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Designing TOC Replenishment Solution in a Mixed (MTO/MTA) Environment

– Implementing MTIA and PTA –

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In 2008-2011, he was a faculty member of Goldratt Schools, and participated in writing Goldratt Schools book – "TOC for Production Management (2010)"

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He is also one of the Founding members of TOCPA – TOC Practitioners Alliance.

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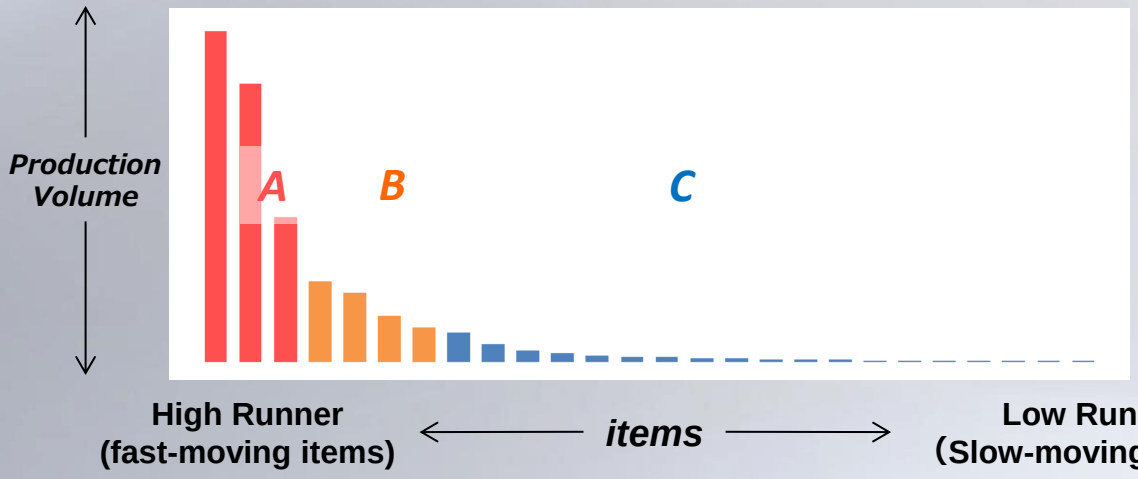
Agenda

- Why Mixed (MTO/MTA) Environment?
- Difficulties of maintaining both performance of MTO and MTA
- Core Conflict – Market Constraint vs. Capacity Constraint
- The key insights into TOC Buffers
- How to conduct a Pilot implementation

Why Mixed Environment?

- TOC has two types of production solutions – SDBR for MTO and Replenishment for MTA.
- MTA gives the production the ability to ensure availability of the goods for the downstream chains with very effective level of stock.
- However, offering excellent availability of ALL items does not make sense. It means that some items are MTA, others are MTO or MTS. Especially, the production is in “High-mix Low-volume production” situation.
- Defining proper MTA items is very important decision-making. For that, we may use the ABC analysis of the product-mix.



More and More Mixed

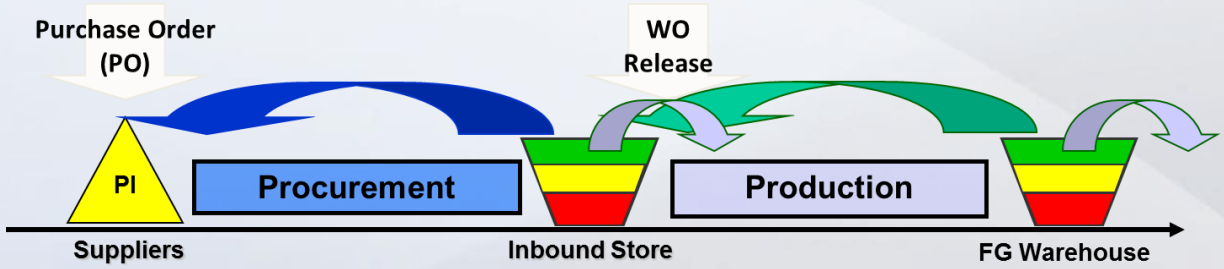
Bellows are some examples of Japanese companies:

- Manufactures that supply the goods to distribution channels
  - The company has grown by selling a wide range of products (specials/projects) through MTO/ETO mode of operation and expanded to new markets that have more demands for standard products.
  - The company had enjoyed “Low-mix High-volume production”. However, Industry 4.0/IoT encourages the movement to “mass customization” – More pressures to respond to customer’s various needs.

- Suppliers that supply the parts to the final manufacturer
  - SDBR user – Before TOC, mainly produced parts for prototype of semiconductor equipment. Improved service level for the customers enables the company to get more orders for mass-produced products.
  - The main customer implemented MTA and decided to extend it to the purchased items through PTA – Purchase to Availability. Some suppliers are asked to participate in the replenishment system.

Challenges for PTA

- For MTA, we have to ensure that the purchased items such as raw materials and components are available when replenishment orders are released.

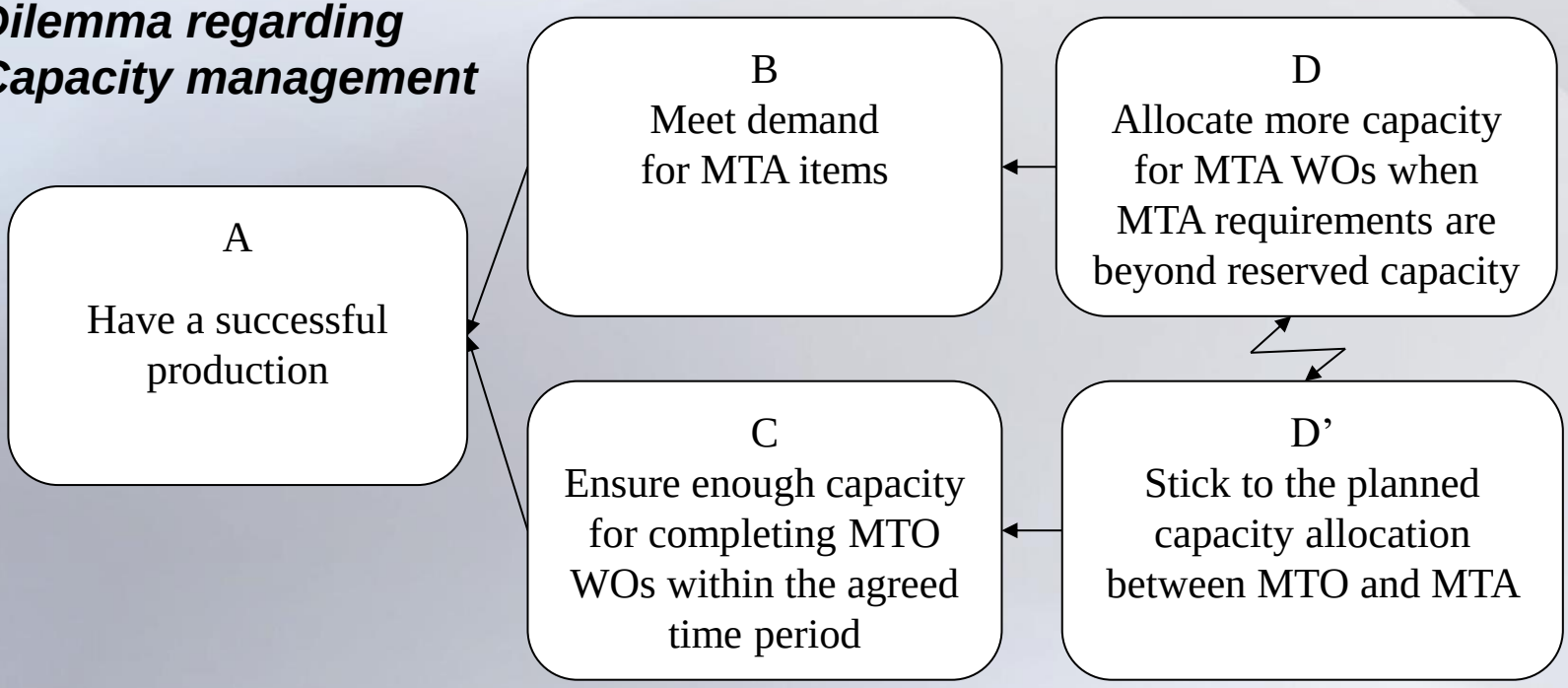


- In many cases, purchase orders (PO) are placed to suppliers through MRP and they operate based on these orders, which is usually MTO system.
- Implementing PTA demands that the suppliers change their supply mode from MTO to MTA. However, it is not realistic to manage all items under MTA. Consequently, they have to deal with Mixed (MTO/MTA) environment.
- How to get your suppliers to participate in the replenishment system? Are you going to ask them to take the following actions?
  - Establish the warehouse and hold inventory to give commitments of ensuring availability
  - And perform frequent replenishment (with smaller quantity)
- Can you see any tangible benefits for the suppliers?

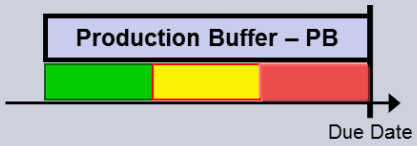
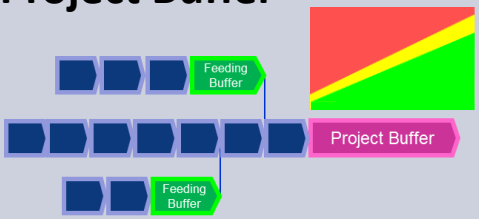
Difficulty: MTO vs. MTA

- Some practitioners claimed that it was difficult to maintain both performance of MTA (Availability) and MTO (DDP and QLT) simultaneously. MTA performance often has been high on the expense of other MTO items.
- Reserving capacity for MTA requirements is effective way of giving safe dates in planning. However, the real problem lies in the execution phase.

Dilemma regarding Capacity management

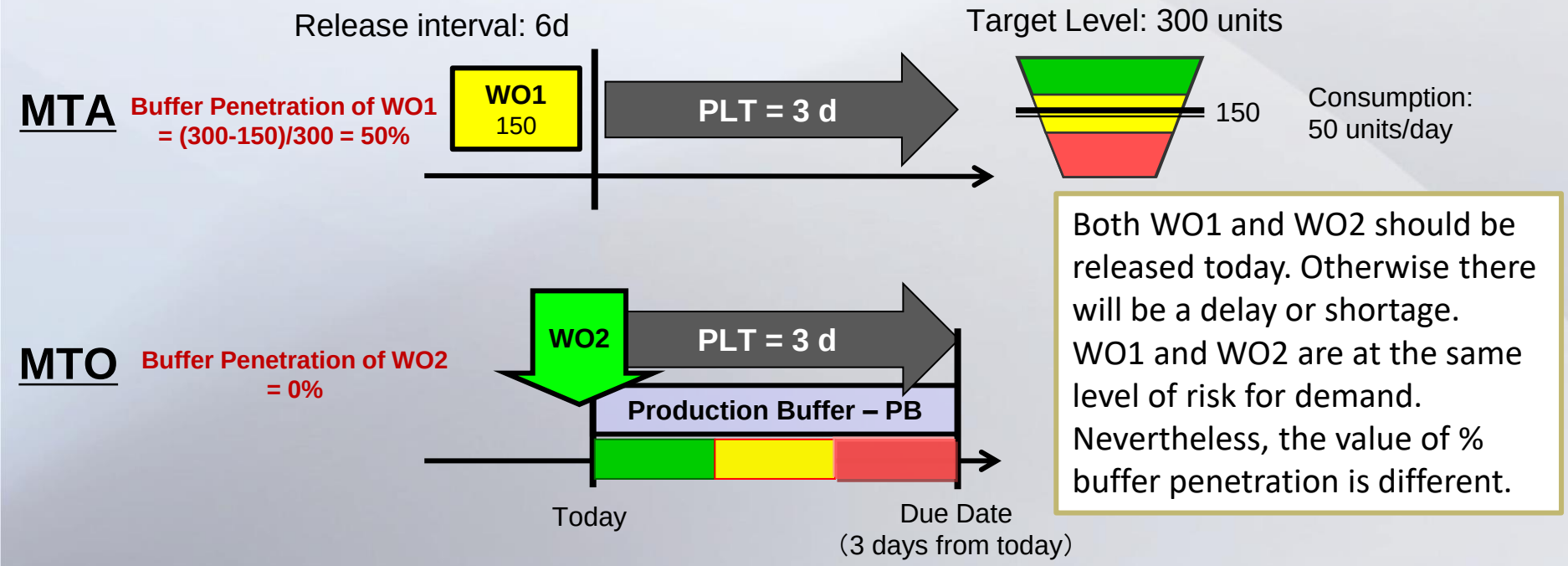


TOC Buffers

TOC Buffer	Type	General Sizing Rule	Practical Sizing Example
Production Buffer 	TIME	"Challenging But Achievable"	(3 x Touch time) plus safety 1/2 of current avg. PLT < PB < current avg. PLT
Stock Buffer 	STOCK	"Maximum Forecasted Consumption within the Reliable Replenishment Time (RRT)"	Past consumption value of avg. plus 2 sigmas for consecutive times of current avg. supply LT (avg. wait time to release + avg. PLT)* 1.2
Project Buffer 	TIME	"1/2 the length of the critical chain"	Use CCPM software

Same Buffer Penetration?

Both MTO and MTA use TOC Buffers. Even though the type of buffer is different, the meaning of buffer penetration is same. So, we are expecting to use color priority system through Buffer Management. Really?



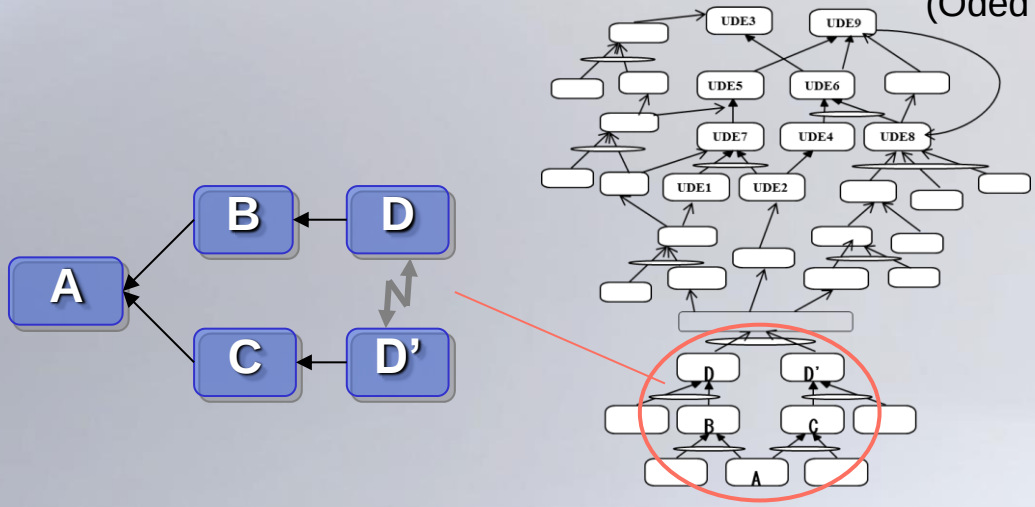
Both WO1 and WO2 should be released today. Otherwise there will be a delay or shortage. WO1 and WO2 are at the same level of risk for demand. Nevertheless, the value of % buffer penetration is different.

Stock Buffer (Target Level) is determined in consideration of not only the PLT but also other elements like "wait time to release" and "demand variability". On the other hand, determining the size of PB does not take into account these elements!

What is Core Problem?

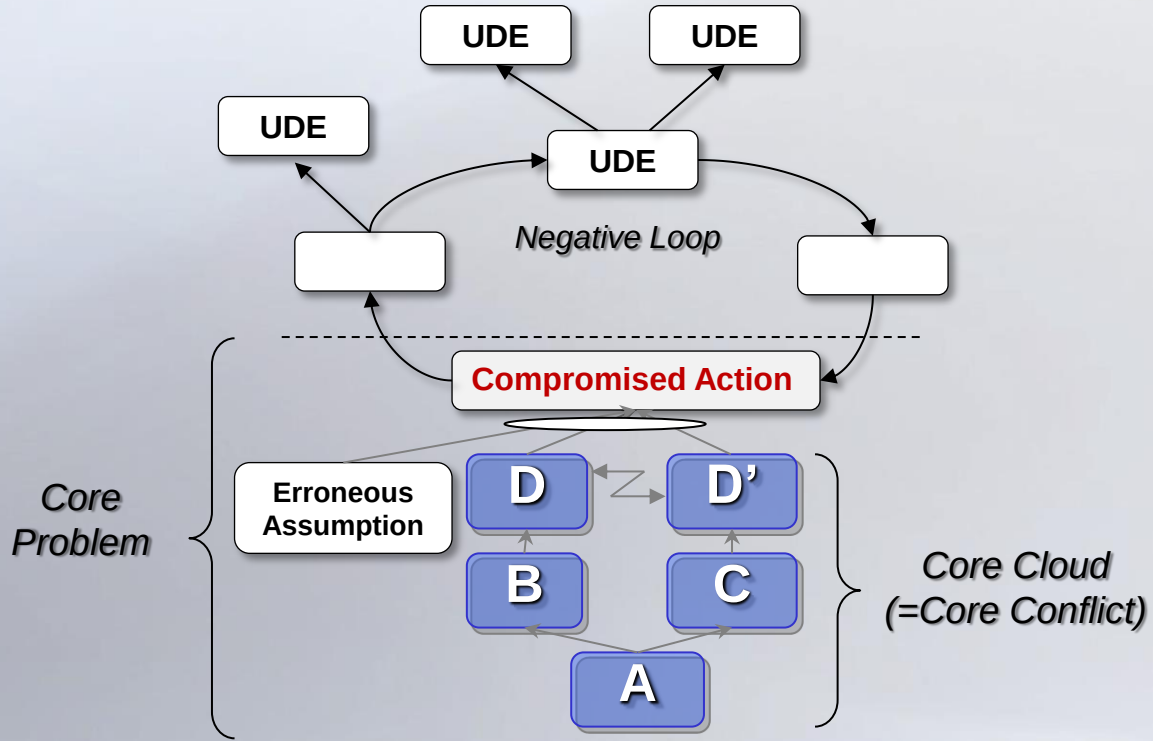
- **Core Problem** – the reason for the existence of several gaps and UDEs (Undesirable Effects)
- Core Problem can be verbalized in three ways:
  1. An erroneous assumption that is used extensively by the managers of the system in managerial decision making;
  2. A conflict between two types of conflicting tactics;
  3. A core cloud presenting the core conflict.

(Oded Cohen, *Ever Improve*, p.50-51)

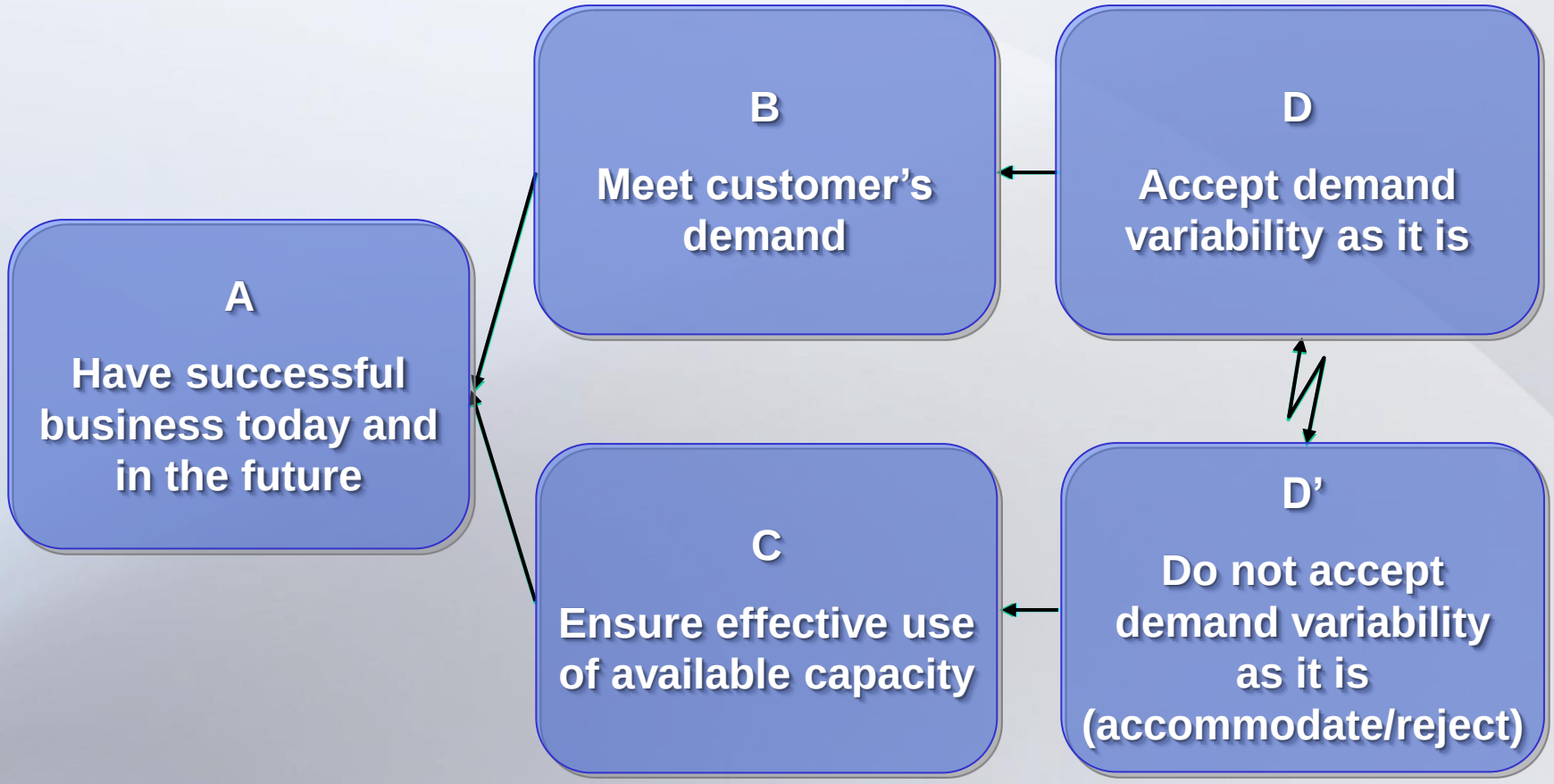


What is Core Problem?

- The conflict between D and D' causes a specific action that the system is currently taking. This action represents the **current mode of operation**.
- Pinpointing the Core Problem means understanding the Core Conflict and its resulting **"Compromised Action"**.

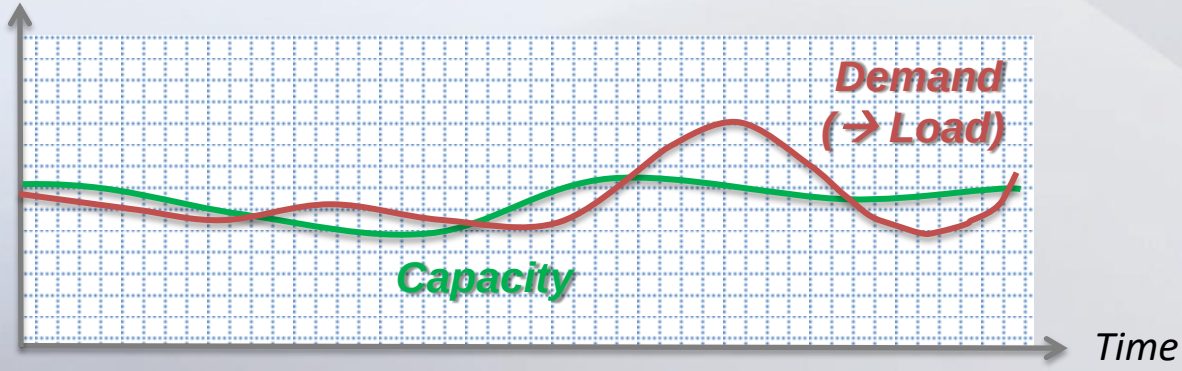


Core Conflict in Operation Management



Variability and Buffers

- Flow is characterized by demand and supply. Both of them have variability. Managing flow requires managing variability.
- Demand variability causes load fluctuation even if the load was leveled in planning. It endangers the performance of the system.



- Variability in a delivery system will be buffered by some combination of:

(Hopp and Spearman, 1995, 2007)

Understand the resulting Compromised Action

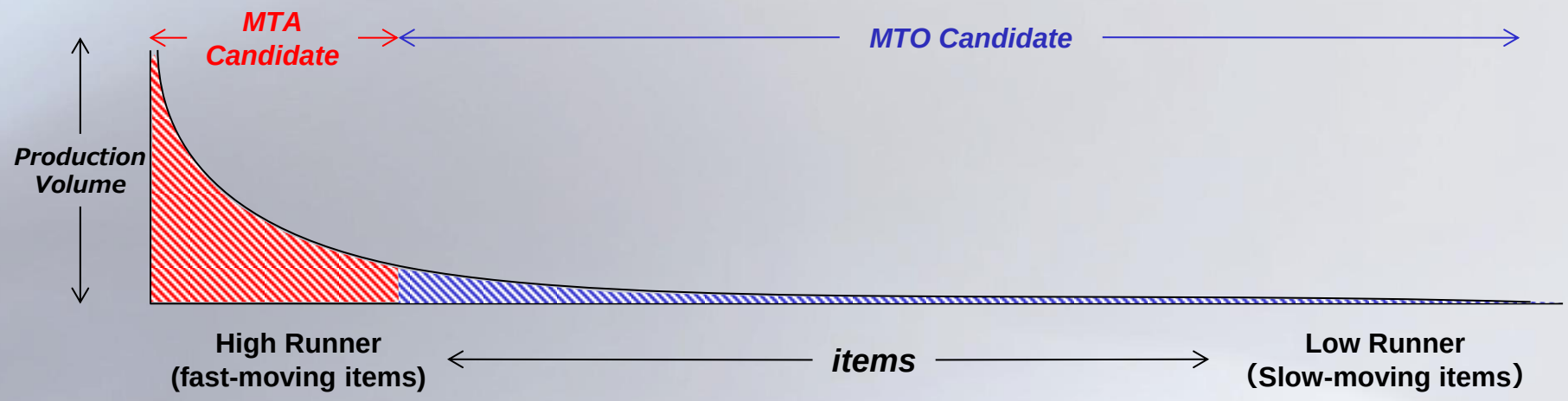
D
Accept demand variability as it is

D'
Do not accept demand variability as it is (accommodate/reject)

Compromised Action

What is the current mode of operation for dealing with demand variability?

Please remember that we are currently living in the following world…



Compromised Action in Mixed Environment

WO for high-runners should always be released with highest priority!

Lack of Buffer

As little as possible!

WO for high-runner

Necessary level of on-hand stock

High-runner item

(fast-moving items)

Waiting for release

WO for low-runner

(slow-moving items)

WO for low-runner

After all, we have to work on low-runners as well..

WO for low-runner

WO for high-runner

Wait time to release

High-runner item

Low-runner item

Demand variability

Time

Capacity

Load

Add capacity to recover delay of release

More inventory to compensate delay of release

Why Compromised?

- Since the Core Conflict exists, the production system is forced to take the compromised action that elongates its response time – wasting the Time Constraint and/or adds extra capacity by spending more money.
- Here are some possible reasons:
  - Since A-class items (super high runners) have a significant impact on inventory in monetary terms, people have a fear of over-stocking.
  - Replenishment frequency of A-class items is usually very high. It is a common belief that the more frequency the less inventory needed at warehouse.
  - As a result, even if these buffer statuses are in red under MTA system, these items have no problem on availability.
- If this is the case, people may hesitate to increase the level of on-hand stock to the top of Yellow/Green according to the BM rule.

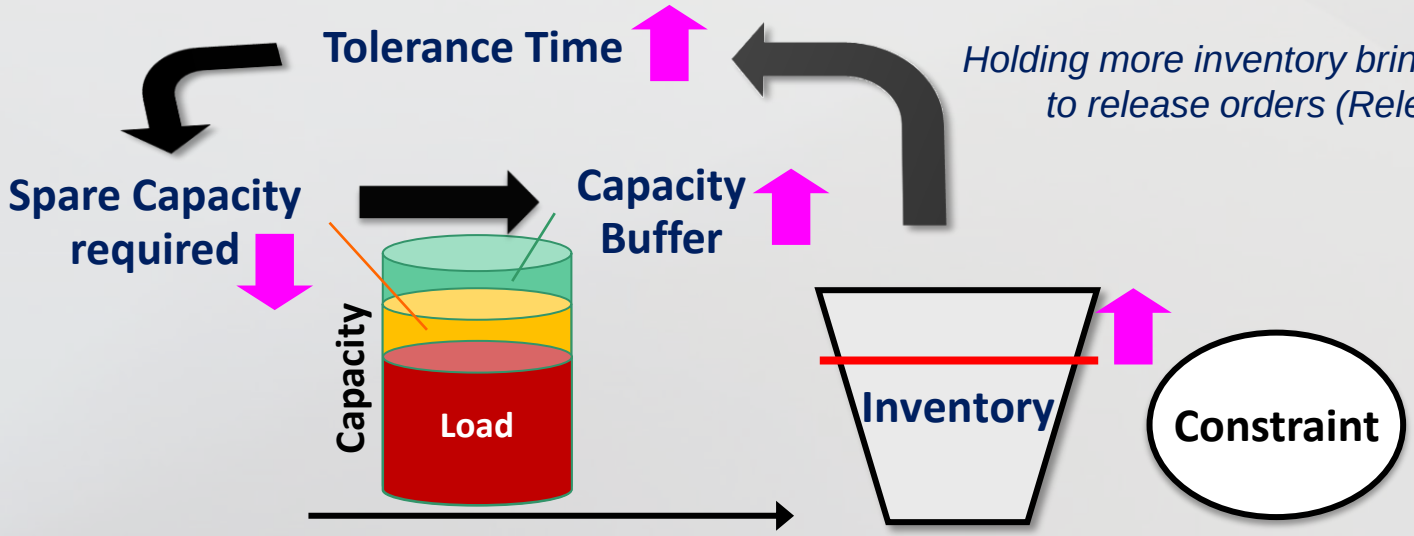
Moving from MTO to MTA

- Moving from MTO to MTA means the change in the way of dealing with demand variability.
- In MTO environments, the prevailing current ways of handling demand variability are:
  - Production WOs are released too early.
  - Purchase Orders (PO) are placed too early.
- These actions are synonymous with increasing Time Buffers. However, they are not effective approaches when the response time is critical.

- In MTA, demand variability should be handled through TOC Stock Buffer!
- Building Stock Buffers is obviously beneficial for the downstream chains as they can enjoy the availability (satisfying Need B in Cloud).
- How does it work for the upstream links?

Insights into TOC Buffers: Buffer Equivalent Exchange

The extra on-hand inventory within Stock Buffer can be exchanged for a free spare capacity to be served as Capacity Buffer.

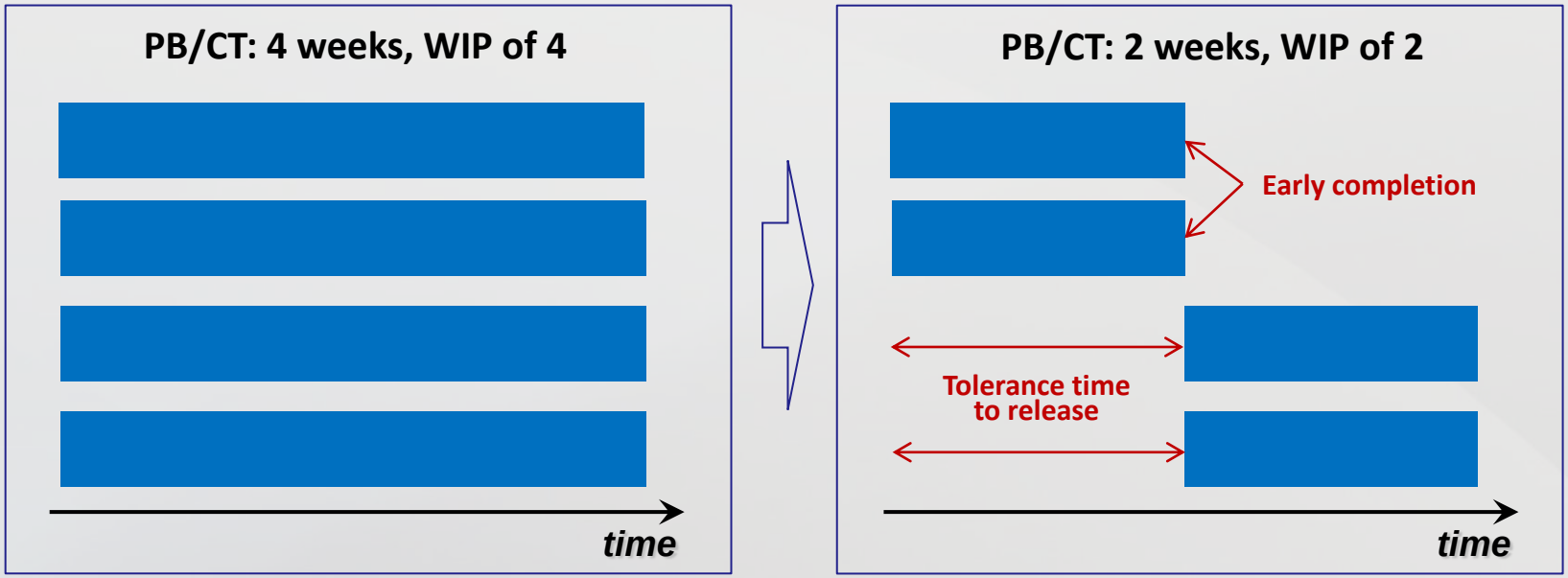


Holding more inventory brings tolerance time to release orders (Release Buffer).

"It's a trade-off. The more inventory we allow before the bottleneck, the more time is available for upstream resources to catch up, and so, on average, they need less spare capacity. The more inventory the less spare capacity and vice versa."

(Eliyahu M. Goldratt, Jeff Cox, *The Goal: A Process of Ongoing Improvement; 30th Anniversary Edition*, p.324-325)

Buffer Equivalent Exchange in MTO and Projects



In SDBR:

- Shortening the size of Production Buffer (PB) brings a tolerance time to release WO. It reveals an excess capacity that accelerates WO completion.

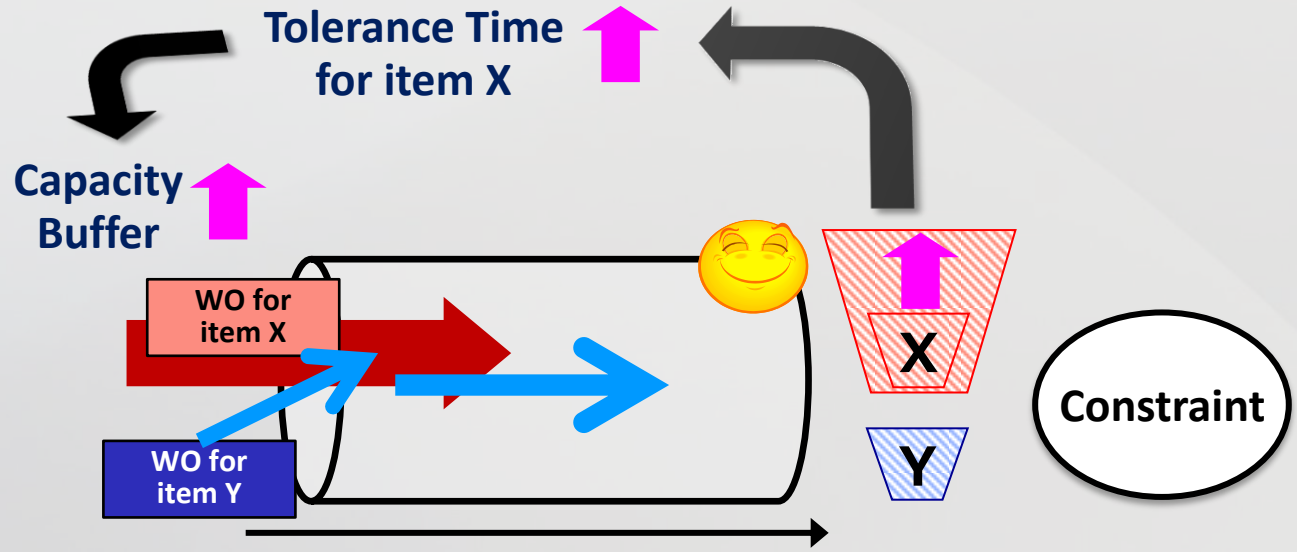
In CCPM:

- Reducing WIP fees up resources (capacity) and enables shorter cycle times (CT) by resource concentration. This brings a tolerance time for staggering and then Full-kit.
- Full-kitting ensures further reduction in CT. It leads to increasing the completion rate.

Buffer Equivalent Exchange in Mixed (MTO/MTA)

The extra on-hand inventory within Stock Buffer for specific items can be used for absorbing the variability that other items have.

Production gains free capacity for giving higher priority to WOs for item Y.



Example:

- X : Y = 70% : 30% (in terms of quantity)
- If on-hand stock of item X is increased from 5d to 15d, then tolerance time for item X is increased by 10d. It is exchanged to a free spare capacity of 7d (10d * 0.7).
- This brings the pipeline Capacity Buffer of 7 days that can be used for giving higher-priority for item Y. It leads to accelerated Y's completion by max. 23 days (7d / 0.3).

Implementation Examples

Case 1) MTIA – Parts manufacturing for marine engines:

- MTA : MTO = 70% : 30% (in terms of quantity)
- Availability increased from 70% to 90% (all in-house parts)
- Wait time at assembly reduced by 63%
- Production LT reduced by 52% (all in-house parts)

Case 2) MTIA Pilot – Automobile components:

- MTA : MTO = 40% : 60% (in terms of quantity)
- Wait time at assembly reduced by 64% with 3% reduction in total inventory
- Production LT reduced by 7%
- The company decided to roll-out of MTIA

Case 3) PTA Pilot – Components supplier for CNC machines:

- MTA : MTO = 70% : 30% (in terms of quantity)
- Fill-rate of sub-assembly plan improved from 81% to 92% (MTO items)
- Replenishment time reduced by 50% (MTA items)
- The supplier agreed to full execution of the solution

How to conduct a Pilot

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1. Current Reality Study (CRS)

- Obtain basic data of production
- VATI Analysis
- Relationship between CO & WO
- The way of purchasing RM
- Develop Deployment Chart of current production planning

2. Develop Procedures/ Select Pilot Area

- Understand NBRs
- Develop Pilot new procedures
- Select a Pilot area & MTA items
- Investigate RRT
- Determine Target Level
- Prepare MTA SKU File & WO File

3. Execute Pilot/ Pilot Validation

- Determine Metrics
- Plan of building on-hand stock & when to start replenishment
- Issue Resolution
- Upgrade the procedures
- Results verified

4. Plan Roll-out Strategy