LOGISTICS TERMS

actively synchronized replenishment (ASR) – A set of demand-driven planning and execution techniques for inventory and material positioning used within material and distribution requirements planning systems to strategically compress lead time and protect and/or increase service levels with less working capital.

ASR – Abbreviation for actively synchronized replenishment.

actively synchronized replenishment lead time – The longest cumulative unprotected leg in a bill of material.

Usage: Creating a buffer for a component in a bill of material protects the leg of the BOM that includes that component from variability upstream from that component.

See: actively synchronized replenishment.

aggregate bill of material structure – The bill of material across the company that includes all identified product interrelationships.

balanced plant – A plant in which the capacity of all resources is equal to a given level of output.

Perspective: In traditional manufacturing, the ideal is a balanced plant where all work center capacities are equal to demand (minimization of costs). In lean the ideal is a balanced plant where capacity is equal to daily demand. In theory of constraints all work centers are structured to balance flow, not capacity.

bill of material decoupling – The process of inserting stock buffers at strategic points in the aggregate bill of material for component parts that have the potential for reducing the lead time of parent items to the market.

Usage: The decoupling effect is for materials planning purpose only – the BOM still describes how products are built.

black buffer status – In general, an indication that the system failed to deliver its commitment. 1. In make-to-order drum-buffer-rope or simplified drum-buffer-rope, the status of a manufacturing order is black when the due date of the customer order is earlier than the current date (the order is late with respect to customer due date.). 2. In make-to-availability, the buffer status is black when the on-hand inventory of an SKU that is committed to availability is zero and there is actual demand for more items. 3. In critical chain project management, the project status is black when the project due date is earlier than the current date.

black hole return on investment items – In make-to-availability, items that have very low or even negative ROI (calculated as annual T for the item divided by the raw material investment in the buffer for the item).

See: star return on investment items.

blocking – In TOC, a condition in which the constraint is forced to be idle because downstream workstations are not able to accept the material processed by the constraint and storage space for the material is not available.
Usage: Blocking, starvation, and breakage of the constraint are of particular importance in theory of constraints as throughput is lost. In contrast, in traditional manufacturing this term applies to non-constraints as well. In a serial line with a constraint midway in the process, blocking occurs when the constraint doesn't have space to offload finished units and therefore must sit idle until space is freed up. Three sources of lost throughput in a drum-buffer-rope are: starvation, blockage, and breakage of the constraint.
See: breakage, space buffer, starvation.

breakage – In TOC, a condition in which the constraint is forced to be idle because the resource has broken down.
Usage: Non-constraints have excess capacity so breakage at a non-constraint is not a significant concern. The impact of non-constraint breakage is reduced by the constraint and space buffers. However, breakage of the constraint has significant impact because it generally results in a reduction in throughput. Three sources of lost throughput in a drum-buffer-rope are: starvation, blockage, and breakage of the constraint.

buffer consumption – In make-to-order drum-buffer-rope and simplified drum-buffer-rope, the depletion of time from the time buffer (i.e., shipping, assembly or constraint buffers). 2. In make-to-availability, the depletion of inventory from the stock buffer. 3. In critical chain project management, the accumulation of activity lateness on a path. For example, the number of days consumed from the feeder or project buffer.
Usage: The interpretation of a space buffer is just the opposite of an inventory buffer. In the case of an inventory buffer, inventory is consumed. In the case of a space buffer, space is consumed by inventory and too much inventory in a space buffer (i.e., the space buffer is in the red zone) means that the constraint is almost blocked and will have to stop if items are not processed at the downstream work center.
See: buffer penetration.

space buffer -- Physical space immediately after the constraint intended to accommodate output from the constraint when there is a stoppage downstream that would otherwise force the constraint to stop working.
Usage: In contrast to other buffers where inventory is consumed or time is consumed, the consumption of a space buffer means that the space is filling up with inventory. A condition of red means that the constraint space buffer is almost full and blockage of the constraint will occur unless space behind the constraint is freed so that the constraint can continue operating.
See: constraint.

buffer hole – In make-to-order drum-buffer-rope and simplified drum-buffer-rope, a designation indicating that a manufacturing order for a given part to be run on the constraint or to be shipped is not physically at the constraint or shipping respectively. The order is therefore late either to the constraint or to the shipping point.
Usage: Orders that create buffer holes in the green region are expected and are no cause for concern. Orders that create buffer holes in the yellow region are somewhat expected but the buffer manager should nevertheless locate the order and let subsequent workstations know

that an order that represents a yellow region hole is coming their way. Orders that create red region holes should be expedited along their entire path in order to achieve timely completion. Late orders are considered in the black region and are problematical. Some firms will make them a low priority since the order is now late while other firms will keep them as a high priority in order to minimize the lateness.
Syn.: hole in the buffer.

buffering – The process of placing a cushion between two dependent entities to eliminate statistical fluctuations from passing between them or to reduce the lead time when treated as one continuous flow or path. The cushion can be time, stock, cash, capacity, etc.
See: buffer max.

buffer level
Syn.: buffer target.

buffer management – A control mechanism based on the amount of time (till the due date) or stock remaining used in the execution phase of TOC applications (operations, project and distribution). Buffer management consists of four main functions:

1. *Prioritize* tasks/orders based on buffer penetration / consumption.
2. Signal when to *expedite* individual tasks/orders that are at risk (normally identified by penetrating the red zone of the buffer).
3. Provide *feedback* to the planning process to consider changing certain parameters, like buffer sizes or even take more drastic actions like adding capacity.
4. Identify prime causes of delay to *focus ongoing improvement* activity.

Usage: In make-to-order production, for example when a CCR buffer is used in DBR, work is released into the execution a specific time interval (known as the buffer) prior to its scheduled processing at the constraint. The time buffer is divided into three zones known as the green, yellow, and red zones. During the first 1/3 of the time buffer, an order is said to be "in the green zone"; during the middle 1/3 it is "in the yellow zone"; and in the final 1/3 it is "in the red zone". Work should typically arrive at the "bank" of work in process in front of the constraint when the order is in the yellow zone. If it has not arrived when the order is in the red zone, (this is often referred to as there being a 'hole' in the red zone), the job is located, usually marked in some way, such as with a red tag, and expedited if necessary. If the number of red zone penetrations rise significantly this signals production planning to either change buffer parameters or take more drastic actions (e.g., add capacity) before the system goes out of control. Records are kept of which work areas are causing holes in the red zone. This information is used to direct continuous improvement efforts.
See: process of on-going improvement.

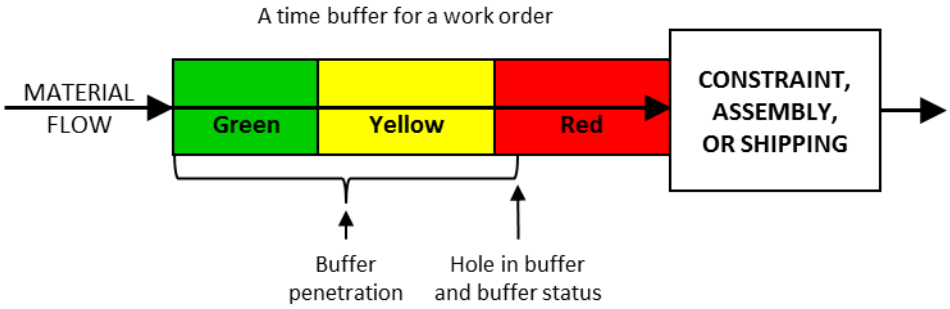
buffer manager – The person who is responsible for periodically checking buffer status and managing specific buffers, including establishing buffer sizes and locations, monitoring buffer status daily and communicating corrective actions required to maintain the buffers. The person is also responsible for recording the causes of buffer penetration into the yellow, red and black zones. These causes are used to identify areas to be targeted for process improvements.
See: buffer management.

buffer max

Syn.: buffer level, buffer target.
See: replenishment time.

buffer penetration – 1. In make-to-order drum-buffer-rope, simplified drum-buffer-rope, and supply chain, an indication of the location of a hole in a time buffer.

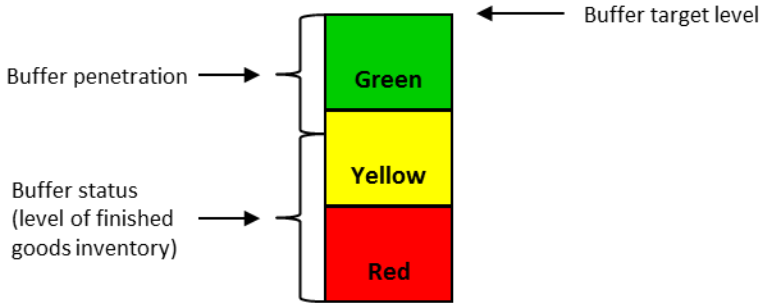
Usage: Buffer penetration for a work order is indicated by stating in which region of the buffer the hole for the work order is located.



2. In make-to-availability, a measure of the level of finished goods inventory not in the buffer relative to the buffer target level for a stock buffer.

Usage: Buffer penetration for a given end item is an indication of the level of finished goods relative to the target buffer level for the item.

Example: If the level of finished goods for an item is 60% of the buffer target level, buffer penetration is 40% and is said to be in the yellow zone of the buffer.



A stock buffer for an SKU

3. In critical chain project management, a measure used to monitor the status of a project. The amount of buffer consumed at any point in time expressed as a percentage of the total buffer.

Usage: When a task or chain of tasks is not complete and the total elapsed time since start (or release) of the project is longer than the (cumulative) estimated time(s), the expected completion time extends into, or penetrates, the associated feeder or project buffer. The higher the buffer penetration percentage is the less remaining protection for the project.

Example: Suppose 10 of the 25 days of project buffer have been consumed. The buffer penetration is 40%, which is in the yellow zone. Penetration in the yellow zone causes the buffer manager to investigate the situation and, if necessary, plan what action to take if penetration reaches the red zone. Buffer burn rate is used to judge whether the buffer penetration is serious enough to require action.

See: buffer, buffer burn rate, buffer hole, buffer management, buffer status, critical chain project management, green zone, red zone, yellow zone.

buffer responsiveness – A characteristic of buffers that describes how quickly the size of the buffer and, in some cases, the boundaries between buffer regions, is adjusted as a function of the variability of demand for the item in the buffer.

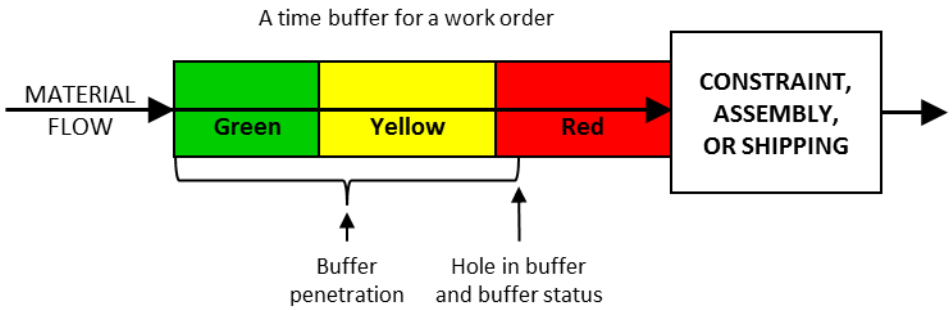
Usage: Buffer responsiveness is determined by the buffer manager. If the buffer target is adjusted quickly in response to changes in demand for the item, the buffer is considered responsive. Buffer target adjustments need not be symmetrical as more damage is caused by lost sales than by carrying excess inventory for a brief time period.

Example: An item remaining in the red for two replenishment periods might trigger increasing the buffer max by one third while a buffer remaining in the green for three replenishment periods might trigger reducing the buffer max by one third. A fashion item for which obsolescence is likely might be an exception to the rule and have symmetrical trigger points.

buffer status – 1. In make-to-order drum-buffer-rope, simplified drum-buffer-rope, and supply chain, a measure of the relationship between the time available to complete an order and the standard production lead time, determined as follows:

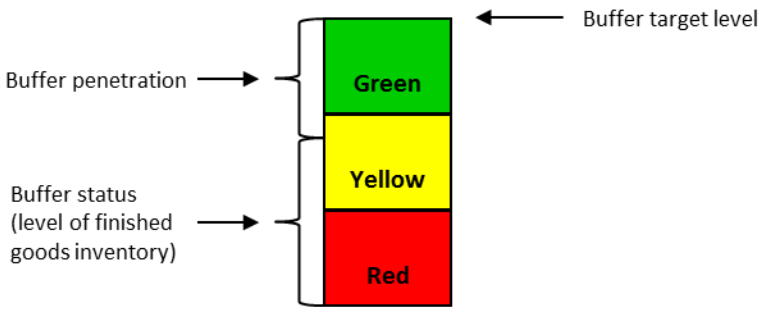
buffer status (%) = (available time) / (standard production lead time) x 100%

Usage: Buffer status is used to determine whether expediting is necessary for an order. Although there are not fixed percentages for the three regions of the buffer, many times the buffer is divided into three equal regions. In this case, if the buffer status for a work order is between 67 and 100%, the order is assigned the color green indicating that no action is necessary. If the buffer status is between 33 and 67%, the color yellow is assigned, indicating that plans should be made for expediting the order. If the buffer status is between 0 and 33%, the color red is assigned, indicating that the expediting plans should be executed immediately.



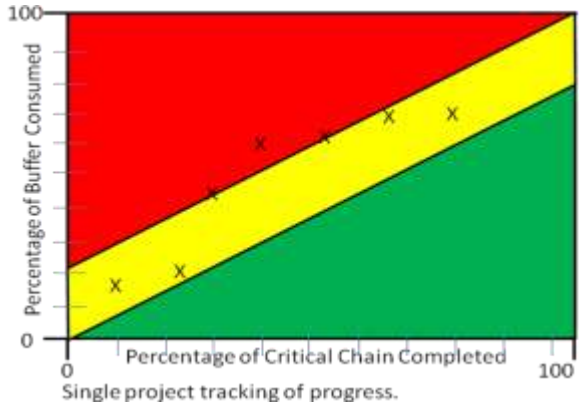
2. In make-to-availability, a measure of the level of finished goods inventory of a part compared with the buffer target level.

Usage: When the finished goods contains two-thirds or more of the target level, the buffer status is green; between one-third and two thirds the status is yellow; and between zero and one-third it is green. The cutoffs of one-third and two-thirds are common but other cutoffs are also used.

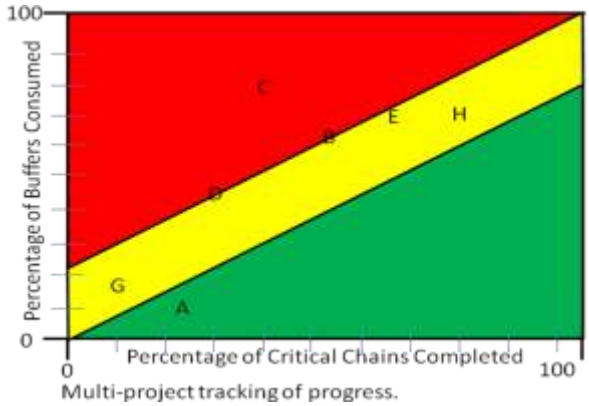


A stock buffer for an SKU

2. In make-to-availability, a measure of the priority of a work order.
   Usage: The buffer status of a work order in process is based on the number of units, stated as a percent of the target level, that are downstream from the work order.
   Example: If the target level for a part is 600 units and there are 150 units in finished goods and 100 units in process downstream from order 123, then order 123 has a buffer status of (150+100)/600 = 41.67%, which is generally considered to be in the yellow region.
3. In critical chain, a measure of the project buffer consumed in relation to the proportion of the critical chain (or project) completed. The buffer status of a project has to be adjusted for the amount of the critical chain or project completed. The color associated with the buffer status is determined by the amount of the buffer penetration in relationship to the progress of the project as denoted by the amount of critical chain completed. The slopes of the green and yellow zones are determined by the user.
   Usage: Fever charts are useful in both single and multi-project environments. In a single project environment, the status of the project is plotted periodically (say weekly) to show the relative status of the project to the remaining protection. If a project is in the red early in the project then the project manager may want to take immediate action to bring it back to the yellow or green status before his/her actions become limited. In a multi-project environment, a program manager can use the multi-project fever chart to determine which projects are in trouble (red region) with respect to remaining buffer protection and allocate resources across projects to bring the troubled projects back in the yellow or green zone.



Single project tracking of progress.



Multi-project tracking of progress.

buffer status report – A recurring report that provides a snapshot of the status of each production work order in a make-to-order drum-buffer-rope or simplified drum-buffer-rope environment, each stock-keeping unit in a make-to-availability environment and each project in a project management environment.

Usage: 1. In a make-to-order environment using drum-buffer-rope, the buffer status report shows the current status of each production order in the constraint, assembly, and shipping buffers. 2. In a make-to-availability environment, the buffer status report describes the status of buffers of raw material and work-in-process inventories, and also describes the status of finished goods in the central warehouse. This information is used to determine priorities. 3. In critical chain project management, the buffer status report provides the current status of the resource, feeding and project completion buffers for each project. In constructing the buffer status report, the key question is "How much time remains until a resource completes its current task? This information is used to determine buffer penetration at control points in the project and system.

See: buffer status.

buffer target – The "order up to" level of a stock buffer in TOC distribution. It is computed as the "maximum" forecasted consumption of an item within the average replenishment time for that item factored by the unreliability of the replenishment time. The buffer max is adjusted downward (usually 1/3 the buffer max) for a "too much green" condition (too many reviews where the inventory status was green) and is adjusted upward (usually 1/3 the buffer max) for a "too much red" condition (too many reviews where the inventory status was red).

Example: Suppose an item has a maximum weekly consumption of 100 units and an average replenishment time of two weeks with rare occasions of replenishment lead time (RLT) being 3 weeks. Suppose to protect for these rare occasions we increase the buffer size by 50%. The buffer max is:

Buffer max = 2 week RLT x max weekly consumption 100 x 150% unreliability

= 2 weeks x 100 units/week x 150%

= 300 units.

Syn.: buffer max.

capacity buffer – 1. In multi-project critical chain environments a time interval used that restricts the release of new projects into the system, ensuring the effective use of the drum resource. It also helps reduce the number of tasks in progress. This buffer is based on the capacity of a strategic resource or resource skill set (e.g. firmware engineers).

Usage: The capacity buffer ensures that there is enough stagger between the start of projects to minimize peak loads on all resources. It also minimizes delays on the drum resource tasks so delays in one project do not delay the start of drum tasks in the succeeding projects.

2. In a make-to-availability environment extra capacity of the capacity constrained resource or other heavily loaded resources that is available quickly and at a reasonable cost (possibly through subcontracting) to react to sudden increases in total demand.

See: drum resource, make to availability.

capacity constraint resource

Syn.: capacity constrained resource.

central warehouse injection – A primary injection in the distribution/replenishment application**;** a central (or plant) warehouse is required to decouple the fluctuations from both supply and demand and thus provide a smooth flow of goods to customers and a reduction of disruptions in the supplying side.

cheetah items – Items that are sold very fast relative to their stock levels, resulting in relatively high inventory turns.

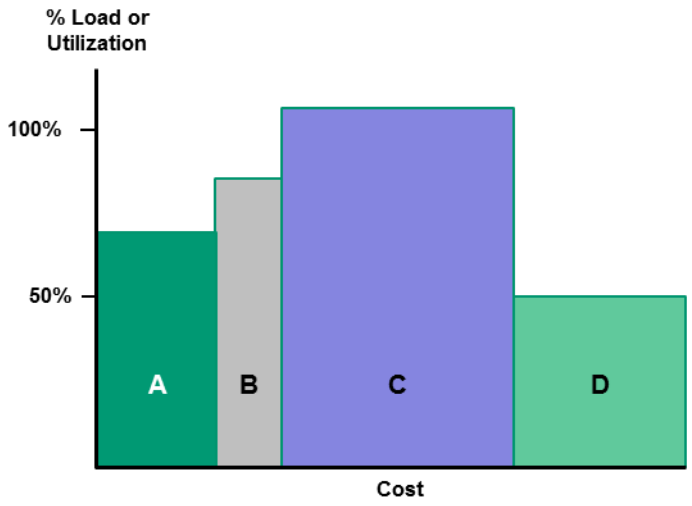
Usage: Due to the relationship between variability and stock levels, cheetah items are those that have relatively high demand in relationship to the variability of demand.

convergent point – … 2. In projects, a task where two or more proceeding paths must be completed prior to the succeeding task starting.

Usage: When a noncritical path merges with the critical chain a feeding buffer is inserted on the noncritical path where it converges with the critical chain. This buffer reduces the likelihood that the noncritical path may become the critical chain.

See: feeding buffer.

cost utilization diagram (CUT diagram) – A histogram that compares the utilization or load of each of the organization's resources with its cost. The height of the bar for each resource indicates its utilization and the width indicates its cost.



Department CUT Diagram: Cost vs Utilization of Resources

current planned load date – The date on which the CCR is expected to complete processing all currently known orders.

Usage: One-half of the production time buffer is added to the current planned load date to determine a safe date for committing to the customer. In other words, the current planned load date should normally fall at about the middle of the production time buffer.

See: full planned load, planned load.

customer tolerance time – The time a customer is willing to wait for a product or service. If replenishment lead time is less than customer tolerance time, the product can be make-to-order. Otherwise it must be make-to-availability or make-to-stock. Traditionally called demand lead time.

DBR_G – Abbreviation for drum buffer rope for goods.

DBR_S – Abbreviation for drum buffer rope for services.

DDMRP – Abbreviation for demand driven material requirements planning.

demand driven material requirements planning (DDMRP) – A method of planning inventories that involves five components: 1. inventory positioning, 2. grouping of parts into buffer profiles based on lead time; variability in demand and supply; whether the part is made, bought or distributed; and whether significant order multiples are involved, 3. dynamic buffers, 4. planning rules that tie supply orders to consumption, and 5. visible and collaborative execution.

distribute to availability – A distribution strategy in which a central warehouse is maintained and manufacturers/suppliers ship to the central warehouse based on the consumption from both the central warehouse and regional warehouses, and distributors and/or retailers pull inventory from the central warehouse based on consumption at their locations.
See: make-to-availability.

distribution – A situation in which storage and consumption locations are remote from the production facility and the customer tolerance time is less than the time it takes to make the product available to customers. Distribution includes warehousing and shipment from plant to plant.

drum-buffer-rope (DBR) – The TOC method for scheduling and managing operations when there is an internal resource constraint.
Usage: DBR uses the following: 1. the drum, generally the constraint or capacity constrained resource (CCR), which processes work in a specific sequence based on the customer requested due date and the finite capacity of the resource; 2. time buffers which protect the constraint and shipping schedule from variability; and, 3. a rope mechanism to choke the release of raw materials to match consumption at the constraint. Simplified drum-buffer-rope (S-DBR) challenges the need to schedule the constraint and to have a CCR buffer to protect the schedule. Instead S-DBR monitors the planned load to ensure that the CCR has adequate capacity to handle all the demand to be delivered by the required due dates.
Usage: Both DBR and S-DBR use buffer management to continuously improve a production environment.
See: assembly buffer, buffer, buffer management, capacity-constrained resource, constraint buffer, drum resource, drum schedule, shipping buffer, simplified drum-buffer-rope.

drum-buffer-rope for goods (DBR_G) – The traditional TOC application of drum buffer rope for the production of goods, in contrast to the application of DBR to services, particularly professional, scientific and technical services (DBR_S).

See: drum-buffer-rope for services.

drum-buffer-rope for services (DBR_S) – The application of drum buffer rope to services, particularly professional, scientific and technical services, in contrast to the traditional TOC application of DBR for the production of goods (DBR_G).
See: drum buffer rope for goods.

dummy constraint – A constraint that is inexpensive relative to other resources in the system.

dynamic buffer management – The procedures for making changes to the target inventory levels in a make-to-availability system based on behavior patterns of the finished goods inventory.

dynamic buffer sizing – The process of resizing buffers based on monitoring of the number of jobs that require too little or too much expediting.

elephant items – Items that sell slowly relative to their stock levels, resulting in relatively low inventory turns.
Usage: Due to the relationship between variability and stock levels, elephant items are those that have relatively low demand in relationship to the variability of demand, or for which demand has decreased.
See: cheetah items.

elephant order – A large manufacturing order placed to restructure a buffer to a new higher buffer target.
Usage: Elephant orders are usually triggered when a buffer has penetrated the red region three consecutive times and the buffer target or limit has been increased by one third. The order is the difference between the last red region position and the new buffer limit. This order is usually significantly larger than a normal order and therefore slows down the flow of other later orders released to the shop floor.
Example: Suppose the buffer target is currently 300 units, current buffer status is 60 and the buffer status has been in the red zone for the past three review cycles. Order quantity is therefore:

Order quantity =	1 1/3 (current buffer max)	–	current buffer status	+	in-transit inventory
=	1 1/3 (300)	–	60	+	0
=	400	–	60	+	0
=	340 units.				

See: buffer management.

finished goods buffer – In a make-to-availability environment, a quantity of finished goods that provides instant availability to the next link in the supply chain. Elements of the finished goods buffer that are important are the target size and the actual on-hand inventory (buffer status) at this location and at this time. The primary finished goods buffer is located strategically at a central warehouse. Replenishment by the retailer, distributor, and/or regional warehouse is pulled through the supply chain from the central warehouse. The status of the finished goods

buffer at the central warehouse provides the release timing and quantity for production to replenish it.

See: actively synchronized replenishment, demand driven material requirements planning, make to availability, raw material buffer, stock buffer, work-in-process buffer.

floating bottlenecks – A situation in which the bottleneck changes over time due to changes in product mix.

Usage: The appearance of floating bottlenecks is a function of the degree to which a plant is balanced and the extent to which the product mix changes over time. The closer a plant is to being balanced, the smaller the change in product mix that is required to cause the constraint to move.

four concepts of flow – Production concepts underlying Ford's assembly line and Ohno's Toyota Production System are:
1. Improving flow (or equivalently lead time) is a primary objective of operations.
2. This primary objective should be translated into a practical mechanism that guides the operation when not to produce (prevents overproduction).
3. Local efficiencies must be abolished.
4. A focusing process to balance flow must be in place.

free goods – Goods that do not require processing on the constraint resource, i.e., goods that are produced solely on non-constraints.

full kitting – 1. In drum-buffer-rope and simplified drum-buffer-rope, the process of staging or ensuring availability of all inputs (raw materials, tooling, specs, etc.) for an upcoming manufacturing order prior to release to the shop floor. 2. The process of clarifying requirements, getting approvals, staging materials, etc. for a project before release to the system.

Syn.: kitting.

kitting

Syn.: full kitting.

full planned load – In a make-to-availability system, the load that includes all production orders and all replenishment orders that are not yet released. In a mixed environment, containing both make-to-order and make-to-availability production orders, the full planned load should include also all the make-to-order orders including those whose due-dates are within the planned horizon of time but have not yet been released.

Usage: The full planned load differs from the planned load in a make-to-availability system in that sometimes there are replenishment orders that have not yet been released to the shop floor due to temporary capacity limitations. The full planned load takes these released orders into account. When considering the full load versus capacity on the CCR one should use the full planned load.

See: current planned load date, planned load.

garbage time (of a bottleneck) – Time spent by a bottleneck resource that either should not be done at all or that a non-bottleneck resource should be doing.

green check period – The length of time that an item can be in the green zone before deciding for a recommendation to reduce the buffer (i.e., the target level) for the item is made. The recommended default length of the green check period is twice the replenishment time.

Usage: If an item is continuously in the green zone of the buffer for twice the replenishment period, consideration should be given to reducing the buffer target for the item.

hole in the buffer

Syn.: buffer hole

holistic operations rules – The processes for managing operations from a system perspective. These processes are drum-buffer-rope (simplified drum-buffer-rope) and buffer management.

holistic project management rules – The process for managing a project from a systems perspective. These processes include:

1. Achievement of delivery commitments is the primary measure for managing projects.
2. Challenging but achievable estimates of task duration are used.
3. Resource conflicts are resolved and the critical chain through the network is determined. Resources are monitored to identify potential critical resources.
4. Buffers are inserted at strategic points.
5. Buffer management is used for corrective actions and causes of buffer penetration are reviewed periodically as part of the process of on-going improvement.

holistic supply chain rules – The process for managing a supply chain from a systems perspective. These processes include:

1. Using a central warehouse to aggregate the statistical fluctuations of both supply and demand.
2. Retailers and distribution centers ordering daily and replenishing frequently.
3. Using buffer management to adjust buffer levels, set priorities and improve flow.

inventory turns sales offer – An offer to customers to increase their inventory turns significantly by implementing the make-to-availability strategy. Distributors' and retailers' prime measure is return on investment (inventory) and by reducing inventory significantly and maintaining or improving sales (through less stock outs) the return on investment increases significantly (even more so if the inventory investment saving is reinvested in inventory variety to increase sales more so).

just-in-time manufacturing management philosophy

Syn.: Toyota Production System.

See: lean manufacturing management philosophy.

lean manufacturing management philosophy – A pull production philosophy focusing on the elimination of waste (time, resources, materials, etc.) and non-value-adding tasks to increase flow and reliability. Lean tools include mixed model scheduling, level production, kanban, multi-skilled workers, productivity improvement groups, total quality management, setup reduction, value stream mapping, preventative maintenance, mistake proofing, one-piece flow, quality at the source, supplier partnerships, five whys, U-lines, and work place organization, five Ss (sort, simplify, scrub, standardize and sustain), and Kaizen (improvement process).

lean supply chain management philosophy – A holistic supply chain philosophy using a pull distribution method. Ideally a day's worth of demand is made and shipped each day. Mixed model scheduling and shipping system in addition to a kanban control system are frequently components of a lean supply chain. In some lean chains, shipments are directly to the user's production assembly line with appropriate sequencing and quantities.

See: lean manufacturing management philosophy, theory of constraints manufacturing philosophy, theory of constraints supply chain management philosophy, traditional manufacturing management philosophy, traditional supply chain management philosophy.

light blue order – A non-priority order that is placed to use protective capacity in make-to-availability and make-to-order environments.

Usage: Light blue orders are worked on when the equipment is idle and work is immediately stopped when other work appears. In make-to-availability environments light blue orders are managed by stock buffer targets. Light blue orders are launched and worked on when idle capacity exists but if necessary the color priority system (green-yellow-red) is implemented to pull the order to completion. Light blue orders are used for item that generally do not compete with the company's other products and are usually sold in a totally segmented market. In both make-to-availability and make-to-order environment where the market cannot be segmented, client orders can be made using the protective capacity if the client is insensitive to long lead times.

load control – 1. In a multi-project critical chain environment, the function of staggering projects so that a new project is not released until one exits the virtual drum or project system. 2. In a production environment (whether drum-buffer-rope or simplified drum-buffer-rope) load control ensures that new production is not released to the shop floor until an equivalent amount of work exits the constraint or shipping buffer.

See: prerelease production lead time.

logical product structure (LPS)

Syn.: product flow diagram.

make-to-availability (MTA) **–** A combination of a marketing message of commitment to the availability of particular items at a particular location with the required production policies for achieving it. Make-to-availability fits a consumption-driven production environment (supplying according to consumption) used to respond immediately and reliably to demand where the customer tolerance time is less than the production lead time, hence inventories are maintained in the supply chain to ensure 100% availability with minimum stock. Customer orders are composed mainly of very small quantities of known (repeat) items and the commitment to the market has to include the maximum immediate demand for a single order, enabling reduced inventories and increasing inventory turns. Stock buffers of finished goods inventory are usually kept at a central or plant warehouse to aggregate orders from downstream links and serve as a basis for production scheduling of manufacturing facilities. The amount consumed from the centralized stock buffers establishes the production quantities and the buffer status determines the priorities for manufacturing. Downstream supply chain links maintain small inventories, order daily and replenish frequently from an upstream centralized manufacturing facility. The manufacturing facility then replenishes its centralized inventory buffer by placing production

orders. The centralized buffer acts as the strategic control point managing both supply and demand across the supply chain.

make-to-availability injections – Conditions that must be in place to effectively manage the supply chain using a make-to-availability management strategy:

1. Management is committed to availability with no excess inventory at the plant (central) warehouse, with the plant (central) warehouse as the major regulator of the whole replenishment system.
2. Stock buffers in the plant (central) warehouse are maintained to ensure 100% availability, with production work orders released according to the consumption from the plant (central) warehouse.
3. Open work orders are prioritized according to the status of their corresponding buffers in the plant (central warehouse).
4. Buffer management for recovery actions is in place.
5. Availability of raw materials and components is monitored and managed.
6. Buffer penetration reasons are reviewed periodically (weekly) for a process of on-going improvement.
7. Capacity is monitored to identify capacity constrained resources and to manage accordingly.
8. Transfer batch sizes are challenged and sized to support flow.

make-to-order injections – Conditions that must be in place to effectively manage production using a make-to-order management strategy:

1. Achievement of the delivery commitments is established as the prime measurement for the production process.
2. Production buffer is set to be challenging but achievable with production work orders released accordingly.
3. Open work orders are prioritized according to the buffer status of the corresponding customer order through the use of buffer management.
4. Buffer management for recovery actions is in place.
5. Availability of the selected critical raw materials and components is monitored/managed.
6. Buffer penetration reasons are reviewed periodically (weekly) for a process of on-going improvement.
7. Capacity is monitored to identify capacity constrained resources and to manage accordingly.
8. Transfer batch sizes are challenged and sized to support flow.

   Usage: While many of the injections of make-to-availability and make-to-order are similar one must be careful. For example, both use stock buffers for raw materials but make-to-availability stocks all raw materials while make-to-order stocks only critical materials. Make-to-availability uses the consumption of stock buffers to prioritize work while make-to-order uses time buffers to prioritize work. Stock buffers may show no change, change slowly or change rapidly while time buffers are depleted uniformly.

market potential lead time – The point in time where a customer is willing to pay a premium for a product or service.

Example: Suppose the industry lead time for a product is 5 weeks. Most customers will base their business on this being the standard. However, customers may be willing to pay a premium for faster deliveries, for example, a 25% price premium for a 3 week delivery, a 50% premium for a 2 week delivery, and so on. In the absence of suppliers with the ability to

respond quickly, the market may be unaware of these premium opportunities. Overnight shipping is an example of this market potential lead time.

minimum batch progression – The distance, in terms of a manufacturing routing, a minimum batch progresses through a manufacturing process.

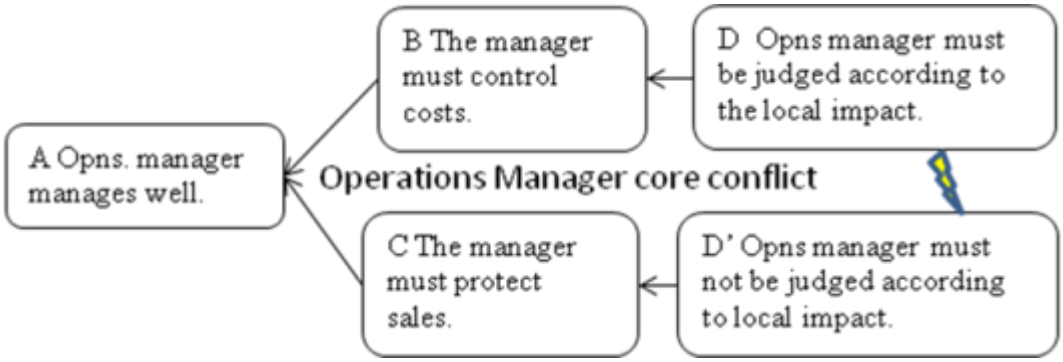
Usage: Some production operations require a minimum batch size (for example, due to the size of a mold). Frequently this minimum batch size is greater than the customer order size. In these cases it might be wise to hold the excess work-in-process inventory immediately after the production operation requiring the minimum batch so that excess finished good are not produced. In V-plants, holding work-in-process inventories after this stage might protect against demand from a number of products; the alternative is to attempt to forecast which finished product will require the finished-goods inventory first.

non-constraint – Resources that have more capacity (many times idle) than the system constraint. Instead of attempting to achieve their full utilization, non-constraints should subordinate themselves to support the constraint in achieving the system's goal. Non-constraint capacity is divided into productive capacity (time to support the constraint production), protective capacity (time needed to catch up when Murphy strikes) and excess capacity (time available for addition throughput opportunities or available for trimming).

See: constraint.

Occam's razor – The simpler the explanation the better. Given a situation where two hypotheses are equally acceptable the hypothesis with the fewer assumptions should be accepted. Occam's razor is also called the principle of parsimony or succinctness.

operations manager core conflict – The traditional rules (local optima) for operations (opns.) manager create a core conflict. The conflict is:



Example: The operations manager is under constant pressure to reduce waste and the biggest waste in operations is viewed as idle time on a resource (person or equipment). The assumption on the BD side of the EC is: BD A resource standing idle is a waste. Therefore the local efficiency measure is used to measure the resource. The operations manager then looks for work (even if it's not needed now) to keep the resource busy. When work is increased on the shop floor local efficiencies go up and top management is satisfied. BUT the increased work in process dilutes the priorities of what work is needed now and inhibits flow which jeopardizes sales.

The TOC solution to this conflict is to use holistic rules for managing the shop floor: drum-buffer-rope (simplified drum-buffer-rope) and buffer management.

order lead time – The time from the consumption (sale in most cases) of an SKU until it is ordered for replenishment.

Usage: During the order lead time the system continues to consume from the stock buffer. Orders are generally placed daily (in some systems they may be placed even more frequently) and shipments are made as frequently as practical. If an item is used on Monday and the order to replenish the item is placed the following Friday, the order lead time is four days. In a reorder point (ROP) system, replenishment orders are not issued until the stock level reaches or drops below the ROP. In TOC distribution orders are typically placed daily, making the order lead time for all items one day.

See: replenishment lead time.

order quantity – The selling point should order the difference between its current on-hand inventory and the buffer target level adjusted for any adjustments in the buffer level minus in-transit inventory (inventory already ordered but not received).

Example: Suppose the buffer target is 300 units, current on-hand inventory (buffer status) is 225 and 20 units are in-transit. Order quantity is therefore:

Order quantity = buffer target – (current on-hand inventory + in-transit inventory)
= 300 – (225 + 20)
= 55 units

See: buffer status, buffer target, replenishment time.

penetration (of the buffer)

Syn.: buffer penetration.

permanent bottleneck – Functions that continue to be internal bottlenecks regardless of the level of resources committed.

Usage: In service organizations, the information technology (IT) function and the sales and marketing function are permanent bottlenecks.

planned load – The total load on a resource of all the firm orders that have to be delivered within a certain horizon of time. The time horizon used to determine the planned load is generally longer than the production buffer by at least a factor of two. The planned load is used extensively in simplified drum buffer rope (SDBR) to ensure smooth flow and to make due date commitments that can be reliably achieved.

Usage: Planned load is used to validate that a relatively loaded resource has enough capacity to meet the market requirements. It is also used to quote safe delivery dates by means of adding half of the time buffer to the current front of the planned-load to denote a "safe-date" to promise delivery. The release time for the just-received order is the front of the planned-load minus half of the time buffer.

prerelease lead time – The time between acceptance and administration supporting a customer order and the release of the order to the production (project) process.

Usage: Prerelease lead time is required so that orders do not flood the production (project) process. The clock for prerelease lead time starts after order processing and provides the time

essential to ensure the smooth flow of the order through the production process. The length of time is primarily determined by the load on the production (project) process and the urgency of the customer order. The termination of this lead time is determined by the rope signal in drum-buffer-rope (or simplified drum-buffer-rope) or the signal to start a new project in critical chain project management.
See: replenishment lead time.

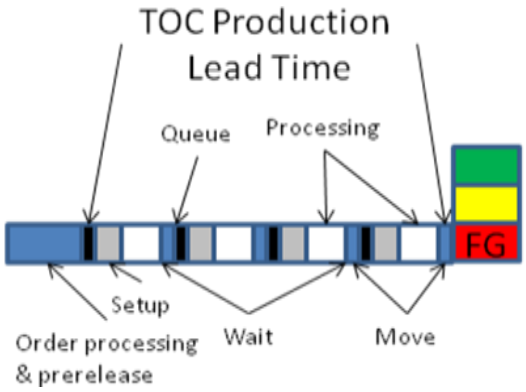
prerelease queue – A queue of orders that have not yet been released to the shop floor because their production buffer (reliable production lead time) does not require them to be released yet

product flow diagram (PFD) – A diagram of a production system that shows the material flow from raw materials to finished products through the system.
Usage: In a product flow diagram, each operation performed by a resource is indicated by a separate representation of the resource. If, for example, resource R1 performs four different operations, the symbol for R1 will appear four times on the product flow diagram. A product flow diagram illustrates both the material dependency of products and processes as well as resource dependency, or what resources are required to produce each end item.
Syn.: logical product structure.

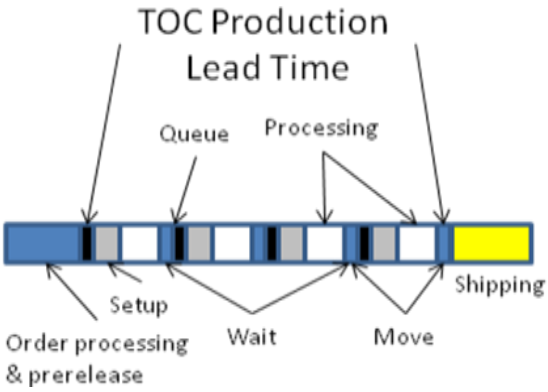
production buffer – In simplified drum-buffer-rope, the amount of time required to reliably complete production of the work order. Due to the unavoidable existence of disruptions in production environments, the time required will be larger than just the sum of individual production steps. The production buffer is sized to dramatically reduce the likelihood that variation in the system will cause missing the due date, yet not result in excessive work-in-process inventory.
Usage: When an order is placed with a specific due date, the order might have to wait for release to the shop floor either due to the current load on the shop floor or due to the fact that from now to the customer order due date is longer than the production buffer. This wait time is prerelease production lead time and is not part of the production buffer.
Perspective: The simplified drum-buffer-rope approach to buffering is quite different from the lean kanban approach. While both are pull systems, kanban includes buffers between each sequential pair of work centers while simplified drum-buffer-rope ties the rope from order completion, based on customer due date, to release of raw materials across the entire production process. This production buffer approach significantly reduces lead time and work-in-process inventories compared to kanban. It also can be used in very complex routings such as job shop environments.
Syn.: reliable production lead time.
See: buffer management, constraint buffer, make-to-availability, shipping buffer.

production lead time (PLT**)** – The total time from when a manufacturing order is released to the shop floor until the order is ready for shipment (make-to-order) or placement in finished goods (make-to-availability). See below. PLT is comprised of:
1. Queue time for a machine to be available for the WO (the resource that is needed for the next operation is occupied and there is a queue of WOs to be processed);
2. Setup time for the assigned machine to get ready to process the specific WO;
3. Process time – the actual time when the material is being worked on;

4. Wait and move times occur when an order is completed at one work center and it has to be moved to another work center; and
5. Protective time – to cover for unexpected and unplanned activities – "Murphy."



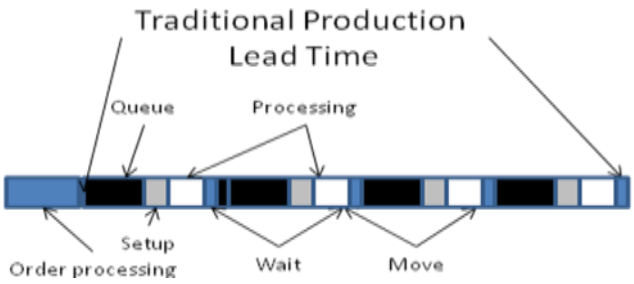
Make-to-availability environment



Make-to-order environment

Order processing lead time (the time to process the customer order at the manufacturer) and prerelease time (the time until release to the shop floor) occur prior to the TOC production lead time. Placement into the finished goods inventory in a make-to-availability environment marks the end of the production lead time. Shipment to the customer in a make-to-order environment marks the end of the production lead time.

Perspective: In contrast to traditional production lead time where once order processing is complete the manufacturing order is released to the shop floor regardless of the current load on the shop. Thus queues are significantly longer and therefore production lead time is longer.



See: replenishment lead time.

productive capacity – Resource capacity that is required to produce output sufficient to satisfy the demand of the constraint.

Perspective: Resource capacity is divided into two types: productive and idle. Idle capacity is further divided into protective and excess. While some believe that all capacity beyond productive capacity is waste, TOC claims that some protective capacity is needed at non constraint resources in order to protect the throughput of the system. When everything is running smoothly there might be considerable idle capacity. But when Murphy strikes some protective capacity is needed to fill the buffers back up. Capacity above protective is excess capacity and provides management additional sales opportunities.

Syn.: sprint capacity.
See: excess capacity, idle capacity, protective capacity, waste.

pull management philosophy – In manufacturing and supply chain the pull of materials or finished goods to downstream operations or links in the supply chain based on actual demand. Both lean and theory of constraints manufacturing and distribution systems are pull systems.

pull seasonality – A situation in which the environment determines the demand pattern for an item and the organization is unable to influence the pattern.
See: push seasonality.

push management philosophy – In manufacturing and supply chains materials and finished products are pushed down stream in the plant and in the supply chain respectively based on a forecast of consumption for the consumer.

push seasonality – A situation in which the organization takes actions that create a peak in demand.
Usage: Actions that can create a peak in demand include promotions, announcement of future price increases, and use of measures that motivate salespeople to increase sales at the end of a financial reporting period.
See: pull seasonality.

raw material buffer – A stock of raw materials that provides instant availability to a gateway process. These buffers are usually used for material with long lead time and with high enough demand to warrant stocking.
Usage: In some instances lead time to get raw materials is too long to react to market demand. In these instances a raw material buffer can be held at or near the plant to ensure that key materials and/or long lead time raw materials are available when needed.
See: actively synchronized replenishment, demand driven material requirements planning, finished goods buffer, make to availability, stock buffer, work-in-process buffer.

reasonable max level
Syn.: buffer target level

region I
Syn.: red zone.

region II
Syn.: yellow zone.

region III
Syn.: green zone.

reliable production lead time (RPLT)
Syn.: production buffer.

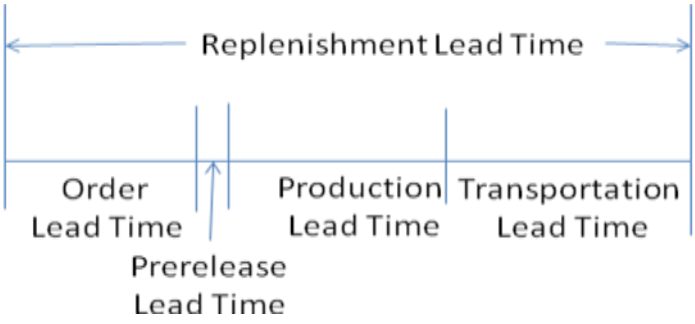
reliable replenishment time – The time within which a part can reliably (80-95% of the time without expediting) be obtained if absolutely necessary.
Syn.: time to reliably replenish.

replenishment for goods (R_G) – The traditional TOC application for distribution of goods, in contrast to TOC replenishment for services, particularly professional, scientific and technical services, (R_S).

replenishment for services (R_S) – The TOC application for resource management in services, particularly professional, scientific and technical services, in contrast to TOC replenishment for goods (R_G).

replenishment lead time – The time from order placement to restocking an item. It can be composed of the sum of the order, pre-release, production and transportation lead times. Replenishment lead time is calculated as:
= order lead time + prerelease lead time + production lead time + transportation lead time
where:

- order lead time is the time it takes the client to place the order;
- prerelease lead time is the time that the order waits to be released under a drum-buffer-rope (or simplified-drum-buffer-rope) scheduling system;
- production lead time is the time to manufacture including setup, queue, processing, post operation wait, and move times; and
- transportation lead time is the shipment time from manufacturing facility to customer location.



resource alert
Syn.: resource buffer.

return on investment $_{SKU}$ (ROI_{SKU}) – The return on the investment in a particular stock-keeping unit (SKU) in a supply chain. The ROI_{SKU} is calculated as:
ROI_{SKU} = (Annual T of SKU) / (TVC/unit x buffer size for SKU) x 100%
Where TVC are the truly variable costs per unit of the item.

ROI_{SKU} – Abbreviation for return on investment$_{SKU}$.

seven focusing steps – A set of seven steps consisting of the original five focusing steps plus two additional steps inserted at the beginning of the process:

1. State the goal of the organization.
2. Define global performance measures.

Seven focusing steps are appropriate for not-for-profit and government organizations where the goal is different from making more money and a clear definition throughput based on goal units is necessary to construct a global performance measurement system.

See: five focusing steps, goal, process of on-going improvement, throughput.

simplified drum-buffer-rope (S-DBR) – The process of managing operations based upon the market drum and a shipping buffer (in this application called a production buffer) while monitoring the planned load on any capacity constrained resources. More recent developments of S-DBR have added a mechanism to quote safe dates for delivery.

Usage: S-DBR can be used in the vast majority of shop floors with the one exception of having sequence-dependent setups. The rationale of S-DBR is that the market demand is the major constraint, but it does not preclude the possibility having a capacity-constraint resource(s). The capacity control in SDBR is done through the planned-load. It only uses one type of buffer, namely, the production buffer.

See: capacity constrained resource, drum, planned load, production buffer.

star return on investment items – Items that have very high return on investment (calculated as annual throughput for the item divided by the raw material investment in the buffer for the item).

See: black hole return on investment.

starvation – In TOC, the condition of the constraint being idle due to lack of material to process.

Usage: In traditional manufacturing, starvation applies to all work centers; in contrast, in a drum-buffer-rope system the focus is on preventing starvation at the constraint because starvation at the constraint causes throughput loss. The constraint is protected against starvation by a buffer between the constraint and upstream work centers. Three sources of lost throughput in a drum-buffer-rope system are: starvation, blockage, and breakage of the constraint.

See: blocking, breakage.

stock buffer – A quantity of material held at a point in the supply chain to decouple demand from supply. The point where stock buffers are held can be at the raw material stage, at an intermediate production stage (as work-in-process inventory) or at the finished goods stage. Stock buffers reduce the lead time to market (quoted lead time) and protect the system's throughput.

Perspective: Stock buffers are used in both make-to-availability and make-to-order environments for raw materials and in-process items. Finished goods stock buffers are also used in plant (central), regional, and distributor warehouses and retailers. In contrast, time buffers are used for constraint, assembly, shipping, and production buffers in make-to-order environments. Stock and time buffers should not be confused.

Syn.: piece buffer.

See: buffer, time buffer.

strategic constraint – A resource whose capacity is very expensive or difficult to elevate and thus there is a desire to grow to the state where this resource becomes the constraint.

strategic gating – The process of prioritizing tasks for execution based on their value to the organization.

supply lead time – 1. The time to replenish a buffer if using stock buffers and buffer management. 2. The time to process the purchase order and ship the item to a customer for make-to-availability items. 3. The time to process the purchase order, manufacture the item, and ship it to the customer for make-to-order items.

tactical gating – The controlled release mechanism for service tasks.

Usage: Tactical gating is based on the following principles:

1. DBR scheduling
2. Use of full kitting
3. Small batches
4. Recognition of task priority as determined by strategic gating.

target level – In a make-to-availability system, the total desired level of finished goods plus work-in-progress inventory that is required to assure availability for a part.

Usage: In a make-to-availability system all of this material representing the target level does not have to be at the finished goods stage – some will be in finished goods and some will be in process or in-transit. The initial target level is defined by the "maximum" forecasted consumption within average replenishment time factored by unreliability of the replenishment time. In practice the initial target level can be calculated by either (a) multiplying the average demand within replenishment time by a factor of 1.5 - 2.0, or (b) use the actual maximum sales that have occurred during the reliable replenishment time based on sales history for the most recent six to 12 months. After implementation buffer management is usually to self-adjust the target level based on actual demand pulls.

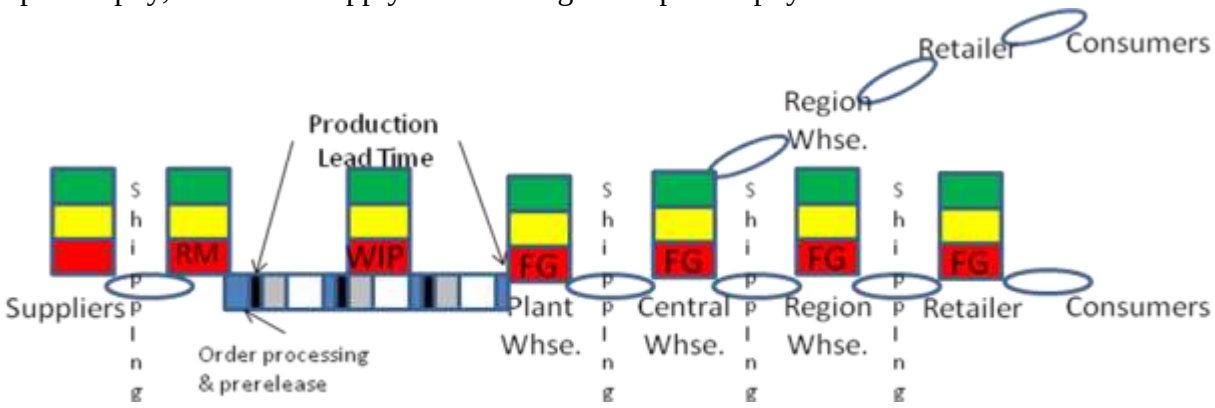
theory of constraints manufacturing management philosophy – A holistic manufacturing philosophy using a pull distribution method that applies to all types of manufacturing: make-to-availability, make-to-order, engineer-to-order, etc. in a wide array of plant types: I-plants, V-plants, A-plants, T-plants and combination plants. It is based on planning, controlling and monitoring a few control points (gating, divergent, convergent, shipping) based on the constraint capacity whether the constraint is a resource or the market. Throughput accounting with its measures of throughput, inventory and operating expense are considered an integral part of this philosophy. This allows focusing on the throughput opportunities available to the organization. Methods for sales, marketing, project management, human resources, and strategy and tactics also have been developed in making it a holistic philosophy.

See: lean manufacturing management philosophy, lean supply chain management philosophy, theory of constraints manufacturing philosophy, traditional supply chain management philosophy, traditional supply chain management philosophy.

theory of constraints supply chain management philosophy – A holistic supply chain philosophy using a pull distribution method that involves setting stock buffer sizes and then monitoring and replenishing inventory within a supply chain based on the actual consumption of the end user, rather than a forecast. Each link in the supply chain holds the maximum expected demand within the average replenishment time, factored by the level of unreliability in replenishment time. Each link generally receives what was shipped or sold, though this amount is

adjusted up or down when buffer management detects changes in the demand pattern. Shipments usually are frequent and replenish all items to the appropriate buffer level.

See: lean manufacturing management philosophy, lean supply chain management philosophy, theory of constraints manufacturing philosophy, traditional supply chain management philosophy, traditional supply chain management philosophy.



throughput per shelf – Throughput per unit of shelf space in a specified period of time.

time to reliably replenish (TRR)

Syn.: reliable replenishment time.

TOC_G – TOC for goods, in contrast to TOC for services, particularly professional, scientific and technical services (TOC_S).

TOC_S – TOC for services, particularly professional, scientific and technical services, in contrast to TOC for goods (TOC_G).

too much green – A condition in which the buffer status has remained in the green zone for too long (usually three replenishment cycles), indicating that the buffer target is too high. The buffer target is usually lowered one third.

too much red – A condition in which the buffer status has remained in the red zone for too long (usually three replenishment cycles), indicating that the buffer target is too low. The buffer target is usually raised one third.

touch time – The time in the life of a manufactured product (or a project) where the product is physically being worked on – the product is being touched by a person or machine. In typical production operations products spend most of the time waiting in queue – touch times tend to be less than 10% of the total production lead time. The ratio of touch time to total lead time provides a measure of appropriateness of the production versus the project management methodology for a process. The higher the percentage of touch time versus total lead time the more appropriate critical chain is versus the drum-buffer-rope (or simplified drum-buffer-rope) production solution. A second measure used to determine which TOC methodology to use is degree of uncertainty of the process. The higher the degree of uncertainty of tasks the more appropriate is critical chain.

Usage: The touch time is one method of determining whether a process should be planned and controlled using the production or the project solution. The higher the touch time compared to the

total lead time the more appropriate is critical chain project management rather than drum-buffer-rope or simplified drum-buffer-rope.

Toyota production system (TPS**) –** A manufacturing philosophy originated by Toyota Motor Company that focuses on reducing setup times, batch sizes, lead times, and variations to reduce waste and increases flow and quality.

Perspective: Many of the Toyota production system concepts are based on Henry Ford's assembly line concepts. The Toyota production system is the predecessor of the Just-in-time and lean manufacturing philosophies. The Toyota Production System was highly successful at Toyota Motor Company and was based on getting inventories to the user just-in-time. When consultants and managers in the US brought the Toyota Production System concept and tools to its manufacturers they used the term: Just-in-time philosophy. With the lack of success in implementing Just-in-time in the 1990's, many of its tools gave birth to the lean philosophy. There is little difference among the concepts of the Toyota production system, Just-in-time and lean manufacturing philosophies.

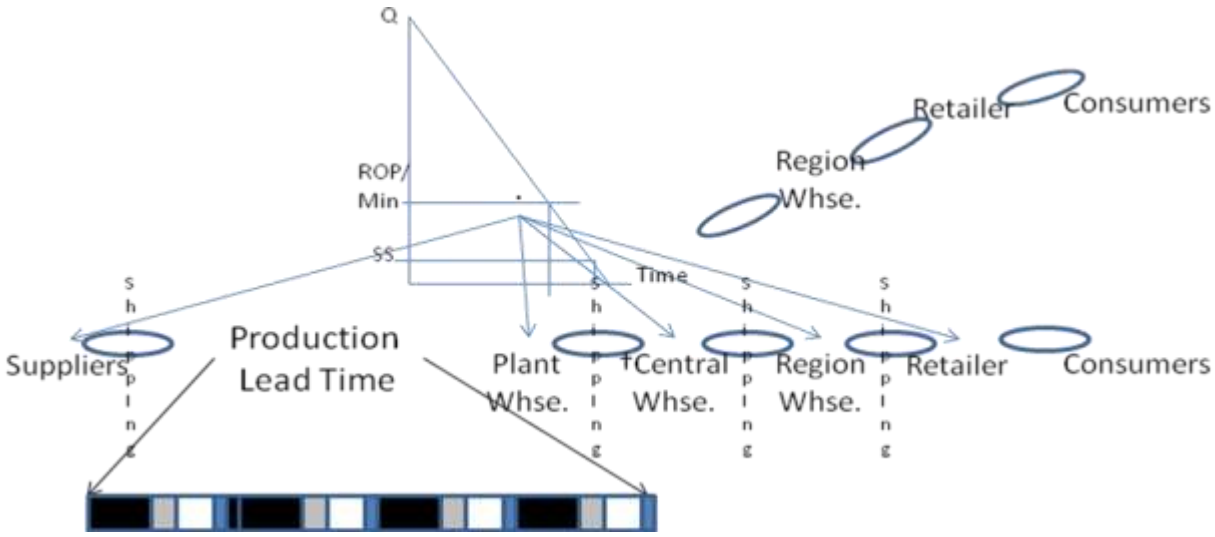
See: lean manufacturing management philosophy.

traditional manufacturing management philosophy – A philosophy of managing a manufacturer that focuses on local optimization to achieve maximum short-term organizational profits. Costs associated with such items as purchasing and transportation lot sizes (generally big batches purchased or transported at reduced prices), materials handling, economic order and production quantities, warehouse and stock locations, etc. are minimized under the assumption that these cost savings translate into additional organization profit. Worker and equipment utilizations and efficiencies are maximized in an attempt to minimize product cost. These manufacturing actions and measures generally result in a push system based on a forecast of consumption and create large production batches pushed into the production process and transferred to downstream links in the supply chain in the attempt to achieving lowest unit cost at each task in the process.

See: lean manufacturing management philosophy, lean supply chain management philosophy, theory of constraints manufacturing philosophy, theory of constraints supply chain management philosophy, traditional supply chain management philosophy.

traditional supply chain management philosophy – A philosophy of managing a supply chain that focuses on local optimization to achieve maximum short-term organizational profits. Costs associated with such items as purchasing and transportation lot sizes, materials handling, warehouse and stock locations, etc. are minimized under the assumption that these cost savings translate into additional organization profit. Worker and equipment utilizations and efficiencies are maximized in an attempt to minimize product cost. These actions generally result in a push system results with a small central warehouse and inventories located throughout the supply chain with each link attempting to minimize its own costs. Lot sizes are generally based on ROP/EOQ or min-max levels for each item. The underlying principle of a traditional supply chain is that "sum of the local optima is equal to the global optima."

See: lean manufacturing management philosophy, lean supply chain management philosophy, theory of constraints manufacturing management philosophy, theory of constraints supply chain management philosophy, traditional supply chain management philosophy.



transportation lead time – The time it takes to ship the goods to the downstream link.

value driver – Any important factor that significantly affects the value of the firm.

virtual buffer penetration – A method of determining the priority at a stock point of shipping an item to a downstream link in the supply chain based on stock status at the downstream link and material in-transit.

wake-up call
Syn.: resource buffer.

white buffer status – In general, an indication that a manufacturing order was released earlier than required. In make-to-availability, white buffer status means that a production work order was released when the stock in the system (on hand plus stock in transport plus open work orders in WIP) exceeds the stock target level. Inventory dollar days should be charged to the item until the buffer level drops to or below the buffer target. White buffer status is a measure of doing things that should not be done.

work-in-process buffer – The strategic placement of stock buffers in the production process to reduce production lead time by decoupling demand and supply.
Usage: This tactic is very useful when there are major divergence points in the production flow.
See: actively synchronized replenishment, demand driven material requirements planning, make-to-availability, raw material buffer, stock buffer, work-in-process buffer.