

**“Never Say I know” and “Never Say I Don’t Know”**

You always know something but never everything

2018 TOCICO Webinar

## Basic TOC

# Time buffers, Stock buffers and buffer Management

## The key insights and their universal use

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# Who needs buffers?

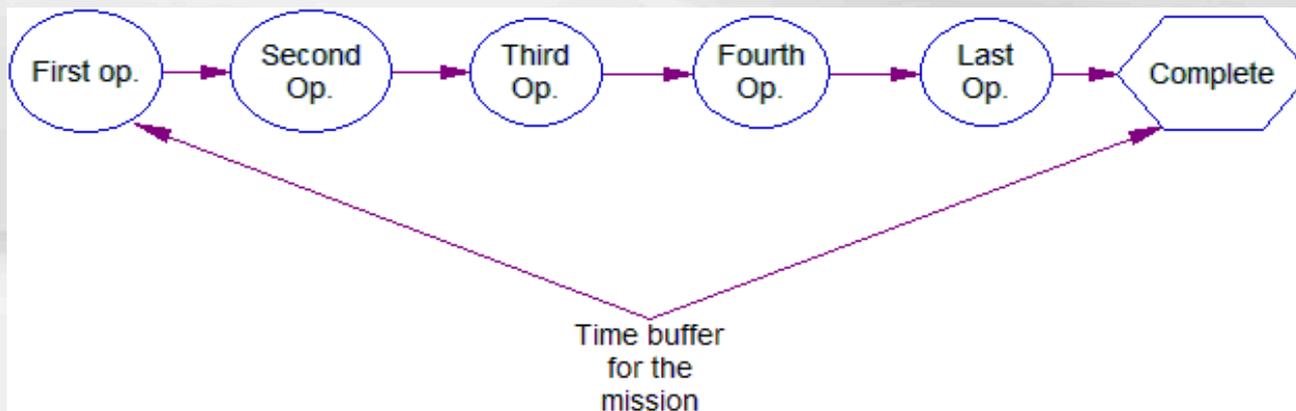
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- Definition (Merriam-Webster):
  - a means or device used as a cushion against the shock of fluctuations in business or financial activity
    - My definition: a protection against the negative impact of uncertainty
- Everybody uses buffers all the time!
  - We add a buffer to our estimation of completing a mission
  - We go too early to the airport to catch a flight
  - We have stock of food in our home for ‘just in case’
  - We carry cash, not just a credit card, in access of what we need
- **Buffers are seldom used officially in organizations!**
  - Is it common to recruit an employee or buy a machine because “we might need it”?

# Drum-Buffer-Rope

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- The key methodology for managing production and missions consists of three parts:
  - **The Drum:** The key planning for a period of time based on the 'exploitation' scheme for the constraint
  - **Buffer:** the time given to cover a sequence of operations from the start up to the protected area
  - **Rope:** Not letting the buffer to be longer than its decided size. Practically it means starting the order not earlier than: due-date for completion minus the time-buffer. It is often called: **choking the release**





# More on time-buffers

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- Time-buffers protect the **time commitment** we have to make
  - The time buffer is a **liberal estimation** of the time it might be required to meet the time commitment
    - It is definitely and knowingly longer than the average time the sequence of operations might take!
    - It considers a certain level of uncertainty that could impact the lead-time to fulfill the commitment
    - The uncertain impact has to include other work that might compete on the time of the relevant resources, downtime and quality problems
    - It does NOT consider very rare events that have huge impact on everything we do, like an act of terror
- **Most buffers are designed to protect from common-and-expected uncertainty**

# Visibility as a unique feature of TOC buffers

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- Buffers have to be an **integral part of any planning!**
  - Because no planning for the future can be deterministic
  - And because achieving the planning objectives is truly important to us
  - The buffers have to be **VISIBLE** as part of the planning
- Without visibility of the buffers – they tend to be wasted!
  - Because hidden buffers means the planner does not want to reveal the existence of buffers and thus the buffers have to be fully consumed
  - The reason to hide buffers is that striving for efficiency everywhere interferes with using formal buffers
  - The actual result of introducing hidden buffers and then consuming all of them is part of the reality of the vast majority of all organizations

# Placement of the buffers

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- What needs to be protected?
  - Certainly the **commitments to the clients**
  - Possibly ensuring the **proper exploitation of capacity constraints**
  - Possibly **the availability of materials**
  - Possibly ensuring the availability of capacity of resources when they are truly needed
  - Possibly trying to restrain the impact of fluctuations that directly consume the key buffer protecting the commitment
- There is no need to protect the efficiency of non-constraints
- The above needs lead to where buffers are truly needed
  - Certainly not everywhere, which is the regular case when the buffers are hidden, as every step is protected

# Time buffers in Production and in Projects

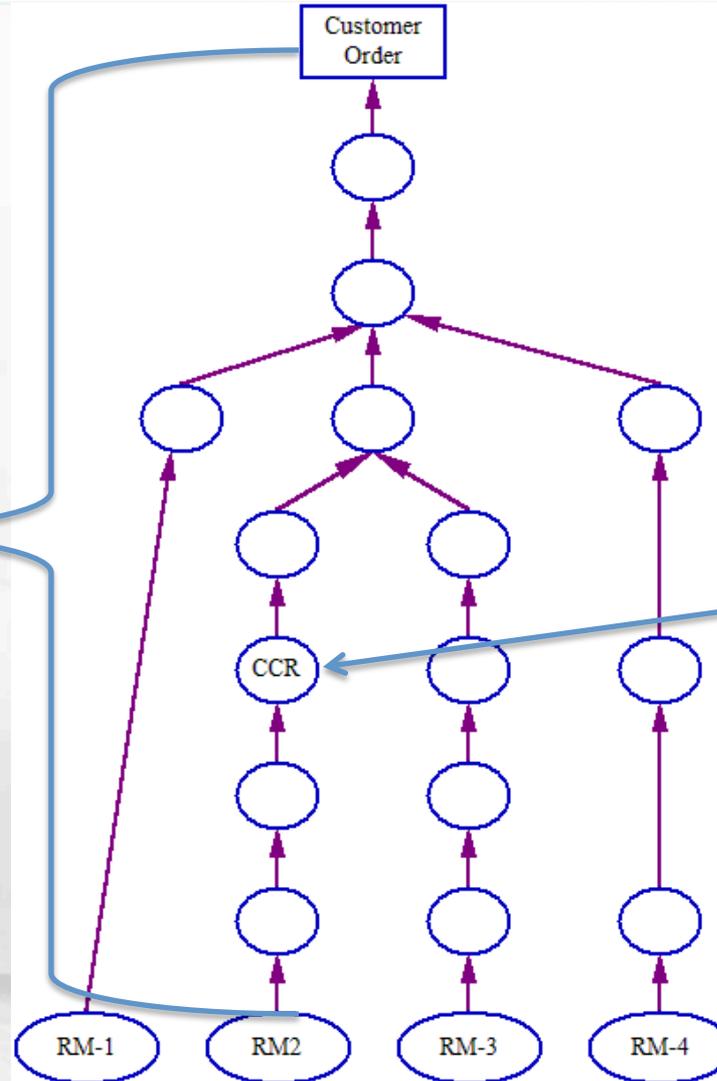
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- Time buffers protect **time**-commitments
- In Production the accumulative touch-time is a small part (<10%) of the total production-lead-time
  - Most of the lead-time is spent when the production-orders wait for resources to become available
  - There is no gain in separating the net touch-time from the buffer
  - The time-buffer is the overall lead-time given by the planning from order-release to the due-date
    - And it should be enough to overcome all regular fluctuations
- In Projects – the Project Buffer is added to the longest chain of tasks from the start to the end
  - Where the tasks are estimated as 50% confidence of completion
  - Then we have Feeding Buffers to protect the Project Buffer from disruptions of shorter chains that connect to the longest chain

# Shipping buffer in Simplified-DBR

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The Shipping buffer covers all the time from order release, including all the assembly legs up to completion



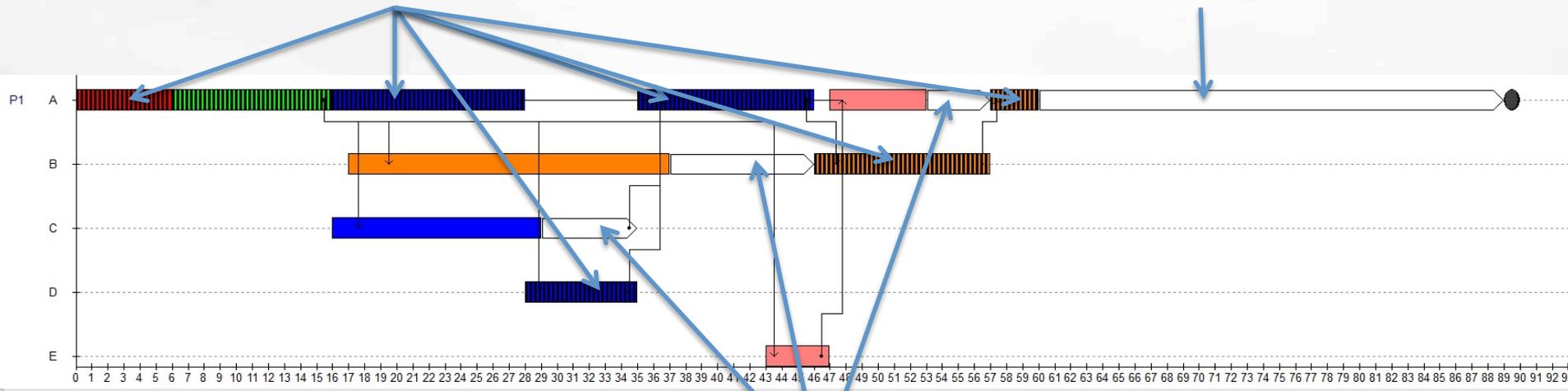
The Capacity-Constraint-Resource (CCR) does not have a special time-buffer in Simplified-DBR

# Time buffers in projects

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The Critical Chain – the longest chain

The Project Buffer



Feeding buffers



# Stock buffers

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- Why we need stock buffers?
  - Why not translate into time?
    - Like maintaining three weeks of stock
  - Translating stock into time means using **forecast**
    - The translation through forecast increases the overall uncertainty
    - One resulting effect is that the inventory level changes even when the stock has not changed
- Using stock buffers is focused on protecting the immediate demand
  - Allowing the offering of perfect availability
- There are **TWO** separate impacts on the level of on-hand stock:
  1. The market demand. Both the average and the level of fluctuations
  2. The supply. Both the average and the level of fluctuations

# The new angle of stock buffers

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- The idea of the TOC stock buffers is that they encompass **both the on-hand stock AND the stock in the pipeline**
  - That means production or purchasing orders are part of the buffer!!!
    - The accumulation of on-hand and pipeline is held fix
    - Unlike the common approach that look for fixing the target inventory
  - When stock goes out of the buffer, either for sale or being scrapped, then a replenishment order has to be released into the pipeline
  - **The replenishment order does NOT have any due-date!**
- The sizing of the stock buffers depends on “reliable replenishment time”
  - Which puts a special focus on reducing the replenishment time
- The idea of not increasing the buffer just because it is possible still holds for stock buffers as well



# The true breakthrough: Buffer Management

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- It is difficult to understand buffers without buffer management
- Once a buffer is a formal and visible part of the planning then the actual state of the buffer guides us to deduce the true priorities; while the behavior of the state of the buffer reveals whether the buffer is about right or not**
- The idea is that during the execution the penetrations into the buffer would be recorded and monitored
  - When most of the buffer has been already consumed then **there is a real threat to the protected area**
    - In such a case we like to be notified in order to decide what can be done to prevent the possible damage to the protected area (commitment)
    - When too many buffers get “red” status, or a very critical penetration is not quickly fixed – then something is wrong in the buffering system



# The buffer status

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- We look for a simple, yet very effective, way to represent the current state of the buffer
  - We need simplicity to make the message clear and easy to follow
- The idea for the majority of the buffers:

## **Divide the buffer into three equal parts: green, yellow and red**

- For a typical time buffer: the first third of the time the order/mission is in green, then it turns yellow, after 2/3 of the time it becomes red
  - Once the order/mission is finished – the monitoring stops, but statistics could be gathered for how much of the buffer was consumed at the end
- Penetration into the last third of the buffer, noted by the Red color, signals a need to expedite the order/mission
  - Assuming there is just enough of the buffer to meet the commitment, if such special attention is taken

# The buffer status for stock buffers

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- The buffer is stock that is spread along the pipeline and on-hand
- The buffer status looks only on the ON-HAND stock – and measure how much is missing up to the top level
  - When 0-33% of the buffer is missing from the on-hand the status is Green
  - Between 33-67% missing – the status is Yellow
  - More than 2/3 of the buffer missing: it is Red
  - Shortage – means Black
- The status of an order in the pipeline is:

**Looking downstream how much stock exists – and how much is missing to the top of the buffer**

# The priority system and the underlining assumptions

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- Part of the power of buffer management is to establish

## **One clear priority system for the whole flow**

- If there are more than ONE set of priorities then the actual result is not being able to follow any priority
- The simple priority scheme is:

**Red >> Yellow>>Green>>No priority**

- What about Black?
  - Meaning orders that are already late, or the on-hand stock is empty
  - When we have black orders their priorities have to be re-evaluated!
    - Because a certain damage already occurred, so maybe the current reds are even more important to keep their commitment, or delivering the black fast is still the top priority

# Identifying what blocks the flow

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- Buffer management can be used to identify blockages in the flow
  - What we call a “blockage” is something that causes an order to become Red
    - For time-buffers it means fluctuations that cause significant delays that could easily push an order into the Red
    - It could be caused by excessive setups or processing times, but also quality problems that require re-work
    - Unavailability of materials, or temporary big load on a resource
    - Stock buffers are impacted by two different disturbances:
      - Fluctuations that cause too long delays – the same as for time-buffers
      - Sudden big sale – way above the average, or having to scrap end-products
- The idea is to generate Pareto List of what actually caused orders to go into the Red, or stay in the Red for too long
  - And then do the cause-and-effect analysis to find the root cause and fix it

# Buffer management for projects and long missions

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- There are cases where the simple 1/3 division is not enough
  1. When the time buffer protects very long lead-time
    - The concern is that the starting tasks would consume a lot of the buffer
      - on the expense of all subsequent tasks
        - Because when the buffer status is still in the Green it seems no one cares
    - Thus, we have to use the pace of buffer consumption, relative to the completed part, to decide whether the situation is about right or not
  2. When the stock buffer is fed by long lead-time, and very little possibility to expedite
    - This is a tough situation for maintaining stock. Increasing the buffer is not good enough. Expensive expediting is much preferable
  3. When the replenishment time is pretty constant
    - Then the 1/3 red-zone might be too large

# Expediting as a formal managerial move

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- A generic means to deal with uncertainty is to provide flexibility to react fast to any disruption
- The status of the buffer is used to identify the situation where that flexibility is truly required
  - Thus, there is a need to prepare the means for urgent reaction
    - Sometimes just giving the right priorities is enough
    - In other cases means like overtime, outsourcing or just calling the best experts for assistance have to be as part of the operational system

**When there is no practical way to provide expediting then the buffers have to larger**

**And then the value of buffer management is mainly to provide feedback on the effectiveness of the buffers**

# Too much green – a warning signal

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- We somehow expect that most orders/missions with a time-buffer would finish in Yellow
  - There could be exceptions where many finish in Red, but then they finish in one day or so
  - When orders finish in Green it might point that the buffer is too long
- Similar expectations exist for stock buffers
  - Being in Yellow is a natural good signal
  - Too long in Green is an indicator that the buffer is too large
- Too much Green requires special care
  - Because no one likes to be exposed to much bigger damage when the buffer is too small



# Too much Red

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- There is more sensitivity to identify when the current buffer is not enough than to be convinced the buffer is too large
  - While this might cause, on average, to use somewhat larger buffers than required, this is usually the smaller price to pay for the benefit of achieving stable and reliable delivery performance
- Too much red is an indicator based on too frequent deep penetrations into the red
  - Warning:

**Not always the response to “too much red” should to increase the buffer!**

**Because, when the reason is the emergence of a capacity constraint then the response has to be increasing capacity or reducing the firm demand!**

# Between time/stock and capacity

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- The key value buffers is to be reliable in ~95% of the cases
- But, when the load on one resource comes too close to 100% then time/stock buffers only delay the problem
- It is critical to understand the two necessary conditions for good exploitation and subordination to the market constraint
  - Having enough **protective capacity** to support the exploitation scheme
    - Both to the market and to the capacity constraint, whenever active
  - **Subordination** has to protect the market and the internal constraint from fluctuations in the rest of the system
    - **Both time and stock buffers are key tools** for subordination to cover for the existing uncertainty
    - Buffer management is the major tool to keep the subordination effective by setting the right priorities

# Strategy angle of handling uncertainty

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- Reliable delivery, meeting all commitments to the market is a worthy strategic objective
- The biggest threat to meeting commitments is from common and expected uncertainty
  - On the other hand, gaining the reputation of being very reliable is a big business opportunity
- Handling uncertainty requires more than buffers
  - Maintaining flexibility and protective capacity
  - Finding ways to reduce the amount of uncertainty
  - Buffers are a critical element for protecting what is truly valuable
  - Buffer management allows to **gain from uncertainty**
    - Reducing the buffers and keeping the right priorities lead to superior reliability relative to all competitors
    - Also providing ways to identify what blocks the flow more than others

# Widening the scope for buffers and buffer management

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- Budget planning
  - Budgets suffer from the same problems as projects:
    - There are too many over-budgets and almost never unconsumed budget
  - Budgets need to be buffered
    - The usual reserve clause is ridiculous – uncertainty is so much more
    - Need to have buffer management that is stronger in the beginning and more permissive towards the end
- Understanding cash buffers
  - Credit lines, and other means to draw cash when truly needed are buffers that should be formally and visible defines and managed
- Capacity buffer
  - Quick means to increase capacity, even when it is relatively expensive, when truly needed
    - Maintaining these buffers adds operating expenses, and thus they have to clearly defined and being properly managed

# Summary of the key points

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- Formal and visible buffers have to be embedded in any planning
- Time buffers protect time commitments or intermediate objectives that are critical for the time commitment
- Stock buffers protect immediate demand
- Time and stock buffers need also the flexibility of protective capacity
- Buffer management is a tool for the execution phase to reach the planning objectives
- Buffer management monitors the current state of the buffers and generate warning when special actions are required
  - Also generate feedback for better future planning

# Ask me questions: it cannot be that obvious!

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- Eli Schragenheim strives to:

## Support TOC Implementations Everywhere!

Feel free to contact Eli regarding questions, reservations and collaborations in TOC initiatives

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