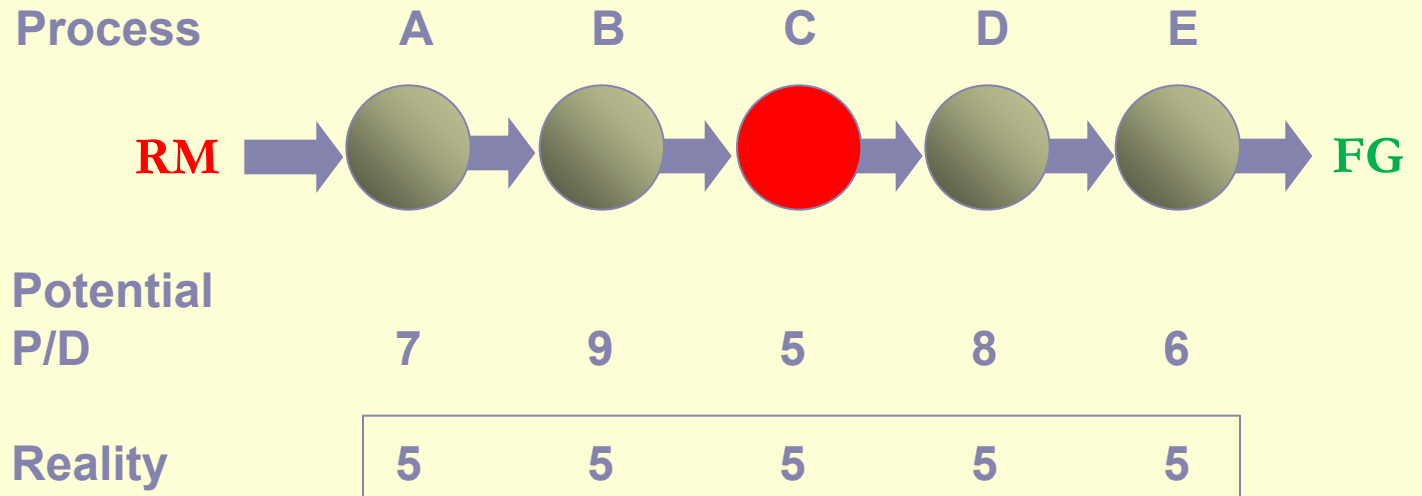
# Reward Based on Efficiency

- Work flows from left to right.



# In reality...

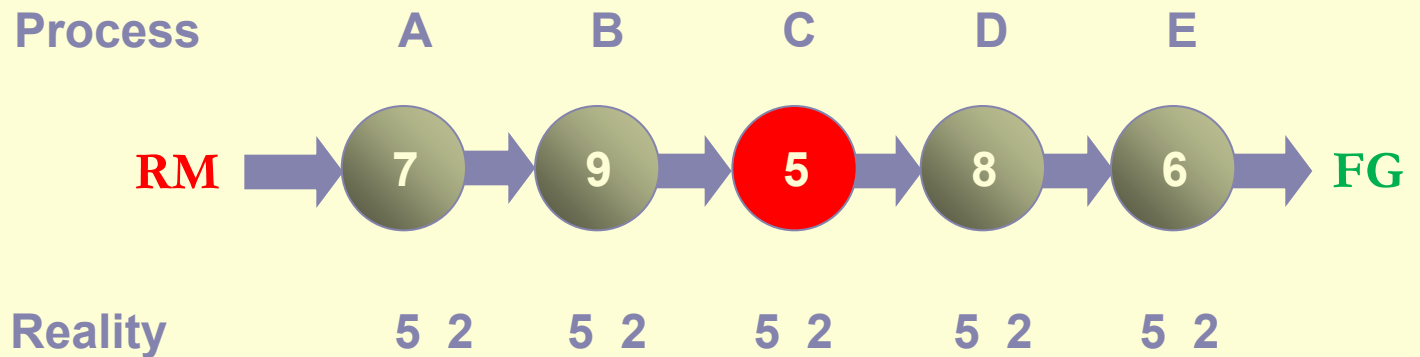
- Processes A and B won't produce more than Process C for long.



P/D=parts/day

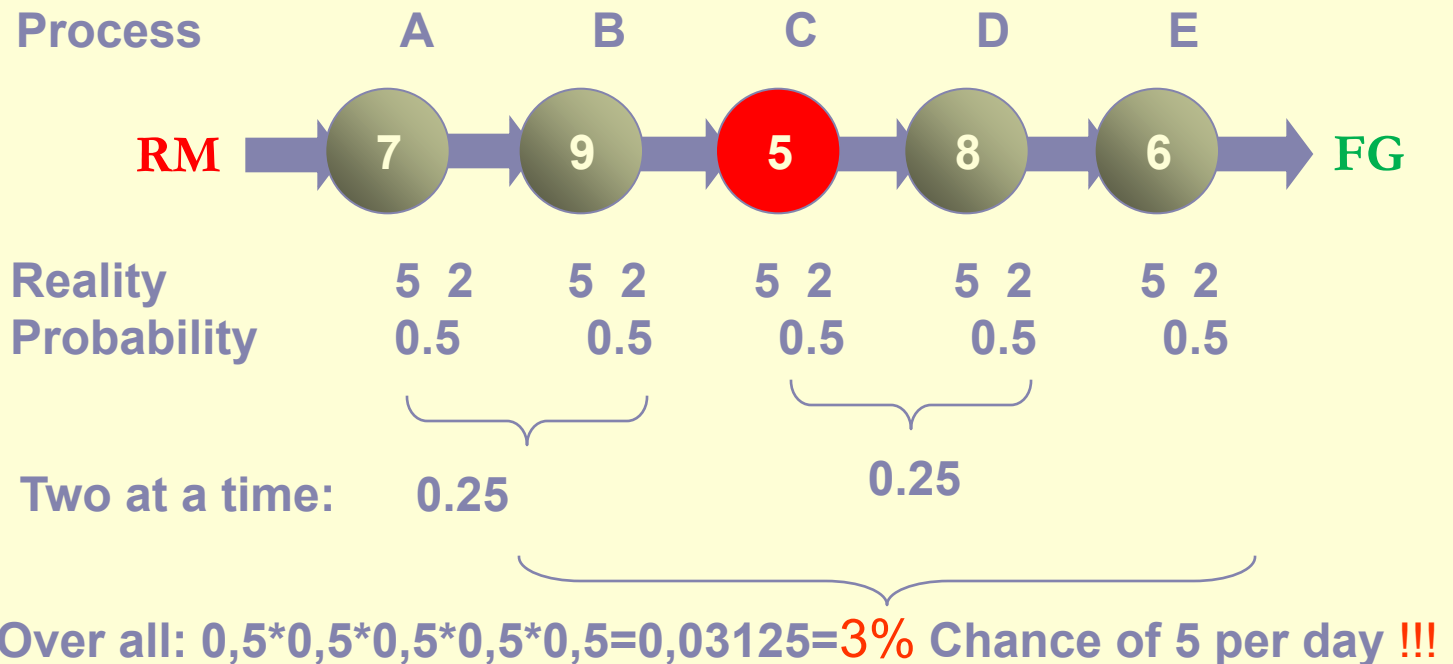
# Then Variability Sets In

- Processing times are just **AVERAGE** Estimates



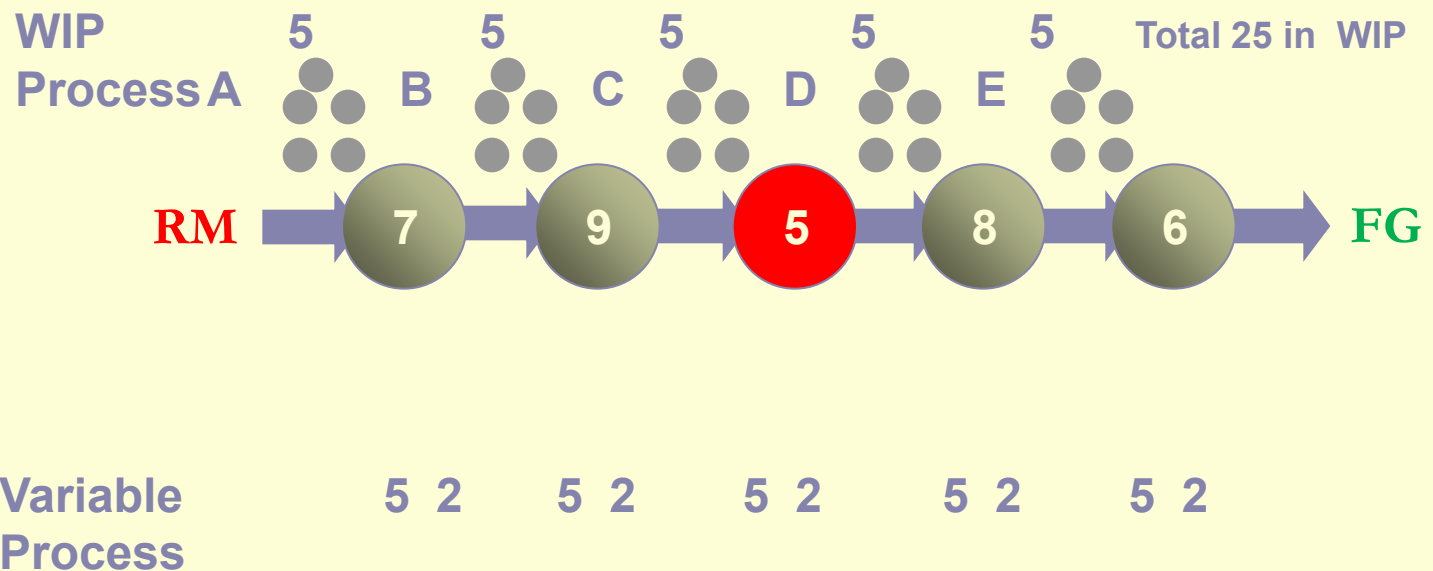
# What's an Average? 50%

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



# Previous Solution (not good one!): Inventory

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



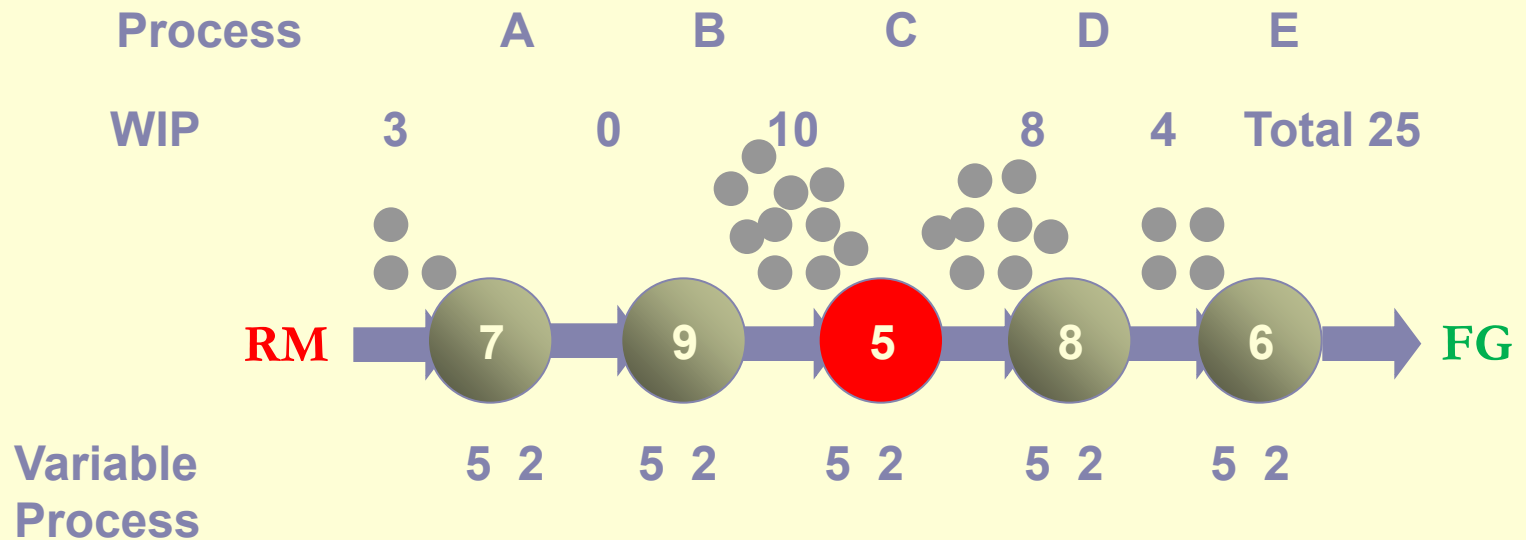
WIP= Work in Progress = NV=Nedokončená výroba

# System Variability Takes Over → Chaos

Inventory (WIP) quickly shifts position.

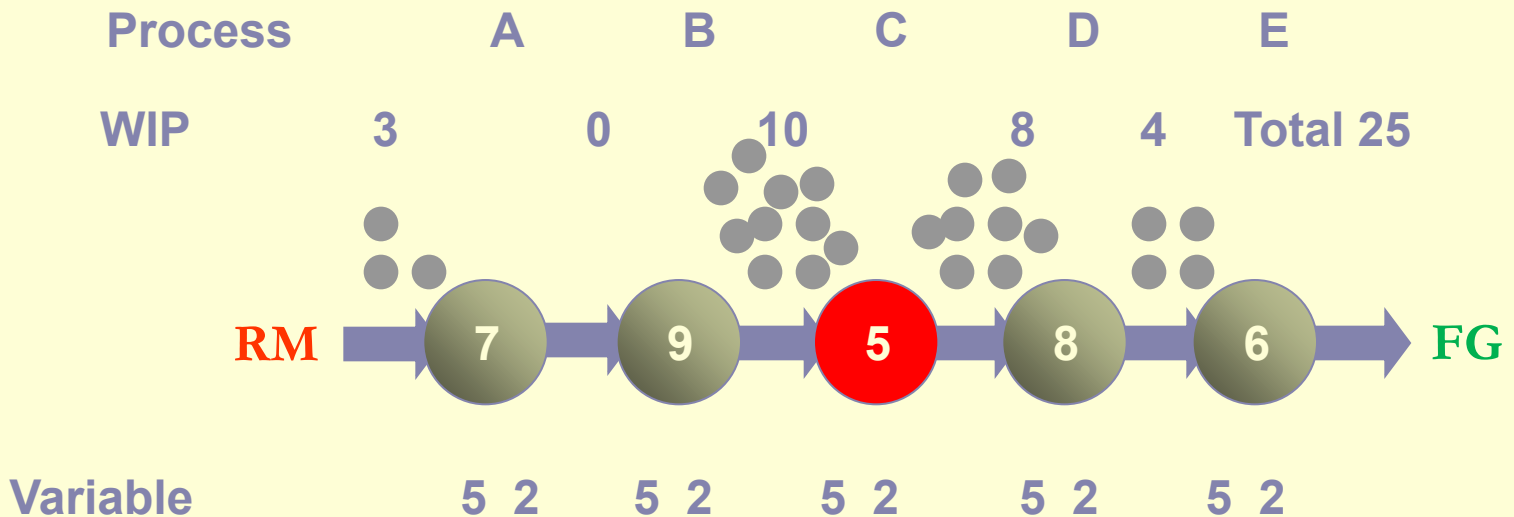
Inventory manager tries to smooth it out.

Distribution problems result. Costs go up !!!



# System Variability Takes Over--Chaos

An Average of 5 means sometimes 3 and some times 7



## Process

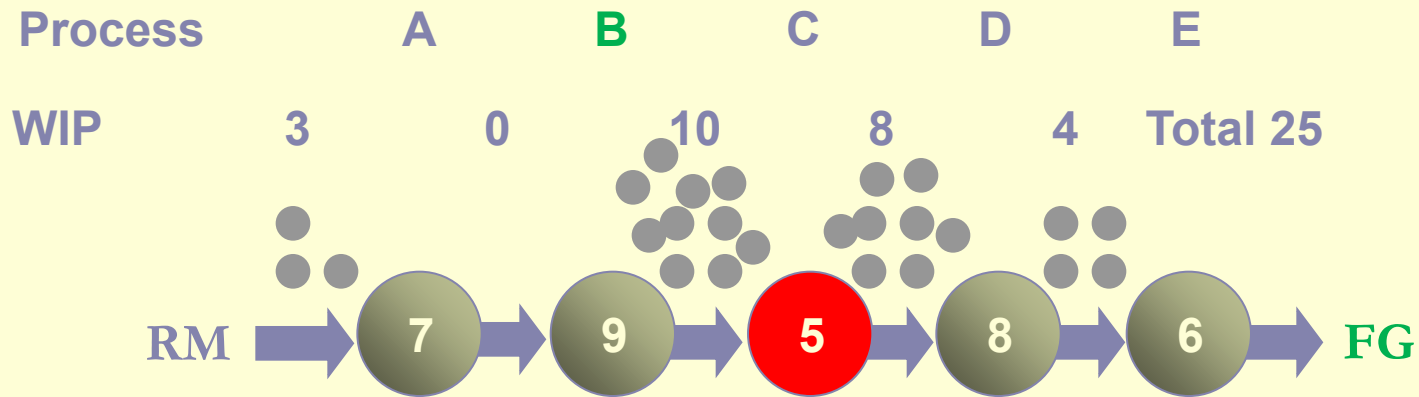
Shifting work-in-process creates **large queues** at some locations. This makes work wait longer to be processed.

(based on Little's law  $\rightarrow WIP = TH \times CT$ )

**TH** = průtok

**CT** = Cycle Time = average time from when the job is released into station (machine or line) to when it exits

# System Variability Takes Over--Chaos



Variable  
Process

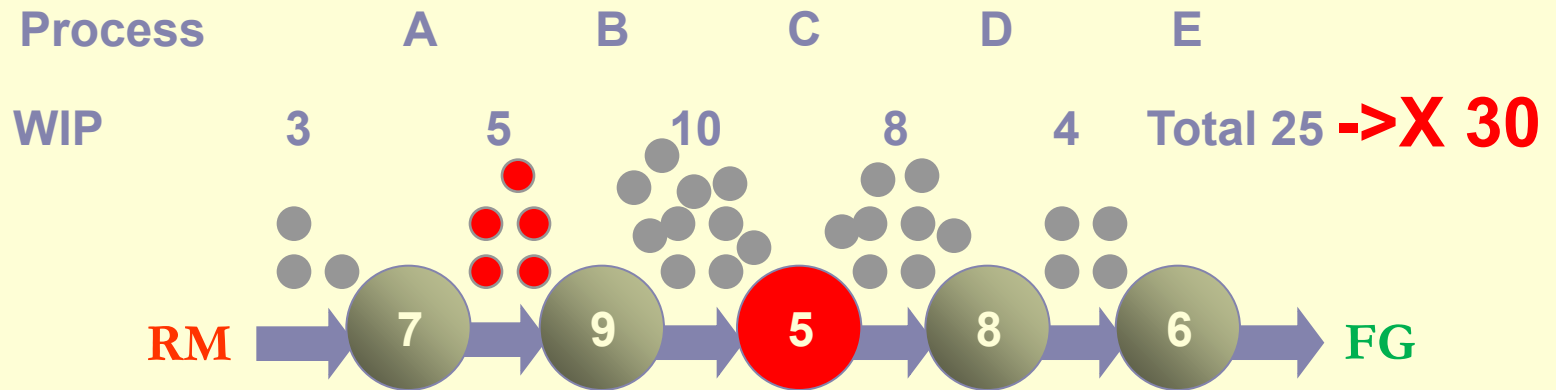
5 2    5 2    5 2    5 2    5 2

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!**)  
 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.**

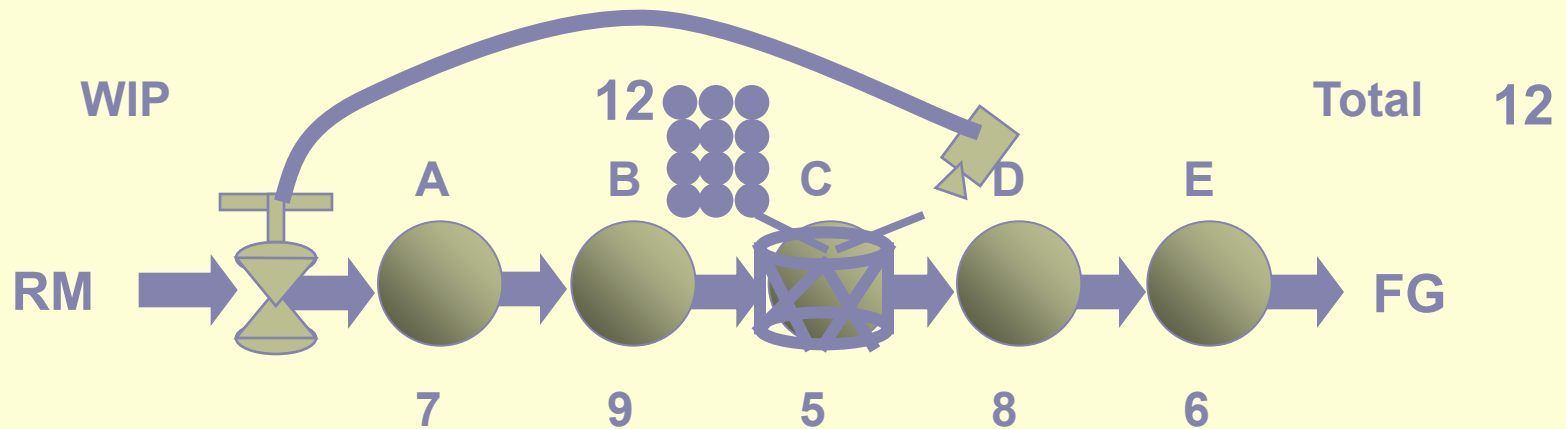
**Step 3. *Subordinate* everything else to the above decision.**

**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 -strom současné reality**

Step 2. Exploit the Constraint (Buffer the Drum) – **časová rezerva**

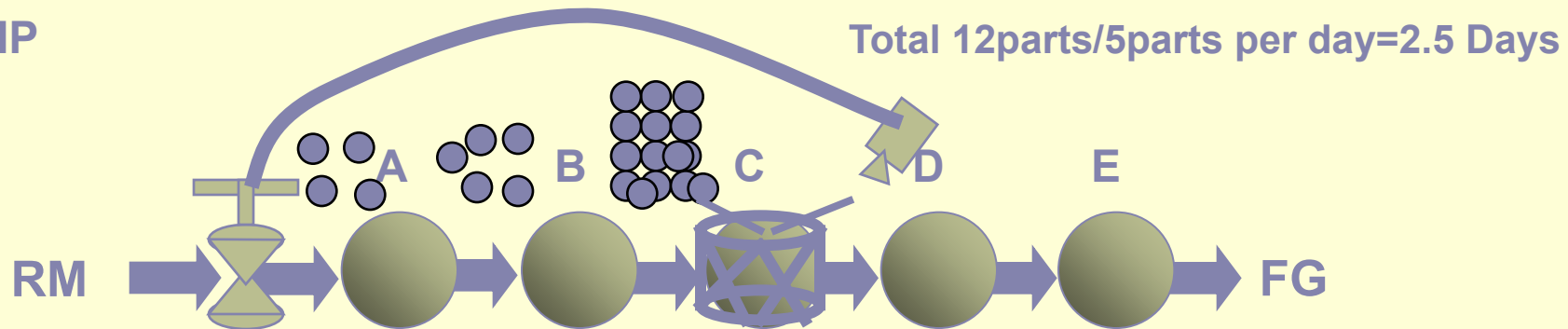
Step 3. Subordinate Everything Else (Rope) – **zpětná vazba**

Step 4. Elevate the Constraint (\$?->**vícenáklady**)

Step 5. If the Constraint Moves, Start Over

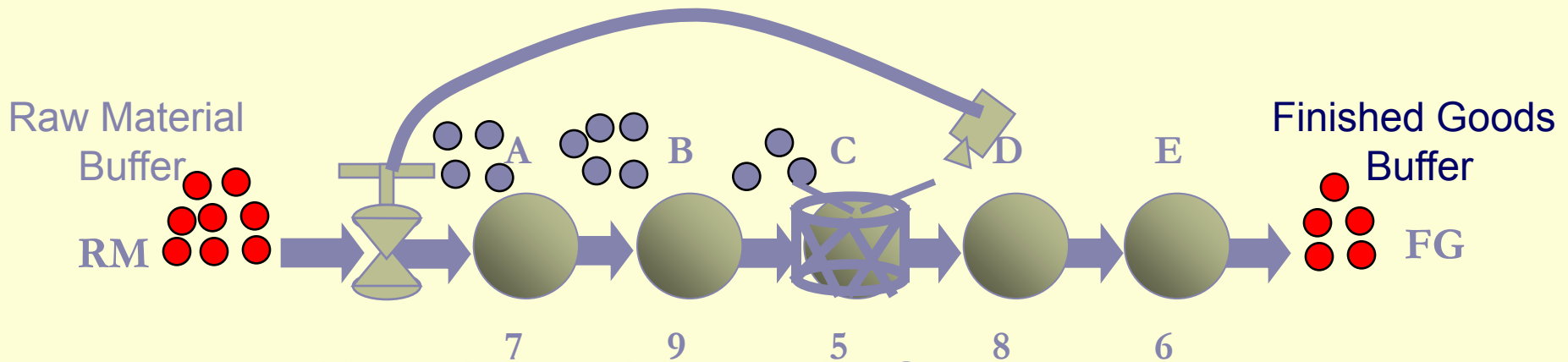
# Understanding Buffers

WIP



- The “Buffer” is Time! **Zásobník reprezentuje čas**
- In general, the buffer is the total time from work release until the work arrives at the constraint. **Jde o čas mezi vstupem komponent do systému až po dobu příchodu k omezení**
- Contents of the buffer alters (see below) – **obsah zásobníku se v čase mění**
- 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

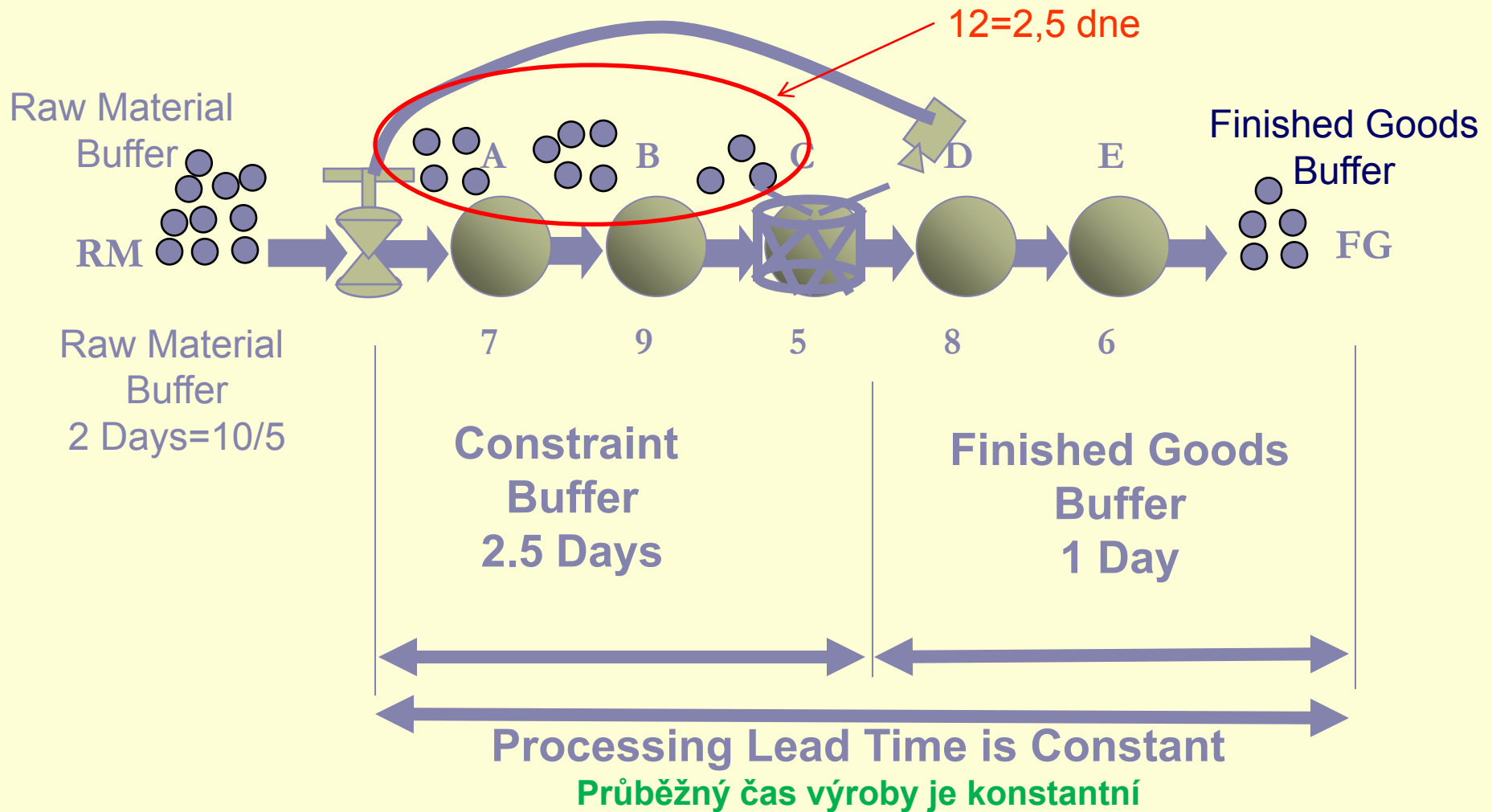


There is variability in the Constraint.

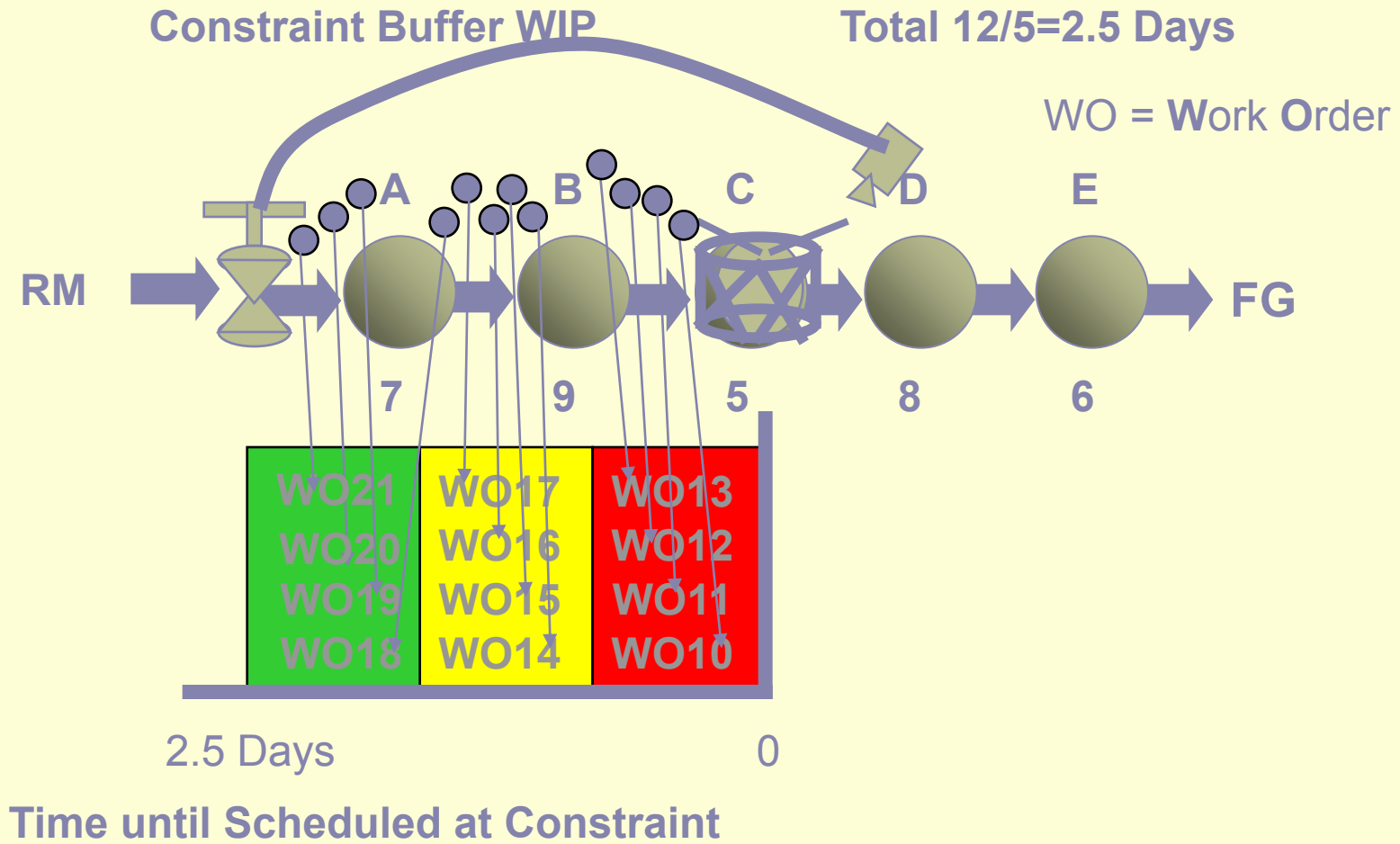
To protect our delivery to our customer we need a finished goods buffer. **Ochrana zákazníků, aby vždy dostali včas požadované výrobky**

- There is variability in our suppliers. We need to protect ourselves from unreliable delivery. **Dodávky v čase kolísají, takže se musíme před tímto nežádoucím efektem chránit**

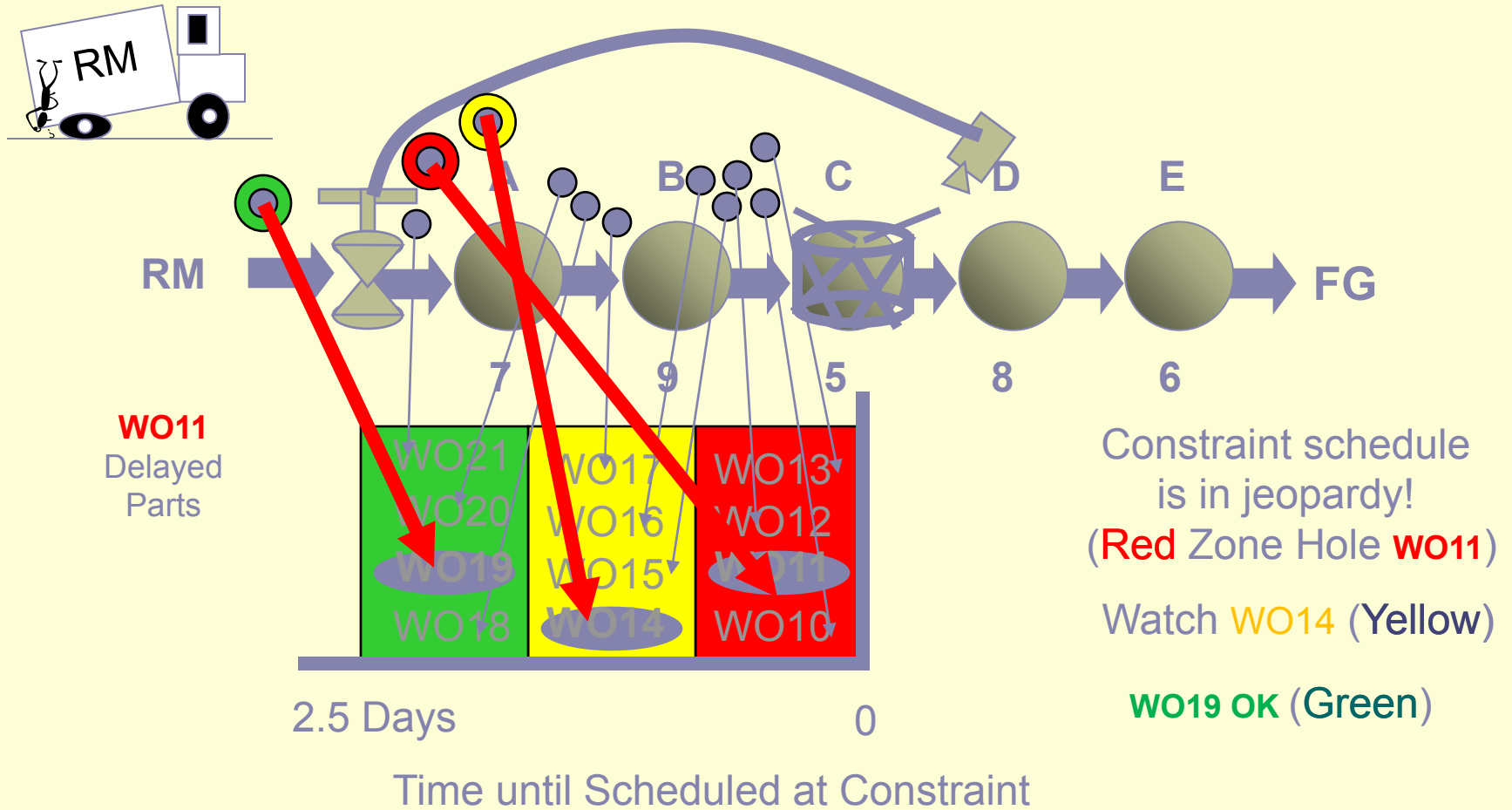
# Buffer Time is Constant-Predictable



# Buffer Management



# 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

**See interesting video**

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

