Acknowledgements

It is a humbling experience to write or edit a dictionary. You immediately find out what you don’t know and how much of what you do know is wrong. In addition, the definitions of terms are constantly changing as we continually develop and define our body of knowledge. We have learned to accept Dr. Goldratt’s 4th pillar of TOC: “never say I know.” From that perspective this has been a rewarding experience.

The second edition of the TOCICO Dictionary could not have been completed without the hard work of a number of volunteer reviewers and term submitters. We sorted the dictionary terms into files based on the certification exams and a miscellaneous category. Some files were well over 100 terms with sometimes two or three definitions for a term and figures supporting the definitions. The review process may have required that a file be reviewed three times in full, and a few stubborn terms required significant back and forth correspondence with a number of individuals.

Alan Barnard, John Blackstone, Oded Cohen, Jelena Fedurko, Rob Newbold, John Schleier, Eli Schragenheim, and Danny Walsh, have the distinction of reviewing and discussing terms from two or more of the six files a number of times. We had many heated discussions with these individuals. As a policy, we always took the opposite position on any definition so that we could get the best arguments from our reviewers. They were worthy adversaries. Many thanks go to each of them; we are in awe of your willingness to help in this massive project.

Charlene Budd, Bill Dettmer, Lisa Ferguson, Ted Hutchin, Vicky Mabin, Carol Ptak, Chad Smith, Shri Srikanth, John Thompson, and Kevin Watson comprise our second group of reviewers and submitters. These individuals reviewed at least one file of terms; again in some cases they reviewed the file two or three times and discussed the dwindling number of terms until we reconciled the last one. Our thanks go to you.

Others individuals submitted terms or reviewed segments of files where they possessed particular expertise. These individuals included Rick Denison, Alex Klarman, Lisa Lang, Lars Peterson, John Ricketts, Rick Stanton, Kathy Suerken, and Julie Wright. Our thanks go to you.

Special thanks go to Dr. Eli Goldratt and Wendy Maxwell for providing the currently correct answer for some really tough questions and their directions on where to find a discussion of an item. The Goldratt Marketing Group allowed access to a number of videos for our review.

Tim Sullivan, one of the 1st edition editors, was extremely helpful in giving us the ground rules used for the first edition so we did not have to start from scratch. And finally Carol Ptak as executive director of TOCICO is amazing. She had the answers we needed and responded immediately to our questions and concerns.

We could not have completed this project without the continued support of our wives and families.

We (Jim Cox and Lynn Boyd) are responsible for any errors that might appear in this volume. Please feel free to contact Lynn if you have any questions or concerns.

The Editors
4-by-4 – A workshop consisting of two four-day blocks: the first four days provide education on the TOC paradigm and the interdependence of the appropriate functional areas (operations, finance and measurements, project management/engineering, distribution/supply chain, marketing, sales, managing people, and strategy); the second 4 days are devoted to identifying the core problem of the organization, the customized solution (including the appropriate functional area solutions), and the implementation roadmap (of injections and intermediate objectives).

See: core problem, throughput-world paradigm.

50% task time estimate – A task time estimate that has a 50% chance (or .5 probability) of being achieved.

Illustration: In the figure below the probabilities given represent the area under the curve to that point in time.

Perspective: The distribution of task times is generally viewed as an asymmetrical positive or skewed to the right distribution, which means the right tail is quite long. Under a significantly skewed distribution, a task time estimate that has 80% chance (or .8 probability) of being achieved might be as much as twice as long as an estimate that has a 50% chance (or .5 probability) of being achieved.

In traditional project management, the resources/resource managers are frequently responsible for and measured based on completing their tasks within the time they have estimated. In view of this responsibility, the resources/resource managers have a strong incentive to provide very high estimated task times. As a result, task time estimates with chance of completion in the 80-90% range are frequently seen. This padding, while seemingly increasing the probability that individual tasks will be completed within the time estimated, has two common effects at the individual task level: either the resource falls victim to the student syndrome and delays starting work on the task until the local protection built into the task estimate is gone, or the resource finishes the task early and continues to “improve” or find other things to do until the task time is consumed (Parkinson’s Law). In addition, using 80-90% task time estimates causes the project duration to be inflated without providing protection for the whole project because the protection built into individual task estimates is used up task-by-task as each task is completed.

In contrast, with the critical chain approach, resources and resource managers are responsible for providing a “50% task time estimate” and are not held responsible for achieving the estimate. Protection is provided by the project buffer for all critical chain tasks and by feeding buffers for non-critical-chain tasks. Frequently the conversion of the given task estimate to a “50% task time estimate” is used in the implementation of critical chain project management. After resources are comfortable with the critical chain methodology they are asked to estimate their own 50% task times. Time estimates may also be established based on task touch times. No matter how the task times are determined they should be challenging but achievable. While the basis for task time estimates may differ, the overarching rule is that the project buffer is 1/3 of the project duration.
Caution: Some lead times are static or fixed. In those cases, a 50% task time estimate is unrealistic and unachievable.
See: Parkinson’s Law, static lead time, student syndrome, touch time.

A-plant – A production environment that begins with a relatively large number of raw materials that pass through a succession of converging operations that create subassemblies, assemblies, and, finally, a relatively small number of end items. The letter A is used to represent the logical network of material flow, which has no relationship to the physical plant layout, because it is wide at the bottom (many raw materials), and converges at the top (few end products).

Examples: The manufacture of helicopters, kitchen cabinets, and footwear.

See: VATI analysis, convergent point.

activation – Putting a resource to work.

Usage: TOC claims that activating a resource is not the same as utilizing it productively to achieve more of the goal. If the work being done is in excess of what is needed to fully exploit the constraint or properly subordinate to it, then the result will be excess work-in-process inventory and/or excess finished goods.

Perspective: In traditional management, non-constraints are frequently activated to levels above what is needed to exploit the constraint (over activation). In TOC non-constraints are activated to level needed to fully exploit (utilize) the constraint.

See: constraint, exploit, over activation, subordinate, utilization.

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

Perspective: ASR is the integration of a pull distribution system with a demand driven material requirements planning system. In contrast, traditional material and distribution requirement planning systems forecast demand for finished products and push inventories through the logistics system based on these forecasts.

See: decoupled explosion, demand driven material requirement planning, strategic inventory positioning.

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

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

See: actively synchronized replenishment.

additional cause reservation – A level III reservation in the categories of legitimate reservation that is used by a person scrutinizing a sufficiency-based logic diagram to question whether the stated cause(s) is(are) sufficient to fully account for the stated effect. A justifiable additional cause will have a significant impact on the stated effect.

Example: The diagram on the left below is read as follows: If 10 My car gets very poor gas mileage then 20 I prefer to take the bus to work. A scrutinizer may use the additional cause reservation to suggest that, 15 I like to read on my way to work, could also be a legitimate cause of preferring to take the bus. The diagram on the right is read as follows: If 10 My car gets very poor gas mileage then 20 I prefer to take the bus to work. If 15 I like to read on my way to work then 20 I prefer to take the bus to work. The two independent causes are described as a magnitudinal ‘and’ connector.
Perspective: A legitimate additional cause will tighten the logic underlying the observed effect and more fully explain its magnitude. Neither cause by itself can fully account for the magnitude or extent of the effect. A scrutinizer may propose an additional cause and the diagram presenter may accept it if its impact is significant. The additional cause reservation is important because eliminating only one of multiple independent causes will not overcome the effect entirely.

See: categories of legitimate reservation, magnitudinal ‘and’ connector, scrutiny, sufficiency-based logic.

**additive rule** – This rule states that local values of a given parameter can be added together to calculate the global value.

**Perspective:** In the cost-world paradigm, the cost savings in one department are added to the cost savings in every other department to determine overall impact; in this manner the cost-world paradigm follows the additive rule when it claims that global improvement is the sum of all the local improvements. In the throughput-world paradigm of TOC, the throughput of one department can NOT be added to the throughput of every other department to determine global throughput; thus throughput does not follow the additive rule. In the throughput-world paradigm global improvement is NOT the sum of all the local improvements.

See: cost-world paradigm, throughput-world paradigm.

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

**aggregation of variability** – 1. The fact that the statistical fluctuation of the time required to complete a series of dependent events or processes is less than the sum total of the statistical fluctuations of each event or process. 2. In a distribution system the variation in demand is less at an aggregation point, such as a warehouse, than at the individual consumption points.

**Usage:** Drum-buffer-rope uses this concept to strategically locate a small number of buffers that usually result in a significant reduction in total inventory and an increase in due date performance. Critical chain project management uses this concept to strategically locate buffers that protect series of tasks which usually results in a significant reduction in project duration and an increase in due date performance. The distribution/replenishment solution reduces the amount of inventory held at consumption points and instead focuses on holding the appropriate level of inventory buffers at aggregation points which usually results in significant reduction in the total inventory in the system and an increase in fill rate.

See: buffer, critical chain project management, distribution/replenishment solution, drum-buffer-rope, statistical fluctuations, dependent events.

**alignment of responsibility and authority** – This well-known organizational behavior principle is the primary injection to the lieutenant’s evaporating cloud, or conflict cloud, in the management of human behavior. The template for the lieutenant’s cloud is provided below. The injection to the lieutenant’s cloud is the proper alignment of responsibility and authority. To construct the lieutenant’s cloud for an alignment conflict answer the questions in each box.
Illustration: In this story line, the company has experienced problems in the past when multiple people inside the company speak directly to the customer. A policy was established that only the account manager can speak with the customer. It happened, however, that the account manager was not available when the shipping manager needed to ask the customer a question about an order that needed to ship immediately or it would be late. The shipping manager (the “lieutenant”) was responsible to ship the order on time but lacked the authority to contact the customer in order to get the information needed to fulfill his/her responsibility. As shown in the cloud below, the injection to evaporate this cloud is giving the lieutenant the authority to contact the customer when it has a direct impact on his or her ability to fulfill the responsibility of shipping on time.

See: assumption, evaporating cloud, injection, lieutenant's cloud.

**ambitious target** — A goal that is considered to be very desirable and yet appears to be unattainable.  
**Usage:** For the vast majority of managers, there is uncertainty surrounding how to go about achieving an ambitious target. Both prerequisite trees and strategy and tactics trees are thinking processes logic tools that can be used to determine how to achieve an ambitious target.  
**Example:** The following statement would be an ambitious target for most firms: “Our company will have annual net profit equal to current total sales within the next four years”.  
**See:** ambitious target tree, prerequisite tree, strategy and tactics tree, thinking processes.
**ambitious target tree** – A necessity-based logic diagram that facilitates the construction of strategic and tactical plans in order to achieve an ambitious target by analyzing obstacles and developing intermediate objectives.

**Usage:** The logic of the ambitious target tree is not subject to sufficiency reservations. The tree in total should be subjected to a completeness reservation, however, by asking whether the tree includes everything needed in order to achieve the ambitious target. The ambitious target tree is similar to the prerequisite tree and is commonly used by Theory of Constraints for Education (TOCfE) advocates in teaching children and in school administration project planning.

**See:** intermediate objectives map, prerequisite tree.

**‘and’ connector** – Use to describe the type of relationship between an effect and its causes. Two types of relationship exist; one (magnitudinal ‘and’ connector) where the causes are independent and both or all of the causes have to be addressed to eliminate the effect and the second (logical ‘and’ connector) where two or more causes are dependent (have to coexist) for the effect to exist. Only one of the causes has to be eliminated to eliminate the effect.

**See:** logical ‘and’ connector, conceptual ‘and’ connector, magnitudinal ‘and’ connector.

**Archimedes lever point** – Archimedes stated: “Give me a place to stand, and a lever long enough and I shall move the earth.” This principle is applied in TOC to describe a system composed of many components. A change to only one or a very few components causes significant change in the system performance with respect to its goal. The TOC processes of ongoing improvement focus on identifying and managing the leverage point(s) in a system.

**See:** complexity, feedback loops, fundamental assumptions (of TOC), leverage point, processes of ongoing improvement.

**arrow as a connector** – Use of an arrow in logic diagrams to denote a logical connection between entities.

**Usage 1:** In sufficiency-based logic diagrams such as the current reality tree, future reality tree, and transition tree, the arrow denotes an “if... then...” relationship. As shown in Illustration 1, the cause is at the tail of the arrow and the effect is at the point of the arrow.

**Illustration 1:** The sufficiency-based logic diagram on the right below is verbalized: If 10 My car is out of gas then 20 I cannot drive my car.

![Illustration 1](image1)

**Usage 2:** In necessity-based logic diagrams such as the evaporating cloud and the prerequisite tree, the arrow indicates that the entity at the tail of the arrow is a necessary condition for the existence of the entity at the point of the arrow.

**Illustration 2:** The necessity-based logic diagram on the right below is verbalized: B In order I have food to eat, D I must have money to buy food.

![Illustration 2](image2)
See: entity, necessity-based logic, sufficiency-based logic.

ASR – Abbreviation for actively synchronized replenishment.

assembly buffer – A time buffer used in an operations environment to ensure that parts that do not flow through a constraint resource, but are assembled with parts that do, are released early enough so that the probability is very high that the constraint parts will continue to flow without delay once they arrive at the assembly operation.

Usage: The assembly buffer is not as commonly used as the constraint and shipping buffers. If variation affecting parts not going through the constraint, capacity-constrained resource or drum resource degrades system performance, an assembly buffer should be used. This type of buffer is not used in simplified DBR.

See: buffer, constraint buffer, shipping buffer, simplified drum-buffer-rope, time buffer.

assumption – A statement, condition, or belief about why a logical relationship exists between entities.

Usage: Assumptions may or may not be shown or verbalized on logic diagrams, but they always exist. Further, assumptions may or may not be valid. Every logical relationship portrayed in all thinking processes (TP) logic diagrams has one or more underlying assumptions. Some assumptions are considered to be 'oxygen', that is, true and well understood by most people throughout our world, and thus, do not have to be documented. When a scrutinizer says, "what's underneath the arrow?" he or she is really asking the TP diagram creator to explain the assumption(s) that allows two entities to be logically connected.

Illustration 1: In sufficiency-based logic diagrams such as the current reality tree, future reality tree, and transition tree, an assumption is often considered to be a valid condition for the system being assessed and usually is accepted without question. The following diagram is verbalized: If 10 I have a dog then 30 I have an animal because All dogs are animals. The statement, All dogs are animals, is the underlying assumption.

Illustration 2: In necessity-based logic diagrams such as the evaporating cloud and the prerequisite tree, the rationale for the necessary condition is verbalized as follows: B In order that I have food to eat, D I must have money to buy food, because BD I must pay for food. The latter phrase is the assumption.

See: evaporating cloud, necessary condition, necessity-based logic, sufficiency-based logic, thinking processes.

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.

banana – Colloquial term used to describe the logical ‘and’ connector.
Usage: In the early days of the thinking processes hand drawn diagrams were common. An ellipse designated a logical ‘and’ connector, however an ellipse drawn by hand frequently looked like a banana. Hence the term banana was commonly used to describe this connector.
Syn.: ellipse, logical ‘and’ connector.

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 (the project is late with respect to customer due 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.

black zone (of the buffer) – In some buffer management applications, a black zone is identified in addition to the three standard zones (green, yellow and red) and orders that are late are shown in the black zone.
See: buffer, buffer management, green zone, hole, red zone, white zone, yellow zone.

blockage – 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.

BM – Abbreviation for buffer management.

bottleneck resource – Any resource whose capacity is less than or equal to the demand placed on it for the specified time horizon.
Usage: Often this term is confused with or incorrectly used interchangeably with similar terms like capacity-constrained resource, drum resource and constraint. Many times policies (batching policies, process batch equal to transfer batch, managing to efficiencies, end-of-the-month syndrome, etc.) cause resources to be incorrectly diagnosed as bottleneck resources. Once these policies are eliminated using steps 2 and 3 of the five focusing steps and replaced with effective policies supporting drum-buffer-rope or simplified drum-buffer-rope, these resources have ample capacity and the market becomes the constraint.

See: capacity-constrained resource, constraint, drum resource, interactive constraint, wandering bottleneck.

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 on the constraint is reduced by the use of constraint and space time 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.

See: blockage, constraint buffer, space buffer, starvation, time buffer.

breakthrough injection – A special state of being or condition designed to dramatically resolve the conflict. This injection is often a highly creative, win-win, out-of-the-box solution to a chronic conflict.

Usage: Usually, there is no experience in the organization with this type of solution. Creating a breakthrough injection is much more than restructuring a compromise or making a minor change to resolve the conflict. Often, a breakthrough injection goes beyond the surface conflict to address a deeper or more generic conflict. Most of TOC’s proven solutions such as drum-buffer-rope, buffer management, critical chain, and the distribution/replenishment solution are considered to be breakthrough injections.

Illustration: The decision to sell comprehensive maintenance and repair service to Pressure Steam’s customers is the breakthrough injection that evaporated the cloud that expressed the conflict of their need to lower prices and raise prices at the same time. (Reference: Goldratt, It's Not Luck, 1994, 252.)

See: chronic conflict, generic cloud, injection, primary injection.

budget buffer – A portion of the overall project budget set aside to cover uncertainties associated with project costs.

Usage: Just as safety time is removed from each activity time, safety cost should be removed from each activity cost. A budget buffer is similar to a project buffer in that the amount set aside for higher than estimated expenses is in reserve to protect the project budget in total. Similar to the project time
buffer the project budget buffer should be substantially less than the sum of the individual budget reserves for each activity.  

**Syn:** cost buffer.

**buffer** – Protection against uncertainty. The protection is aggregated and may take the form of time, stock (inventory), capacity, space or money. Buffers are strategically located to protect the system from disruption.

**Illustration 1**: A time buffer for a work order:

**Illustration 2**: A stock buffer for an SKU:

**Perspective**: The use of buffers in TOC logistical solutions is a key element that differentiates it from other solutions. TOC claims that in a system that has statistical fluctuations and dependent events strategic buffers are necessary to manage the system and to focus improvement efforts.

**See**: aggregation of variability, assembly buffer, capacity buffer, constraint buffer, drum buffer, feeding buffer, hole, project buffer, shipping buffer, statistical fluctuations and dependent events, stock buffer, space buffer, time buffer.

**buffer burn rate** – A measure of the overall rate at which the project buffer is being consumed for the project to date. The second measure of a set of three measures in buffer management for single- and multi-project critical chain project management.

$$\text{buffer burn rate} = \frac{\text{percentage of project buffer consumed}}{\text{percentage of critical chain completed}}$$

**Usage**: The buffer burn rate is used to answer the questions: Is overall progress on the project satisfactory? What is my current project status? A buffer burn rate of 1.0 or less is good. The first measure of project status is percent of the critical chain completed; the third measure is the project buffer consumption rate.
Example: The three measures of project progress are illustrated in the networks below, which show a project with a six week long critical chain (tasks outlined in heavy lines). Each task in the project takes one week. The first measure of project progress is percent of the critical chain completed. In this case, two weeks (shaded tasks) or 33% (2 weeks/6 weeks) of the critical chain tasks have been completed. Is this good or bad? The second and third measures must be analyzed to determine this answer. Suppose all tasks have progressed as estimated except task X and the resource is stuck on that task. The second measure of project progress is buffer burn rate, which at the end of week 3 is (33%/33%), or 1.0. One third of the project buffer has been consumed while one third of the critical chain has been completed. There is no problem at this point in the project as the rate of buffer consumption is equal to the rate of critical chain consumption.

The network below shows the status of the same project at the end of week 4 and the resource is still stuck on task X. At this point 67% of the project buffer has been consumed while the same 33% of work on the critical chain has been completed. The buffer burn rate is now (67%/33%) or 2.0. This is one indication that the project is in trouble. The third measure of project progress, the project buffer consumption rate, shows that the project is consuming project buffer at the rate of one week for every week of work. The ideal consumption rate is for every three time periods, two periods should be critical chain task work completed and one period of project buffer consumption. Since no critical chain work was completed while another week of project buffer was consumed, the project is in serious trouble and immediate action should be taken to bring the project back on schedule.
buffer consumption – 1. 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: Space buffers are placed after the constraint to prevent constraint stoppage (caused by blockage). 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.

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.

Illustration: A hole in a time buffer for a work order is shown below:
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.

Perspective: In lean buffering in the form of kanbans is placed between each pair of sequential workstations to cushion the impact of statistical fluctuations on flow. In contrast, in TOC buffers are placed strategically.

See: buffer max.

buffer level

Syn.: buffer target.

buffer management (BM) – 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. A significant increase in the number of red zone penetrations signals production planning to either change buffer parameters or take more drastic actions (e.g., add capacity at the non-constraint causing delays) 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 ongoing 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 lead 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.

**Illustration:** A work order is not yet present in the red zone of the buffer – it has penetrated the red zone.

![Buffer Penetration Diagram](image)

2. In make-to-availability, a measure of the level of finished goods inventory (raw materials and work-in-process) 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.

**Illustration:** 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.

![Buffer Penetration Diagram](image)

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 regions** – The buffer (time, stock, etc.) is divided into separate segments to indicate the need for proactive action to prevent lateness of a part/product/person or starvation of a constraint. The regions are typically called the red, yellow, and green regions and are generally 1/3 of the total buffer size each although the relative size may differ dependent on the specific characteristics of the process flow and product. Sometimes the term white region is used to refer to orders that have been released early (ahead of schedule) and the term black region is used to refer to late orders. The top figure illustrates stock buffer regions and the bottom figure illustrates time buffer regions.

![Illustration 1](image1.png) The regions of a stock buffer for a part or product.

**Syn.:** buffer zones.

**See:** buffer, buffer management.

**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. An item for which a rapid increase in demand or obsolescence is likely might be an exception to the rule and have symmetrical trigger points. Items may be categorized based on the need for buffer responsiveness to demand changes and buffer rules for each category established.
**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:

\[
\text{buffer status (\%) = \frac{\text{available time}}{\text{standard production lead time}} \times 100}\%
\]

**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 normal progress is being made therefore no action is necessary. If the buffer status is between 33 and 67%, the color yellow is assigned, which indicates that less than normal progress is being made therefore 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 order has fallen behind schedule therefore the expediting plans should be executed immediately.

**Illustration:** A time buffer for a work order is shown below. The buffer status is approximately 20%, so the order is in the red zone.

2. In make-to-availability, a measure of the level of finished goods (raw material and work-in-process) 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.

**Illustration:** A stock buffer for an SKU is shown below. The buffer status of the part is yellow.

3. 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 \(\frac{150+100}{600} \times 100\% = 41.67\%\), which is generally considered to be in the yellow region.

4. In critical chain, a measure of the project buffer consumed in relation to the proportion of the critical chain completed.
Usage: The buffer status of a project has to be adjusted for the amount of the critical chain 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.

Fever charts are useful for indicating buffer status in both single and multi-project environments. In a single project environment, the status of the project is plotted periodically (for example 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.

See: fever chart.

buffer status report – A recurring report that provides a snapshot of the status of work in a given environment: 1. each production work order in a make-to-order drum-buffer-rope or simplified drum-buffer-rope environment, 2. each stock-keeping unit in a make-to-availability environment, and 3. each project or all projects 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 for the manufacturer. This information is used to determine priorities. 3. In a distribution environment, the buffer status report provides the current status for all stock buffers. 4. 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 target is adjusted downward (usually 1/3 the buffer target) for a “too much green” condition (too many reviews where the inventory status was
green) and is adjusted upward (usually 1/3 the buffer target) 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% or .5. The buffer target is:

Buffer target = 2 week RLT x max weekly consumption 100 x 1.5 unreliability

= 2 weeks x 100 units/week x 1.5

= 300 units.

Illustration: A stock buffer for an SKU is shown below.

![Buffer buffer status](image)

Syn.: buffer max.

buffer zones
Syn.: buffer regions.

build, capitalize, and sustain – The groupings used for level 3 of an organizational transformation strategy and tactics tree to group all the necessary and sufficient changes and its preferred implementation sequence under the requirements for “building a decisive competitive edge”, “capitalizing on a decisive competitive edge” and “sustaining a decisive competitive edge.”

See: strategy and tactics tree.

building (S&T tree) – The first major segment of the S&T tree: knowing how to identify, sequence and implement actions to build a decisive competitive edge.

See: capitalizing (S&T tree), strategy and tactics tree, sustaining (S&T tree).

buy-in – A rigorous process of leading a group to full consensus on a solution. The process is designed to overcome the ‘layers of resistance’. The steps are the following:
1. Agree on the problem.
2. Agree on the direction of the solution.
3. Agree that the solution solves the problem.
4. Agree that the solution will not lead to any significant negative effects.
5. Agree on the way to overcome any obstacles that might block or distort implementation of the solution.
6. Overcome unverbalized fears.

capacity buffer – 1. In multi-project critical chain project management, a time buffer placed in the project plan immediately in front of the first use of the drum resource to protect the start of the project against variation (Murphy) from drum tasks in upstream projects.

Usage 1: A capacity buffer enables project acceleration if the drum resource is available early.
Capacity buffers are only used in multi-project environments.
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: buffer, critical chain project management, drum, drum resource, make to availability.

capacity-constrained resource (CCR) – Any resource that, if its capacity is not carefully managed, is likely to compromise the throughput of the organization.

Illustration: In the example shown below the production line has five resources (A through E) with the capacities shown. Resource D experiences enough variation in output that if it is not carefully managed, output will drop below demand and throughput of the system will go down; therefore “D” is a capacity-constrained resource.

[Diagram showing a production line with five resources: A, B, C, D, E. Resource capacities and demand are shown: A and B have a capacity of 25, C has a capacity of 30, D has a capacity of 15, and E has a demand of 14. Resource C is labeled as CCR.]

Syn.: capacity-constraint resource.
See: constraint, throughput.

capacity-constraint resource
Syn.: capacity-constrained resource.

capitalizing (S&T tree) – The second major segment of the S&T tree: knowing how to leverage (sell) a decisive competitive edge.
See: build, capitalize, and sustain, building (S&T tree), strategy and tactics tree, sustaining (S&T tree).

categories of legitimate reservation (CLR) – The rules for scrutinizing the validity and logical soundness of thinking processes logic diagrams. Seven logical reservations are grouped into three levels.
Level I: clarity reservation.
Level II: causality existence and entity existence reservations.
Level III: cause insufficiency, additional cause, predicted effect existence, cause-effect reversal or tautology reservations.

Usage: Level I seeks clarity and understanding of the tree builder’s intentions, that is, finding out what the words and phrases in the logic diagram’s entities really mean and how they are being used. Level II reservations examine the validity of an entity: asking whether the entity really exists; and whether the causal relationship between specified entities really exists. In each of the four reservations of level III, the scrutinizer must actively assist the presenter by proposing a change such as adding or changing some words and/or suggesting a missing condition or an entity that appears to be omitted. Scrutinizers should proceed from level I to level II to level III reservations until they have satisfied their concerns. That is, they should first seek clarity, next ensure causality and entity existence, and finally, propose improvements in the logic. Note that the tree builder is free to accept or reject any reservation at any level.
See: additional cause reservation, causality existence reservation, cause insufficiency reservation, cause-effect reversal reservation, clarity reservation, entity, entity existence reservation, logic diagram, predicted effect existence reservation, scrutiny, tautology reservation, thinking processes.

causal conflict cloud
Syn.: systemic conflict, planning conflict.

causality existence reservation – A Level II reservation in the categories of legitimate reservation that is used to question whether or not the proposed causal relationship between two entities really exists.
Usage: Causality is differentiated from correlation (the degree to which two or more attributes or measurements on the same group of elements show a tendency to vary together) by the verifiability of a causal relationship.
Illustration 1: Examining the following logic diagram, a scrutinizer might ask: “How does gambling produce financial security?”

Illustration 2: Examining the following logic diagram, a scrutinizer might ask: “How does being certified in a field or discipline assure that you know everything about the subject?”

cause-effect – A linkage or relationship between entities in which the existence of one (or more) entity(ies) is(are) said to be the reason for the existence of the other entity(ies). Causality is established if the stated effect always exists when the stated cause(s) is (are) present.
Perspective: In contrast to statistical correlation, causality represents a much stronger directional relationship between two entities than does their correlation or association with one another.
Illustration 1: The following logic diagram is verbalized: If 15 Cause A then 25 Effect X. For example, If 15 It rains on my yard then 25 My grass gets wet.

Illustration 2: Sometimes two or three causal entities are all needed to create the existence of the proposed effect. The following logic diagram is verbalized: If 20 Cause B and 30 Cause C then 60
Effect Y. For example, if 20 My vegetable garden gets ample water, and 30 My garden gets a satisfactory amount of sunshine, then 60 My vegetables grow well.

See: effect, entity, logic, diagram, logical ‘and’ connector.

**cause-effect reversal reservation** – A Level III reservation in the categories of legitimate reservation that is used to question whether the cause and effect have been switched. Also referred to as a tautology reservation.

*Usage:* Sometimes a cause-and-effect relationship can be reversed or turned around. This usually happens when the effect is deduced based on the facts rather than by answering the question, "What caused the effect?" or "What causes what?"

*Illustration 1:* The logic diagram on the left below is verbalized: If 100 I buy dog food then 110 I have a dog. The causality is incorrect because buying the dog food did not cause you to have a dog. Reversal of the causality arrow results in the correct diagram on the right, which reads: If 110 I have a dog then 100 I buy dog food.

![Incorrect diagram](image1)

![Correct diagram](image2)

*Illustration 2:* The “House-on-Fire” scenario is a specific example of cause-effect reversal. The illustration on the left below is verbalized, If 3 A fire truck is parked at my house then 5 My house is on fire. However, the causality is actually the reverse, as illustrated on the right. If 5 My house is on fire then 3 A fire truck is parked at my house.

![Incorrect diagram](image3)

![Correct diagram](image4)

**Syn.:** tautology.
cause insufficiency reservation – A level III reservation in the categories of legitimate reservation that is used when the scrutinizer believes the proposed cause alone is inadequate to explain the effect. A lateral dependency among multiple equally influential contributing causes exists.

Usage: For this type of reservation, the scrutinizer must provide the missing supporting cause or condition that, in conjunction with the original cause, produces the effect. Note that if the scrutinizer is correct, then if either of the proposed causes does not exist the observed effect will also not exist. Illustration: The fact that our primary competitor reduced its prices on comparable products is believed by the scrutinizer to be insufficient to cause our sales to be down. The scrutinizer proposes that it is the combination of price reductions by our competitor and the fact that we have not reduced our prices that causes our sales to be down.

See: categories of legitimate reservation, effect, entity, logical ‘and’ connector, logic diagram.
Perspective: The chain analogy is useful because strengthening most links in a chain will not make the chain stronger – you must strengthen the weakest link. In a similar manner, quickly generating significant improvement in organizational performance cannot be accomplished through improvements anywhere and everywhere, but rather only through focusing on the factor that is limiting global performance, i.e., by focusing on the constraint.
See: constraint.

champion – Someone who is willing to take personal risks to move his or her organization in the direction s/he believes in.
Usage: A champion must have enough or the right supporters to move the organization in the desired direction.

change analogy – The picture below is used to describe the two new buy-in processes based on the more detailed listing of layers of resistance: the plus-plus and the minus-minus. In the plus-plus buy-in process, a person has the choice of climbing a mountain to gain a large pot-of-gold (the plus of the change) or challenging the staying where he/she is to maintain the relationship with the mermaid (the plus of not changing). In contrast, in the minus-minus buy-in process, a person has the choice of being eaten by the crocodile if he/she doesn’t change (the minus of not changing) or of falling off the mountain and breaking a leg therefore needing a crutch (the minus of changing).

Usage: The main idea of the plus-plus buy-in process is that the potential benefit (the pot-of-gold) of the change is much, much bigger than the potential benefit of not changing (mermaid). It capitalizes on
the fact that a large “pot-of-gold” can be a significant motivator for many people to make necessary
crises, especially if it can be shown that either the mermaid does not really exist, that keeping the
mermaid is far less important than the pot-of-gold or in some cases that actually you can bring the
mermaid with you.

change question sequence – 1. One of three processes of ongoing improvement in theory of constraints
(the other two processes are the five focusing steps and buffer management). The three questions that
must be answered in the successful management of change within a system. The change question
sequence answers the following three questions:
1. What to change?
2. To what to change?
3. How to cause the change?
2. Recently, two additional questions that must be answered in the successful management of change
have been added. The revised change question sequence includes the following five questions:
1. Why change?
2. What to change?
3. To what to change?
4. How to cause the change?
5. How to measure and sustain the change?
Syn.: change question sequence.
See: how to cause the change, how to sustain the change, process of ongoing improvement, to what to
change, what to change, why change.

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.

chronic conflict – A contentious situation that has existed for a prolonged period of time. Opposing sides
have been justifying their perspective through selective requirements and prerequisites for so long that
both sides become entrenched in their own beliefs to the point that neither side can see how to break the
conflict without suffering a significant loss.
Usage: Breaking a chronic conflict requires understanding the opposing perspectives. This
understanding can lead to the surfacing of hidden assumptions underlying entity relationships that are
often the key to creating a breakthrough solution. The solution to a chronic conflict requires one side
to offer up a problematic (from their perspective) injection and the other side to somehow eliminate
any of the undesirable aspects of the proposed injection using the negative branch reservation process.
Perspective: The main difference between the day-to-day conflict cloud and the chronic conflict cloud
is the extent to which the unresolved conflict has deteriorated the trust between the parties. When trust
is high, a conflict can be broken with the traditional approach (i.e. both sides working together to break
it on either side) but with a chronic conflict, the cloud should be broken on the side of the initiator (or
else consensus might never be achieved) but the initiator should then request assistance from the other
side to help find a way to eliminate the negative branches related to giving them what they want.
See: assumptions, breakthrough solution, day-to-day conflict cloud, entity, evaporating cloud, generic
cloud, injection, prerequisite, requirement, negative branch reservation.

clarity reservation – The level I reservation in the categories of legitimate reservation that is used when
the scrutinizer:
1. is concerned about the meaning of an individual word, the complete statement contained in an entity,
or a section of the diagram, or
2. does not recognize a reasonable connection between the stated cause and the stated effect.

Usage: The level I clarity reservation is usually the first reservation that is raised by a scrutinizer because it is appropriate to try to understand the entity or relationship between entities before raising a level II or III reservation. Common clarity reservations include definitions of words, the meaning or use of acronyms, phrases, pronouns, word sequences, or confusing punctuation, too brief an entity description such as a sentence fragment, cause and effect within one entity, and compound subjects, verbs, or sentences within an entity. Sometimes the scrutinizer is unfamiliar with the activities, policies, procedures or measures within a function and uses the clarity reservation to build an understanding. Providing verbal clarity may be sufficient for understanding the diagram, and thus, the tree builder/presenter may not necessarily have to edit an entity to satisfy a scrutinizer. Similarly, clarification of a relationship between linked entities may be sought by a scrutinizer. Here again, after an appropriate explanation, it may or may not be necessary to edit the relationship being challenged. Examples of both types of clarity are shown below.

Illustration 1: Consider the entity below: 100 XYZ is a new product development company. Clarity is needed to determine whether XYZ is a new company or an existing company that develops new products.

Illustration 2: Consider the relationship between the two entities, 100 and 110. A scrutinizer might ask for clarity on how gambling provides financial security since to gamble is to take a risk which seems to be the antithesis of financial security.

Illustration 3: Consider the relationships among the three entities, 100, 110, and 120 below. A scrutinizer might ask for clarity on how installing an activity based cost accounting system provides accurate product cost and how price is then established as he/she might be unfamiliar with activity based cost accounting systems and the relationship of cost to price.

See: categories of legitimate reservation, long arrow, scrutiny.
cloud
  Syn.: evaporating cloud.

CLR – Abbreviation for categories of legitimate reservation.

communication current reality tree (CCRT) – A simplified or abridged version of the current reality tree developed to obtain buy-in from organizational personnel including employees, management, and board members.
  Usage: The CCRT connects the core conflict cloud at the base of the logic tree with the undesirable effects (UDEs) associated with the appropriate side of the conflict. This design facilitates communication with management because the CCRT reduces the likelihood of “finger pointing” which leads to defensive postures that block progress toward real solutions. The CCRT accomplishes this by clearly showing that the UDEs result from a systemic conflict and not from the irrational behavior of individuals.
  See: buy-in, core conflict cloud, current reality tree, undesirable effect.

completion buffer
  Syn.: project buffer.

complexity – Traditionally, the more data elements that are needed to describe (the parts and interdependencies in) a system the more complex the system is (defined as detail complexity). In theory of constraints as in the hard sciences, the more degrees of freedom a system has the more complex the system is (defined as conceptual complexity).
  Example: Suppose you had the two systems portrayed as System A and System B. Which system is more complex? Most people would say System B since it has far more data points than System A. But if the four points in System A are independent and the arrows in System B are cause-and-effect arrows, then System B is the simpler system. In System A four points have to be changed in order to change the system but in System B, because the arrows are cause-and-effect relationships, only one point (the point with no incoming arrows) has to be changed to impact the whole system.

See: Archimedes lever point, leverage point.

conceptual ‘and’ connector
  Syn.: logical ‘and’ connector.

conflict assumptions – The four conflict assumptions in an evaporating cloud are answers to the following four questions:
1. Why does D jeopardize C?
2. Why does D’ jeopardize B?
3. Why is D in conflict with D’?
4. Why is there not another way to satisfy B and C?
   **Usage:** Addressing the conflict assumptions directly often breaks the cloud more effectively and efficiently than addressing any or all assumptions underlying each one of the arrows of the cloud. **See:** evaporating cloud.

**conflict cloud** (CC)
   **Syn.:** evaporating cloud.

**conflict resolution diagram** (CRD)
   **Syn.:** evaporating cloud.

**consequence conflict**
   **Syn.:** symptomatic conflict, consequence conflict cloud.

**consequence conflict cloud**
   **Syn.:** symptomatic conflict.

**consolidated cloud approach** – The creation of a single evaporating cloud from three UDE clouds.  
   **Usage:** The consolidated cloud explains the existence of the three UDEs used to create it. The consolidated cloud approach is similar to the three-cloud approach but the resulting consolidated cloud may not reflect the core conflict due to the choice of the specific UDEs used to create the cloud. The generic cloud that results from the three-cloud approach is thought to reflect the core problem. A careful selection of diverse UDE helps ensure the core problem is identified correctly.  
   **See:** core conflict cloud, generic cloud, three-cloud approach, UDE cloud.

**constraint** – The factor that ultimately limits the performance of a system or organization. The factor that, if the organization were able to increase it, more fully exploit it, or more effectively subordinate to it, would result in achieving more of the goal.  
   **Perspective:** The existence of system constraints, and the fact that organizational performance can be improved by identifying and carefully managing or eliminating the constraints are the foundation of TOC.  
   **Illustration:** In "The Goal" the company could not produce orders fast enough to meet market demand and two resources were limiting factors: the NCX 10 machine and a heat treat furnace. These resources were the constraints for UNICO. As UNICO exploited and subordinated to, and eventually elevated, both resources, UNICO’s profits increased. As UNICO continued to exploit the performance of the constraints they eventually had the ability to produce more than their customers were buying and the constraint shifted to the lack of customer orders, i.e., the market became the constraint. UNICO then had to shift the approach of the company to exploit and subordinate to this external constraint.  
   **See:** elevate, exploit, five focusing steps, subordinate.

**constraint buffer** – The time buffer offset used to schedule the release of materials that feed the constraint.  
   **Usage:** If a constraint exists in production, a constraint buffer and a shipping buffer (and sometimes an assembly buffer) are used to protect the output of the system. If the constraint is in the market, the constraint buffer is unnecessary and only the shipping buffer is used. The constraint buffer is not used in simplified drum-buffer-rope. The constraint buffer is sized to significantly reduce the likelihood that variation in the system prior to the constraint will cause the constraint to “starve”, (i.e., not have what it needs in order to meet customer demand), yet will not result in excessive work-in-process inventory.  
   **Perspective:** The TOC approach of buffering the constraint is a major difference from many other production management approaches. This difference is important because if there is a constraint in
operations, this buffer enables the system to more fully exploit the constraint, thereby increasing throughput.

Illustration: A constraint buffer for a make-to-order production situation is shown below:

See: buffer, buffer management, shipping buffer.

**constraints accounting**

Syn.: throughput accounting.

**constraints management** – A term coined by APICS and used to describe the logistics paradigm consisting of drum-buffer-rope, buffer management, VATI analysis, throughput, operating expense, inventory, throughput-dollar-days, inventory-dollar-days, etc.

See: theory of constraints.

**consumer goods strategy and tactics tree** – A strategy and tactics tree designed for producers of end products that sell to distributors and retailers rather than directly to the final customer.

Usage: The consumer goods strategy and tactics tree is for use in a business-to-market environment.

See: transformation strategy and tactics tree.

**control point** – A key point in the flow of work through an operations environment that, if not managed properly, has a high probability of decreasing throughput and due date performance.

Usage: Control points include gating operations, convergent points, divergent points, constraints, and shipping points. In TOC operations management, sequencing schedules at the control points to match the drum schedule and/or shipping schedule increases the probability of on-time performance.

See: constraint, convergent point, divergent point, drum schedule, shipping schedule.

**convergent point** – 1. In production, an operation in a production process in which multiple materials, parts or components are combined into a single component. An assembly operation is an example of a convergent point.

Usage: Convergent points are common in an A-plant and are usually used as control points.

See: A-plant, control points.

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, integration point.
**core conflict** – The systemic conflict that causes the vast majority of the undesirable effects in the current reality of the system being studied. The core conflict is often generic in nature and can be derived by generalizing the various conflicts that underlie the undesirable effects that persist in the system.

**Usage:** In the three-cloud approach, the core conflict is synthesized from three specific conflict clouds (taken from different functions to provide a broad but different perspectives of the system) that together reflect a fundamental issue responsible for most of the system’s undesirable effects. A core conflict is expressed in two prerequisites in the core conflict cloud, namely, entities D and D’.

**Illustration:** A core conflict in operations, which is depicted here, exists because it is not possible to do both: D Use local efficiencies as a primary measure and D’ Do not use local efficiencies as a primary measure.

![Diagram of core conflict cloud](image)

**See:** conflict clouds, current reality tree, prerequisite, three-cloud approach, undesirable effect.

**core conflict cloud (CCC)** – An evaporating cloud that depicts the core conflict present in the current reality of the system being studied. The CCC denotes the system’s goal (entity A), two requirements necessary to achieve the stated goal (entities B and C), and the prerequisites of each requirement (entities D and D’). The prerequisites in entities D and D’ are in direct conflict, and often represent two opposing points of view.

**Usage:** It is relevant to list the assumptions underlying each of the cloud’s entity relationships in the CCC. An assumption which is not valid, that is, erroneous, or can be invalidated through an injection is often key to eliminating the core conflict. Sometimes one of the assumptions is the core problem. **Illustration:** The CCC shown for finance and measures includes a number of assumptions, some of which are shown. The top branch of the CCC is verbalized as follows: In order to A Be a good manager, B the manager must control costs because AB Cost containment is important to financial success (assumption). Further, in order for B the manager to control costs, D the manager must judge according to local impact because BD The only way to achieve good cost performance is through good local performance everywhere (assumption). The assumptions on the bottom side of the cloud are read in a similar manner.
See: assumptions, evaporating cloud, generic conflict cloud, goal, prerequisite, requirement, three-cloud approach.

**core driver** – An entity, often at the bottom of a current reality tree, which does not have any cause(s) indicated. It is a descriptor of the environment and influences the problem area but is beyond the domain of management’s control or influence or represents an entity that management does not want or is unable to address for some reason.

**Illustration:** In the CRT below, entities 15, 20 and 37 are core drivers. We may choose not to address entity 15 and we have no control over entities 20 and 37:
core problem – A part of the current reality that is directly responsible for (i.e., is the source of) the existence of the most significant undesirable effects in the current reality of the system being studied. There may be one or more core problems, however, generally one to three core problems will account for over 70% of the UDEs in an environment.

Illustration: In the CRT below, entity 10 is a core problem:
Perspective 1: A core problem can have one of three manifestations, either as: 1. a fact and entity in reality, such as “Efficiency is used as the prime measure in operations.” that can be directly linked through cause-effect relationships to the majority of the UDEs, or 2. the conflict between D and D’ in a core conflict cloud, such as D Use local efficiencies as a prime measure and D’ Do not use local
efficiencies as a prime measure, or 3. an erroneous assumption responsible for the conflict, such as A resource standing idle is a major waste.
The core conflict cloud can also be a manifestation of the core problem. When identifying a core problem in a CRT, it is important to realize that because not all UDEs are equally important, and because the identified UDEs used to create a CRT do not include all UDEs, the 70% rule is only a guideline intended to ensure that the entity or entities identified as core problems are the source of most of the significant UDEs.
When declaring a fact or an erroneous assumption as a core problem it is important to realize that the core problem can be chosen subjectively. In reality there can be more than one core driver that is responsible for the existence of over 70% of the UDEs. The person conducting the study can choose one of these core drivers as a core problem subject to level of authority and/or personal stamina to address the cause.
Perspective 2: A core problem can be defined at four levels connected through cause and effect. The lowest level is an erroneous assumption about reality that blocks the individual or organization from breaking their core conflict. The second level is the policies that are a consequence of the erroneous assumption (e.g. a policy to decide which side of the conflict to focus on (D or D’), when to switch (As long as …do D…as soon as …do D’….)) or even not to take any action now (maintain status quo) since there are negatives associated with both D and D’. The third level is the measurements we put in place to ensure the policies are adhered to while the fourth level is the “bad” behaviors that result from the erroneous assumptions, (local optima) policies and/or measurements.
See: assumption, core conflict, core conflict cloud, core driver, current reality tree, undesirable effects.

cost allocation – In traditional cost accounting, fixed costs are distributed across products using a cost driver such as direct labor hours or cost or machine hours. The result is a product cost consisting of material costs, direct labor cost and overhead allocation.

cost buffer
Syn.: budget 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.
Illustration:
**Cost-world paradigm** – The view that a system consists of a series of independent components, and the cost of the system is equal to the summation of the cost of all the sub-systems. This view focuses on reducing costs and judges actions and decisions by their local impact. Cost allocation is commonly used to quantify local impact.

**Usage:** In the cost-world paradigm, global impact is believed to be the sum of all local impacts. **Perspective:** This paradigm is in conflict with the throughput-world paradigm, which claims that global improvement is NOT the sum of local improvement and that the use of cost allocation often results in incorrect decisions.  **See:** additive rule, global optimum measure, local optimum measure, throughput-world paradigm.

**Cost world-throughput world core conflict**

**Syn.:** operations manager core conflict.

**CRD** – Abbreviation for conflict resolution diagram.

**Critical chain** – The longest sequence of dependent events through a project network considering both task and resource dependencies in completing the project. The critical chain is the constraint of a project.

**Usage:** The project duration is the total of the critical chain task times plus the project buffer. **Illustration:** The project below has eight tasks and one unit of each of five resources (B, C, M, O, and Y). Tasks M16 and M10 require resource M at the same time, an example of resource contention. One option is to start task M10 earlier to eliminate the contention. Once this is done, the critical chain becomes M11-Y4-O6-M10-M16-C20. This sequence of tasks plus the project buffer (PB) of 33 days determines the critical chain duration of 100 days (although see the Caution below about the length of the critical chain).

**Caution:** Internal organization functions (e.g., resource managers, project managers, software developers) use the term critical chain to describe the unbuffered or unprotected chain of dependent tasks/resources. In contrast to this usage, sales, marketing and other functions that deal directly with clients use the term critical chain to describe the total project duration, which includes not only the total task time on the critical chain but the project buffer also. This total project duration provides the...
basis (adjusted for starting date) for promising project completion dates to clients. Goldratt, in his summary in Session 3: Project Management and Engineering of the Goldratt Satellite Program, uses the terms critical chain and protected critical chain to describe the internal and external uses of the term, respectively. See: critical chain project management, protected critical chain.

critical chain completed (%) – A measure of project progress. The first measure of a set of three measures in buffer management for single- and multi-project critical chain project management.

\[
\text{Critical chain completed (%) = } 100\% \times \frac{\text{number of days of CC work completed}}{\text{total number of days on critical chain}}
\]

Usage: The purpose of calculating the percentage of the critical chain completed is to focus attention on problems that jeopardize progress on the critical chain tasks and thus impact due date performance. Illustration: In the project network below the critical chain is six weeks long (tasks outlined in heavy lines) and two weeks (tasks shaded lightly) have been completed. The critical chain completed is 33% (100% X 2 weeks/6 weeks). Project progress is 33%. To determine whether this is good or bad the second and third measures, buffer burn rate and project buffer consumption rate, must be calculated.

Syn.: project progress.
See: buffer burn rate, project buffer consumption rate, project management measures.

critical chain for goods (CC\(_G\))

Syn.: critical chain.

critical chain for services (CC\(_S\)) – The TOC application for project management in services, particularly professional, scientific and technical services in multi-project environments.
Usage: Some services clients are time sensitive and are not willing to wait until resources would become available as scheduled using traditional critical chain project management. Critical chain for services differs from critical chain in that it incorporates a resource bench, an approach that seeks to ensure resource availability by maintaining a group of skilled professionals for rapid assignment to any project. The resource buffer has sufficient capacity to meet high demand for resources from multiple projects, even when that demand is unpredictable. Whenever the resource level drops below a specified size, replenishment for services automatically replenishes the skill.

See: critical chain.
**critical chain network** – A project network showing the combined task and resource dependencies based on 50% task time estimates and feeding and project buffers.

*Syn.:* dependency diagram.

**critical chain project management** (CCPM) – The TOC solution for planning, scheduling, and managing performance in a project environment.

*Usage:* CCPM is applied in two very different environments: single-project and multi-project. In multi-project environments resources are shared across several different projects concurrently.

In a single-project environment the critical chain project management solution includes the following: 1. removal of existing behaviors that are harmful to the goal of the project, such as bad multitasking, the student syndrome and Parkinson’s Law (work expanding to fill the available time); 2. a plan, or project network, that includes all task and resource dependencies as well as time estimates with safety removed; 3. a schedule showing the critical chain and the buffers; 4. implementation of new behaviors critical to streamlining flow such as the relay runner work ethic and frequent reporting of work remaining; and 5. expediting and improvement activities based on buffer management.

In a multi-project environment the critical chain project management solution has the elements of the single-project environment and in addition has a mechanism for staggering the release of projects. This release mechanism can be either physical, i.e., a “drum” resource, or a policy stating that, for example, no more than six projects can be in flow at any time. As each project’s tasks are completed by the drum resource another comparable project is released to execution. As synchronization within and across projects based on management of the release mechanism improves, the rate of project completion increases significantly. Other names for the drum resource are virtual drum, strategic resource, and integration point.

In both project environments there is an additional element of project control and visibility – buffer management. Critical chain project management requires frequent updates of estimated time required to complete in-progress tasks. This information is used to update the status of the various buffers, which in turn provides the information needed to know when and where corrective action is necessary. *See:* buffer, buffer management, critical chain, drum feeding buffer, drum resource, drum schedule, feeding buffer, integration point, project buffer, virtual drum.

**critical success factor** (CSF) – High level requirements or necessary conditions that must be satisfied to ensure attainment of the system’s goal.

*Usage:* CSFs represent terminal outcomes, very few in number (perhaps no more than three to five), that are high level from the perspective of the whole system. Each CSF has necessary conditions that are prerequisites to its accomplishment. The only real difference between CSFs and necessary conditions is their proximity to goal attainment and their degree of specificity.

CSFs represent the second level (below the system goal) of an intermediate objectives map used to establish the benchmark of system success for strategy development or for system-level problem solving.

*Illustration:*

![Diagram showing critical success factors and necessary conditions](attachment:image.png)
CRS – Abbreviation for current reality study.

CRT – Abbreviation for current reality tree.

CSF – Abbreviation for critical success factor.

current planned load date – In simplified drum-buffer-rope in make-to-order and make-to-availability environments, the date on which the CCR is expected to complete processing all currently known orders. This is the point in time that a new order can be run on the CCR and from which material release and completion dates are calculated.

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. Conversely, one-half the production time buffer is subtracted from the current planned load date to determine the raw materials release date.

See: full planned load, planned load.

current reality branch (CRB) – A segment of a current reality tree providing the causal relationship from the core problem or a lower entity or cause to one or a few UDEs.

See: current reality tree.

current reality study (CRS) – An investigation of the stakeholder expectation gaps and undesirable effects existing in a system in order to determine the system’s core problem.

Usage: The CRS is conducted by a theory of constraints (TOC) professional through interviews with managers in charge of the major processes of the system. The CRS is also intended to reveal whether one of the generic solutions of TOC might be applicable to the area under study. While conducting the CRS the TOC professional also collects signals from the environment that can indicate potential
difficulties that may be encountered in implementing TOC solutions such as mindsets, policies, procedures and attitudes.

**current reality tree** (CRT) – A thinking processes sufficiency-based logic diagram that facilitates answering the question (from the change question sequence): “what to change?” by illustrating the cause and effect relationships between the core problem and the undesirable effects (UDEs) in a system.

**Usage:** The CRT uses “if..., then...” logic to present unbroken chains of cause-and-effect relationships from the core problem or core conflict upward to the undesirable effects. It also presents sequences of entities which depict system-based policies leading to measurements, which in turn, are causing undesirable behaviors to occur.

The CRT is often used when: 1. it is not clear how to implement one or more of the five focusing steps or, 2. the system improvement team has trouble obtaining managerial buy-in of proposed changes. By understanding why the UDEs exist, the system improvement team is able to design a set of interventions or injections to eliminate the core problem, and hence, the majority of the most significant undesirable effects.

There are two approaches to developing a current reality tree – the traditional approach, which starts with a list of UDEs and connects them using cause and effect logic, and the three-cloud approach, which starts with three evaporating clouds from which is developed a generic cloud that becomes the basis for the CRT.

**Illustration 1:** Example of CRT developed using the traditional approach:
Illustration 2: Example of CRT developed using the three-cloud approach:
See: buy-in, change question sequence, core conflict, core problem, injection, sufficiency-based logic, thinking processes, three-cloud approach, undesirable effects, what to change?

**customer current reality tree** – A form of current reality tree (CRT) that focuses on the undesirable effects (UDEs) of an organization’s customers, rather than the UDEs of the organization itself. This CRT is a sufficiency-based logic diagram that illustrates the cause-and-effect relationships that exist between the customer’s core problem and most, if not all, of the UDEs caused by its suppliers.

**Usage:** The purposes of the customer CRT are to 1. identify the customer's core problem with its suppliers, 2. demonstrate that the organization understands the problems that its customer is experiencing in dealing with the organization and similar suppliers, 3. improve the customer’s performance by adding value, and 4. provide the organization with a competitive advantage.

Because the customer CRT requires detailed knowledge of the problems experienced by the organization’s customers, some of the customer’s employees as well as marketing and sales personnel from the organization are usually closely involved in the creation of the tree. By addressing the customer’s core problem with its suppliers through the design of an unrefusable offer, the customer CRT helps create a win-win scenario for the organization and its customer.
See: core problem, current reality tree, sufficiency-based logic, thinking processes, undesirable effect, unrefusable offer.

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.

day-to-day conflict cloud – An evaporating cloud used on a standalone basis (i.e., not as part of a complete thinking process analysis) for a one-time situation when there is an open conflict between two parties. Open means that each party is aware of the conflict.

Usage: The day-to-day conflict cloud is the easiest cloud to construct and hence is used to teach clouds. Breaking such clouds is not easy and the owner of the cloud must adopt the mindset of personal commitment to resolve such conflicts.

Perspective: The main difference between the day-to-day conflict cloud and the chronic conflict cloud is the extent to which the unresolved conflict has deteriorated the trust between the parties. While trust is high, a conflict can be broken with the traditional approach (i.e. both sides working together to break it on either side) but with a chronic conflict, the cloud should be broken on the side of the initiator (or else consensus might never be achieved) but the initiator should then request assistance from the other side to help find a way to eliminate the negative branches related to giving them what they want.

See: chronic conflict.

DBR – Abbreviation for drum-buffer-rope.

DBR_g – Abbreviation for drum buffer rope for goods.

DBR_s – Abbreviation for drum buffer rope for services.

DCE – Abbreviation for decisive competitive edge.

DDMRP – Abbreviation for demand driven material requirements planning.

DE – Abbreviation for desirable effect.

decisive competitive edge (DCE) – A significant sustainable market advantage over competitors.

Usage: A DCE exists only if an organization satisfies a significant market need to an extent that no significant competitor can. In many situations, competitors are unaware of the problems their industry or the conventional mode of operation creates for their customers. An examination of the problems the industry creates for its customer is the starting point for identifying a potential DCE. Price is never considered a DCE. Availability, inventory turns, or reliability are potential retailer’s significant needs and can be turned into a DCE.

A DCE is similar to the traditional concept of competitive advantage but differs in the mechanisms used to identify the DCE. The DCE is identified through an analysis of customer problems created by the suppliers’ industry.

decoupled explosion – In demand driven material requirements planning, component part explosion is stopped (decoupled) at any component part for which a buffer is maintained. These buffered items will explode whenever their buffers reach their respective rebuild zones.

See: 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
5. visible and collaborative execution

**Perspective:** Traditional MRP systems are push systems based on forecasts of demand for finished products and generally focus on local optima throughout the supply chain. In contrast, DDMRP is a pull system based on strategic placement of inventories across the supply chain with strategic buffers positioned for critical raw materials, work-in-process, finished goods and possibly distribution inventories. The system is based on measures such as buffer status that better reflect both a firm’s and a supply chain’s ability to respond effectively to customer demand.

**See:** actively synchronized replenishment.

**dependency diagram**

*Syn.:* critical chain network.

**dependent events** – A series of events in which each event requires that certain preceding event(s) take place before it can be completed.

**Usage:** TOC claims that in systems with statistical fluctuations and dependent events operations are best managed using the concepts of drum-buffer-rope or critical chain project management.

**Example:** A dine-in restaurant is a system of dependent events: the customer does not pay for the meal before the meal is eaten; cannot eat before the food is served; the meal cannot be served before the order is placed; and the order is not placed before the customers are seated at a table. Each event in the system is dependent on the preceding event.

**See:** critical chain project management, drum-buffer-rope, statistical fluctuations and dependent events.

**dependent multi-project environment** – An environment in which projects require resources that are also required by one or more other projects, necessitating the sharing of resources across projects.

**See:** independent multi-project environment.

**deployment chart** – A document used in TOC critical chain implementations that depicts the current technical, managerial, and management information system procedures that are used for managing the flow of customer orders or products, information, and decisions.

**Usage:** The deployment chart provides a clear understanding of where injections from the future reality tree and prerequisite tree (or strategy and tactics tree) fit in the processes, which processes and procedures have to be changed or replaced, and how the new and old processes interact for an effective planning and control system.

**desirable effect** (DE) – A positive or beneficial outcome associated with an organization’s actual or future performance.

**Usage:** A DE is often the opposite of an undesirable effect (UDE). When appearing in a future reality tree, DEs may be either exact opposites of their corresponding UDEs or they may be conditions that signify that the undesirable aspects present in a current reality tree have been overcome.

**Example 1:** For the UDE “Throughput is declining,” the corresponding DE would be, “Throughput is increasing.”

**Example 2:** For the UDE “Production lead times are too long,” the corresponding DE could be “Production lead times are less than competitors’ lead times.”

**See:** current reality tree, future reality tree, undesirable effect.
**directly responsible person** (DRP) – Individuals who have both the responsibility and the authority to change the system in order to solve the organization’s core problem.

*Usage*: Understanding the roles of individuals in the organization, and who the DRPs are, is essential to constructing the solution and obtaining buy-in.

*See*: intimately involved person, outside person.

**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, make-to-stock.

**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.

**distribution core conflict cloud** – Distribution’s core problem is the dilemma of how much inventory to hold to balance the requirements of reducing costs and protecting throughput. For a distribution manager to be viewed as managing well (objective A) the manager must reduce costs (requirement B) and at the same time the manager must protect organization throughput (requirement C). In order for a manager to reduce costs the manager must hold less inventory (prerequisite D). In order for the manager to protect throughput the manager must hold more inventory (prerequisite D’). The problem revolves around the inability of the manager to have the right inventory at the right place at the right time. The objective of distribution is to have the right product at the right place at the right time. See the evaporating cloud below.

![Distribution Core Conflict Cloud Diagram](image)

The basis of the TOC solution challenging three of the BD assumptions: replenishment time is long; vendors are unreliable; and forecasts are unreliable. The key to evaporating the cloud is recognizing that in a distribution environment the client is the constraint and to exploit the constraint distribution must plan and control to have the right inventory at the right place at the right time. To accomplish this, distribution must order daily, replenish frequently, and strategically hold inventory at the factory or central warehouse. The pull through the supply chain must be based on actual consumer consumption without significant batching occurring across the supply chain. The central warehouse buffers the statistical fluctuations of both supply and demand. The consumption at the plant warehouse becomes the basis for scheduling the production processes. Buffer management is used to dynamically adjust buffer levels throughout the distribution and manufacturing systems.

*See*: theory of constraints supply chain philosophy.

**distribution requirements planning**

*Syn.:* traditional supply chain management philosophy.
See: lean supply chain management philosophy, material requirements planning, theory of constraints supply chain management philosophy.

**distribution/replenishment solution** – 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, adjusted for 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.

**Usage:** In the TOC distribution/replenishment solution the largest amounts of inventory are held at a central warehouse, where the variation in demand is the least. Smaller amounts of inventory are held and replenished frequently at the end consumer location where variation in demand is the greatest.

**Throughput-dollar-days and inventory-dollar-days** are used to measure the reliability and effectiveness, respectively, of each link in the chain. Transfer pricing is not used.

**See:** inventory-dollar-days, theory of constraints supply chain management philosophy, throughput-dollar-days.

**divergent point** – An operation in a production process at which material can be transformed into multiple products.

**Usage:** Divergent points are common in a V-Plant and are usually used as control points to direct flow correctly through a plant. It is generally important to control lot sizes at a divergent point so that material is not over allocated to some downstream product in order to increase local efficiency.

**Example:** In textile mill, the dyeing process is a divergent point because the yarn can be dyed several different colors.

**See:** control point, V-plant.

**diving down**

**Syn.** driving down.

**drilling down**

**Syn.:** driving down.

**driving down** – Colloquial term used to describe the process of searching for the cause of one or more entities.

**Usage:** Driving down is a discovery process that is often required in creating the current reality tree (using the original method, rather than the three-cloud approach) or in satisfying causality existence and entity existence reservations. The term relates to the process of asking why an effect exists, determining and validating the cause and continually moving downward in creating the current reality tree until the lowest actionable root cause within the system's sphere of influence is identified.

**Syn.:** diving down, drilling down.

**See:** categories of legitimate reservation, cause insufficiency reservation, current reality tree, entity.

**drum** – 1. In operations, the schedule of the constraint – the “drumbeat” of the organization. 2. In multi-project critical chain project management, the resource whose capacity or capabilities determine the staggering of projects.

**Usage:** Project management organizations typically have more projects active than they can handle without multitasking. A schedule for the drum can be used to stagger projects, thereby reducing both the need for and the opportunity for multitasking, and increasing overall project flow.

**Syn.:** bottleneck, drum resource, pacing resource, strategic resource.

**See:** staggering, virtual drum.
**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. Both DBR and S-DBR use buffer management to continuously maintain flow through the production process and 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<sub>G</sub>) – 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<sub>S</sub>).

**See:** drum-buffer-rope for services.

**drum-buffer-rope for services** (DBR<sub>S</sub>) – 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<sub>G</sub>).

**See:** drum buffer rope for goods.

**drum feeding buffer** – In multi-project critical chain project management, a buffer used to schedule the release of work that feeds drum tasks to prevent starving the drum for work.

**Syn.:** strategic resource buffer, pacing resource buffer.

**See:** constraint buffer, drum.

**drum resource** – The resource that serves as the drum for the organization.

**Usage:** In operations, two situations can exist. The drum resource can be a constraint or capacity-constrained resource. In using drum-buffer-rope the scheduling and execution of the drum resource are based on the drum (constraint schedule). In simplified drum-buffer-rope, scheduling and execution are based on the market being the drum with secondary attention directed to any capacity-constrained resource. In both situations, the drum resource is managed by buffer management.

**See:** constraint buffer, drum, drum-buffer-rope.

**drum schedule** – The detailed work schedule for operations that sets the pace for the entire system.

**Usage:** The drum schedule must be based on market demand and the finite capacity of the system constraint. In operations, the drum schedule combined with the rope mechanism helps limit work—in-process inventory which, in turn, reduces lead time and increases system performance.

In a multi-project environment using critical chain project management the drum schedule determines the planned start and estimated completion dates of projects using the drum resources and therefore sets the pace and determines how many projects a system can complete within a specified time period.

**See:** critical chain project management, drum-buffer-rope, drum resource.

**dry tree** – Colloquial term used to describe any thinking processes logic tree that has been scrutinized for validity using the categories of legitimate reservation and is considered to be very solid or tight from a logical perspective.
Perspective: Opposite of a "wet tree," which is considered to be not very solid or logically tight.
Ant.: wet tree.
See: categories of legitimate reservation, long arrow, scrutiny, thinking processes, wet tree.

dual-cloud process – A process for considering the unresolved conflicts related to causes and consequences of undesirable effects (UDEs) separately when developing clouds.
Usage: In the dual-cloud process, the assumed cause (i.e., specific actions or rules) of a UDE are addressed in a systemic conflict cloud to derive “D” and consequences of a UDE (i.e., the actions or rules that the one dealing with the UDE feels pressure to take to deal with the UDE) are addressed in a symptomatic conflict cloud. The two clouds are connected through the UDE in that D of the systemic cloud creates the undesirable effect and D of the symptomatic cloud is an action that must be taken to remove the UDE.
Illustration:

![Diagram showing dual-cloud process]

See: symptomatic conflict, systemic conflict.

dummy constraint – A constraint that is inexpensive relative to other resources in the system.
Perspective: Dummy constraints should always be eliminated.

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.

EC – Abbreviation for evaporating cloud.

effect – An entity that is the direct result of one or more causes.
Illustration: A cause-and-effect diagram is shown. This relationship is verbalized: If 10 Cause then 20 Effect. For example: If 10 I default on a loan then 20 My credit rating goes down. A drop in my credit rating is an effect of defaulting on a loan.
effect-cause-effect – A method used to validate the existence of a cause-and-effect relationship for which the existence of the proposed cause is not easily provable through direct observation. This is done by proving the existence of a second effect that could only be present if the proposed cause actually exists.

Illustration: By showing that the second effect exists, the existence of the proposed common cause is demonstrated to be valid. In the logic diagram below, it is proposed that: 20 My car battery charge is low is the cause of 30 My car won’t start. If it can be shown that: 40 The car’s lights are very dim, that would support the existence of a low battery charge and provide reinforcement that it is the cause of the car not starting.

effectiveness – A measure of the extent to which a process fulfills its intended purpose.

Illustration: An organization is effective when it produces the right product at the right time in the right quantity. Inventory dollar day (IDD) is a measure of the effectiveness of the production process. The IDD target level is zero. IDD measures “things that should not have been done but nevertheless were”. For example, making inventory to keep workers busy when, based on current demand, the workers should have been idle creates inventory dollar days and the production process is ineffective. When an item is made early it collects inventory dollar-days until sold.

See: efficiency, inventory-dollar-days, throughput-dollar-days.

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. Based on these three consecutive red zone reviews, the buffer target should be increased by 1/3 or 100 units. Order quantity is therefore:

\[ \text{Order quantity} = \frac{1}{3} (\text{current buffer max}) - \text{current buffer status} + \text{in-transit inventory} \]

\[ = \frac{1}{3} (300) - 60 + 0 = 400 - 60 + 0 = 340 \text{ units.} \]

See: buffer management.

elevate – The key word in the fourth of the five focusing steps: elevate the system constraint.

Usage: To elevate is to take actions that do not exploit the constraint or subordinate to it, yet the result is that the system produces more goal units. These actions usually require investment or outsourcing.

Example: In the book “The Goal” (Goldratt, North River Press, 1984), the NCX 10 cannot produce enough output to meet the market demand. UNICO took many actions to exploit the NCX 10 and to subordinate to the need to exploit the NCX 10. However, they still could not produce enough system output to satisfy market demand. They elevated their capacity to perform the functions of the NCX10 by bringing back old, less efficient equipment that could perform the same operations as the NCX 10.

See: exploit, five focusing steps, subordinate.

eclipse – The graphical element used to indicate a logical ‘and’ connection within a sufficiency-based thinking processes logic diagram by encompassing two or more arrows coming into an entity.

Illustration: In the following logic twig, both indicated causes, 10 and 20, must exist to cause 25 to exist. The diagram is verbalized: If 10 Work center 41 is broken down and 20 Work center 41 is an active constraint then 25 Throughput is down.

See: logic twig, logical ‘and’ connector, sufficiency-based logic, thinking processes.

eMBEDDED CONFLICT – A situation in which one of the requirements of an evaporating cloud can be viewed as the objective of a second cloud at a lower level of the system, with the same opposing actions D and D’ in conflict at the lower level.

Illustration:
*Syn.* nested conflict.

**Engines of disharmony** – Processes in an organization that cause problems in achieving the organization’s goal. These include:
1. Many people not knowing (i.e., cannot clearly verbalize) how what they are doing is essential to the organization.
2. Most people not knowing how what many of their colleagues are doing is essential, or at least contributes, to the organization.
3. Organizational Conflicts – People operating under conflicts such as conflicting policies or conflicts in resource allocation.
4. Inertia – Many people required to perform tasks for which the reason no longer exists.
5. Individual Conflicts – Gaps between responsibility and authority.

*See:* engines of harmony.

**Engines of harmony** – Processes in an organization that support the achievement of the organization’s goal. These include:
1. Each person knowing exactly how he or she contributes to the organization and knowing that the contribution will be recognized.
2. Each person knowing exactly how others contribute to the organization and knowing that their contributions will be recognized.
3. Aligning all rules with the goal and strategy of the company.
4. Systematically identifying and removing gaps between responsibility and authority.
5. Putting in place a constraint-focused continuous improvement program and culture.

**See:** engines of disharmony.

**entity** – A statement, generally in a rectangle or rectangle with rounded corners, that describes a part of the system being studied using a thinking processes diagram.

**Usage:** Effects, causes, actions, conditions, injections, intermediate objectives, and obstacles are all considered to be entities. An entity should be stated as a complete sentence; however, the statement should not be a compound or a complex sentence and should not contain a cause-and-effect relationship.

**Illustration:** The phrase, 20 Car battery, is not a valid entity. However, 20 The car battery is dead, is a valid entity because it is a complete sentence.

<table>
<thead>
<tr>
<th>Invalid entity</th>
<th>Valid entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 Car battery</td>
<td>20 The car battery is dead.</td>
</tr>
</tbody>
</table>

**See:** cause, effect, injection, intermediate objective, obstacle, thinking processes.

**entity existence reservation** – A level II reservation in the categories of legitimate reservation that is used to challenge the validity of a proposed statement of fact, whether part of a logic tree or not.

**Usage:** The scrutinizer of a thinking processes diagram may ask the question: “Does this entity really exist in your world as you have stated it?” The presenter then either proves its existence, or modifies the entity or removes it from the logic diagram.

**Illustration:** For example, when scrutinizing the following entity a scrutinizer might say, “Please explain how entity 50 is possible.”

<table>
<thead>
<tr>
<th>Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 I have more money than I will ever need.</td>
</tr>
</tbody>
</table>

**See:** categories of legitimate reservation, entity, scrutiny, thinking processes.

**entry point** – Any entity within a sufficiency-based logic diagram that does not have a cause or causes as indicated by the absence of an incoming arrow(s).

**Usage:** By convention, when creating a logic diagram, an entry point entity that is encased in a round-cornered rectangle is assumed to exist in the situation or the organization’s current reality and may be designated as a fact of life. An entry point entity encased in a square-cornered rectangle is an injection, and may be either an action to be taken, or a condition or system state that does not yet exist.

**See:** entity, fact of life, core driver, injection, sufficiency-based logic.

**evaporating cloud** (EC) – The precise definition of a problem. A necessity-based logic diagram that describes conflicts and helps identify erroneous assumptions and resolve conflicts in a “win-win” manner. A cloud is composed of an objective A, two requirements (B and C) that must be met to achieve A and two prerequisites (D and D’) that express the conflict.
Usage: The EC has two primary uses: 1. it serves as a structured method of describing, communicating and resolving conflicts, and 2. it is an integral part of the three-cloud approach to creating a core conflict cloud which then forms the base of a current reality tree. In this latter use, the EC helps answer the question (from the change question sequence): “What to change?”. The EC has two major steps: 1. Constructing a logically sound cloud (the five box diagram) and all the supportive arguments (assumptions) to explain its existence in reality; and 2. Developing a solution by selecting injections that can negate an assumption and cause the conflict to disappear. That is the reason for using the term “evaporating”.

Illustration: A portion of the EC below is verbalized: In order to A Satisfy our customers, B the shipping department must ship clients’ orders on time, because AB Clients consider our due date promise a commitment. The latter statement is an assumption.

<table>
<thead>
<tr>
<th>A We satisfy our customers</th>
<th>B The shipping dept. must ship clients’ orders on time. (Lieutenant’s responsibility)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB Clients consider our due date promise a commitment.</td>
<td>BD Violating our due date commitment to a client causes serious problems.</td>
</tr>
<tr>
<td>AC Having one contact point eliminates communication problems.</td>
<td>C Management must provide the clients one contact point.</td>
</tr>
<tr>
<td>D Management allows the shipping manager to call the client.</td>
<td>D’ Management allows only the account managers to call clients. (Lieutenant’s lack of authority)</td>
</tr>
<tr>
<td>DD’ Two different managers communicating with the client violates the policy of one contact point</td>
<td>CD The account manager is responsible for that client.</td>
</tr>
</tbody>
</table>

Syn.: conflict cloud, conflict diagram, conflict resolution diagram.
See: change question sequence, necessity-based logic, objective, prerequisite, requirement, thinking processes, three-cloud approach.

ever-flourishing company – An organization that continuously and significantly increases value to stakeholders (employees, clients and shareholders). The organization achieves its goal and meets the necessary conditions of satisfied employees and satisfied customers now and in the future.

excess capacity – Capacity that is not used to either produce or protect throughput.
Illustration: In the diagram below, every resource in the production process has considerably more capacity than the market is demanding. The exact amount of excess capacity is unknown because it is not clear how much protective capacity is needed for each resource, but it is likely that workcenters A, B, C and E have some excess capacity. The limiting internal resource is D.
See: excess capacity, idle capacity, productive capacity, protective capacity, throughput.

exclusive ‘or’ designator – A symbol using the word OR enclosed by “< >” (i.e., <OR>) that, when placed between two causes of a single effect signifies mutually exclusive causes. When placed between causes of a single effect it means that if one cause happens, the other cause does not.

Illustration 1: Exclusive OR (cause)

Illustration 2: Exclusive OR (effect)

exploit – The key word in the second of the five focusing steps: decide how to exploit the system constraint(s).

Usage: In the case of an internal resource constraint, to exploit is to get more goal units by taking actions that make the best use of or take the best advantage of the constraint.

Example: In the book “The Goal” (Goldratt, North River Press, 1984), when the constraint was the NCX10, actions that UNICO took to exploit it included staffing the machine during lunch, breaks, and shift changes, which resulted in more productive utilization of the constraint. Management also increased the yield at the constraint by doing quality inspection just prior to the NCX10 so that any defective parts were pulled before wasting constraint time. In general, other actions used to exploit a constraint include, but are not limited to, creating a schedule for the constraint resource, implementing total productive maintenance, reducing setup times at the constraint, and implementing an unrefusable market offer when there is a market constraint.

See: constraint, five focusing steps, market constraint, unrefusable offer.
**fact of life (FOL)** – 1. An assumption that has been validated for a given organization and its environment. 2. A statement about reality included to provide sufficiency in a cause-and-effect relationship.

**Usage:** In general, facts of life document the prevailing understanding or collective rationale of the thinking process diagram builder or team. Linking a fact of life with one or two related entities using a logical ‘and’ connector provides a tight logical relationship sufficient to establish the cause the subsequent entity.

**Illustration:** Entity 10 is considered to be a fact of life by the diagram builder. Using a logical ‘and’ connector (shown as an ellipse) to link entity 10 with entity 20 provides the rationale that, in the tree builder’s environment, logically yields entity 30 Our sales are down.

Caution: Even though some assumptions can be treated as “facts of life” (e.g. we are confident enough about it to take action as if it was true), they should always be thought of as challengeable assumptions.

See: entity, logical ‘and’ connector, sufficiency-based logic, thinking processes.

**feedback loop** – A set of logical cause-and-effect relationships that is connected in such a way that it produces either an increasing (positive) or decreasing (negative) condition or behavior within a system.

**Usage:** The definition above and usage of the term feedback in TOC is different from the definition in most other systems methodologies such as system dynamics. In these other systems methods, positive feedback describes a series of effects that are self-reinforcing, and negative feedback describes a self-correcting or balancing effect. In contrast, TOC’s definition of feedback is always a reinforcing feedback, either positive or negative, depending on the starting situation. In TOC, negative reinforcing loops are present in a system having problems that are getting worse, whereas positive reinforcing loops are active in a well-performing system, that is, steadily improving. In general, feedback involves both the transmission and the return of information. Since feedback loops exist in all real systems, it is important to actively identify and record them in any current reality and future reality tree diagrams, both for correct diagnosis and to utilize for effecting an improvement. Entities in a feedback loop are good candidates for leverage points.

**Illustration:** The example below is a negative feedback loop. If 10 We reduce the number of set-ups to increase efficiency then 20 We run larger batches and group like parts together. If 20 We run larger batches and group like parts together then 30 We release materials that are not yet needed. And if 30 We release materials that are not yet needed then 40 We reduce the protective capacity of the work center. Cause-and-effect loops back from 40 to 20 because reducing protective capacity reinforces running larger batches.
Syn.: reinforcing loop.
See: cause-effect, current reality tree, future reality tree, leverage point, negative feedback loop, positive feedback loop.

**feeder buffer**

Syn.: feeding buffer.

**feeding buffer** – A time buffer placed between non-critical chain work and the critical chain to protect the critical chain, the project’s constraint, from variation on a non-critical chain path of work.

Usage: The feeding buffer helps determine when to start non-critical chain work.

Syn.: feeder buffer.
See: buffer, buffer management, convergent point, critical chain.

**fever chart** – A graph showing the status of a project or multiple projects. The graph has percentage of project buffer consumed on the vertical axis and percentage of critical chain completed on the horizontal axis. The colors red, yellow, and green represent project status.

Usage: One approach to drawing the regions is as follows: if the buffer burn rate is something less than 1.0, the project status is green. If the buffer burn rate is approximately 1.0, the project status is yellow. If the buffer burn rate is something greater than 1, the project status is red. The project manager is responsible for determining the boundaries of the yellow zone.

Illustration 1: The graph on the left below reflects the status of a single project. The points (1, 2, 3 …) represent status reporting dates (weekly, for example) over time.

Illustration 2: The graph on the right below reflects the status of multiple projects. The points (A, B, C …) represent the status of different projects at a given point in time.
**Caution:** Buffer status (red, yellow, or green) as reflected in a fever chart may differ from buffer status reflected by the buffer region percentages (red, yellow and green boundaries).

See: buffer burn rate, project management measures.

**financial decision making** – Theory of constraints measures provide an organization with information useful for understanding the performance of the system as a whole as well as making a number of decisions, including:
1. Mix of products or services to offer.
2. Investment in plant and equipment.
3. Make vs. buy alternatives.

See: throughput accounting.

**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 buffer target (max size of the buffer), buffer status (the actual on-hand inventory), order frequency and order lead time for the sku 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.

Perspective: In a traditional (make-to-stock) environment, a single unit order point (min-max or economic order quantity) inventory system is used for ordering inventory. It is based on a forecast of the item.

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

**fire** – Colloquial term used to describe a situation that requires an immediate decision or immediate action.

Usage: Frequently fires originate with subordinates, and the fire is brought to the boss’s attention for a decision or action.

**firefighting** – Colloquial term used to describe the process of putting out fires, i.e., solving problems that require immediate attention, frequently on behalf of subordinates.

Usage: In traditional organizations, functional lines and levels in an organization chart dictate the authority of most individuals but in many cases decisions and actions cross these lines and levels. In these cases, when a problem occurs the subordinate generally must go to his/her boss (the lieutenant) and ask for a decision or action. In many cases the boss is constantly multitasking – trying to do both important work (i.e., the manager’s own work) and urgent work (i.e., solving subordinates’ problems) and therefore loses focus.

See: alignment of responsibility and authority.

**fire prevention** – Colloquial term used to describe the process of using the lieutenant's cloud to align authority with responsibility for subordinates in order to eliminate fires.

Usage: The purpose of the firefighting evaporating cloud is to determine how to preclude the need for firefighting in similar situations in the future. Firefighting is frequently the result of one of three major causes: lack of knowledge, authority, or confidence on the part of subordinates. The purpose of the firefighting cloud is not to fight fires but to prevent future fires.

Example: The lieutenant’s cloud is an example of a firefighting cloud.

See: lieutenant’s cloud.
**five focusing steps** – A systematic five-step approach used to continually improve a system’s ability to produce goal units:
1. IDENTIFY the system's constraint(s).
2. Decide how to EXPLOIT the system's constraint(s).
3. SUBORDINATE everything else to the above decision.
4. ELEVATE the system's constraint(s).
5. WARNING!!!! If in the previous steps a constraint has been broken, go back to step 1, but do not allow INERTIA to cause a system's constraint.

One of three processes of ongoing improvement in TOC.

*See:* process of ongoing improvement.

**floating bottleneck**

*Syn.:* wandering bottleneck.

**flying pig injection** – Colloquial term used to describe a breakthrough solution or injection that initially seems impossible to implement.

*Perspective:* A flying pig injection is so named because it appears to be so difficult to achieve that it has the same near zero probability of occurrence as seeing a flying pig.

*Illustration:* The securing of a $100 million loan to finance the development of a new, un-patentable product for a 25 year old recent engineering graduate would be considered, by almost everyone, to be a flying pig injection.

*Injection: Secure a 100 million dollar loan.*

*See:* breakthrough injection, injection, primary injection.

**focus** – Identifying one (or a few) elements or leverage points that have significant positive impact on the system’s achievement of its goal.

*Usage:* Focus encompasses doing what should be done as well as not doing what shouldn’t be done. Focus translates into the significant reduction or elimination of multitasking.

**focused duration**

*Syn.:* touch time.

**FOL** – Abbreviation for fact of life.

**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.

*Syn.:* free product.

**free product**
**freeze (defrost) mechanism** – In a critical chain implementation or when multitasking is prevalent, the stopping of work on tasks for projects that represent the lowest priority of in-process projects.

*Usage*: Some recommend that projects representing 25% (more or less may be required) of the load on resources be temporarily frozen to reduce bad multitasking. Freezing can take place at the project, path, department or task levels, dependent on the severity of multitasking. At each level of freezing, multitasking is reduced significantly allowing the rate of project completion to increase significantly. As current projects are completed, frozen projects are defrosted based on priority and to maintain flow. Once all frozen projects are defrosted, new projects are released based on completion of in-process projects. Freezing projects allows freed-up resources to focus on existing projects, reduces multitasking, and allows time for full kitting of all projects.

**FRT** – Abbreviation for future reality tree.

**full kit manager** – A manager responsible for ensuring that all projects have everything needed for project completion prior to project release.

**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 of the order to the shop floor. 2. In critical chain project management, the process of clarifying requirements, getting approvals, staging materials, etc. for a project before the project is released for execution.

**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, load control, planned load, prerelease wait time.

**fundamental assumptions** (of TOC) – Basic beliefs thought to generally apply to all social systems:
1. People are good ... but we all have “bad” assumptions that block us from seeing and unlocking inherent potential within ourselves, others and the organizations we work in.
2. Every conflict can be removed ...if we can find and challenge the erroneous assumption(s) causing the conflict.
3. Every situation (or system), no matter how complex it initially appears to be, is exceedingly simple ...if we can find the one or few high leverage points, the inherent simplicity in any situation or system.
4. Every situation can be substantially improved ...if we can just think clearly in all situations we encounter using these assumptions.

*Usage*: In “The Choice”, Dr Eli Goldratt states that once someone makes the choice to believe and act according to these four assumptions, then he or she can reach a full life and that not even the sky is the limit.

The four fundamental assumptions of TOC expand on the two fundamental assumptions of the hard sciences as TOC is dealing with social systems that involve people. The two fundamental assumptions of the hard sciences are captured in Sir Isaac Newton’s quote: “Natura valde simplex est et sibi consona” which means “Nature is exceedingly simple and harmonious with itself”. Newton’s quote is
claimed to capture the two fundamental beliefs of the hard sciences: the assumption that the universe (and all other complex systems) are governed by inherent simplicity; and that within such systems there is inherent harmony (there cannot be any contradictions within the governing rules).

With his “Theory of Constraints”, Dr. Eli Goldratt introduced these two fundamental beliefs of the “hard sciences” and, as importantly, the thinking processes and methods of a scientist to the world of analyzing, improving and managing organizations or social systems. He expanded these two base assumptions with two further assumptions to incorporate important dynamics within social systems: “People are good” and “Every situation can be substantially improved”.

**future reality branch** – A thinking processes sufficiency-based logic diagram for examining potential solutions before they are implemented.

**Usage**: A future reality branch is similar to a future reality tree except that it is used to test and solve problems related to evaluating a specific action or evaporating a cloud. It is the result of applying the negative branch reservation process.

**See**: cloud, future reality tree, negative branch reservation process.

**future reality tree** (FRT) – A thinking processes sufficiency-based logic diagram that facilitates answering the question (from the change question sequence): “To what to change?” by presenting a sequence of cause-and-effect relationships that links proposed injection(s) to desired effects (DEs).

**Usage**: The FRT is constructed prior to implementing any changes in the system. The purposes of an FRT are: 1. to logically demonstrate that the selected injection or injections, together with any secondary or supporting injections, and their associated effects will cause the majority of the existing UDEs in a system to be replaced by DEs; and 2. to identify and prevent from occurring any new problems or UDEs that might result from implementing the proposed injection(s). The latter objective is achieved through the negative branch reservation process.

There are two methods of constructing a future reality tree. The original method started with an injection at the bottom of the tree and built upward to reach desirable effects. A more recent method starts the future reality tree with an evaporating cloud, rotated 90 degrees clockwise. Assumptions underlying each arrow of the cloud are used along with injections developed from the cloud to build upward to desirable effects.

**Illustration 1**: A future reality tree constructed using traditional approach is shown below:
Illustration 2: A future reality tree constructed using an evaporating cloud as a foundation is shown below:
See: change question sequence, desirable effects, entity, negative branch reservation process, sufficiency-based logic, undesirable effects.

**garbage time** (of a bottleneck) – A colloquial term used to describe time spent by a bottleneck resource that either should not be done at all or that a non-bottleneck resource should be doing.

**generic cloud** – 1. The generalized cloud created in the three-cloud approach. By selecting three diverse problem areas, the generic cloud represents a synthesis of three relatively independent evaporating clouds and contains the core conflict that is responsible for many of the undesirable effects present in an organization or unit of study.

2. A general or basic conflict cloud between two people that represents various underlying day-to-day conflicts.

  Examples: Generic clouds include: managing according to the cost-world versus the throughput-world, local versus global, an individual’s well-being versus what is best for system, short-term versus long-term, and the lieutenant’s cloud.
Illustration: As shown below, a generalized conflict for a married couple might be described as "Live for today versus Save for tomorrow". One of the day-to-day conflicts underlying this generic conflict might be, "Spend money on a fun-filled weekend versus do not spend money on a fun-filled weekend". Another one might be, "Buy a boat versus do not buy a boat."

See: consolidated cloud, core conflict, evaporating cloud, lieutenant’s cloud, three-cloud approach.

global measures – Measures used to judge the performance of the system as a whole.
Usage: In the throughput-world paradigm of TOC, throughput (T), investment (I) (formerly referred to as inventory), and operating expense (OE) are global measures. Net profit, return on investment and cash flow are also global measures for a for-profit organization.
See: inventory, investment, local optimum, operating expense, throughput, throughput-world paradigm.

goal – The purpose for which the system was created as determined by the owners of the system.
Usage: In addition to a goal, systems have necessary conditions that must be met or the system will not be able to continue to generate goal units now and in the future.
Example: The owners of most for-profit companies identify the goal as “to make more money now and in the future.” In addition, they also recognize that it is absolutely necessary that the company satisfy its customers now and in the future and that they must provide a secure and satisfying environment for employees now and in the future or they will be unable to reach the goal. The term “ever-flourishing” is used to describe an organization that performs exceedingly well with respect to both its necessary conditions and its goal.
See: ever-flourishing, necessary condition.

good enough curve – A concave curve with a relatively flat top with goal units (e.g., net profit, throughput, or happiness) on the vertical or Y axis and the decision variable (e.g., number of open projects, orders released to processing or level of multitasking) on the horizontal axis. There are three phases to the curve: too little, good enough, and too much of the decision variable.
Usage: On the left side of the curve the impact of having too little of the decision variable (e.g., too few open projects or orders) is depicted. The effect of this level of the decision variable is a low number of goal units (e.g., throughput is low due to starvation of the constraint). In the middle or flat portion of the curve the goal units are relatively stable over a wide range of the decision variable. The right side of the curve shows the effect on goal units of values of the decision variable that are too high. Three points are significant: 1. No one optimum solution exists for the decision variable to achieve the maximum goal units. This concept is counter to the academic search for an optimum solution for many situations. Instead, there is a wide range of values for the decision variable that provides equally acceptable numbers of goal units. 2. One of the basic concepts of the theory of constraints is that managers should strive to develop a good enough solution to a problem and then buffer the solution to minimize the risk that the planned goal units will not be achieved. 3. In the first phase (i.e., the left portion of the curve) the limiting factor is not enough work, while in the third phase (the right portion of the curve) the limiting factor is too much work, which causes confusion, resource
conflicts, and multitasking, with a consequent drop in productivity.

In a real situation, the investigator would identify the undesirable effects of the current situation and could then, using cause-and-effect logic (a logic branch or CRT), tell where on the curve the organization is. If the undesirable effects are caused by too little of the decision variable then more of the decision variable is applied. If the undesirable effects relate to too much of the decision variable then the decision variable is usually reduced by 25% (e.g., 25% of open projects are frozen). This action usually brings the organization to the good enough region of the diagram. Buffer management can then be used to continually refine the solution.

Illustration:

![Diagram of goal units and decision variable]

**Syn.:** plateau curve  
**See:** u-curve.

**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 (which translates into three greens in a row).

**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 (usually by one third) for the item.

**green zone (of the buffer)** – The buffer management term for region I, the least critical region of the buffer.

**Usage:** Green, a sign of freedom to move or continue, is used to refer to this zone because holes are not a problem in this region of the buffer as parts are generally not supposed to arrive yet or work is not supposed to be completed. Monitoring the green zone will detect early completions that may indicate that the overall size of the buffer can be decreased, or that the rope is not functioning properly.

**Perspective:** TOC logistical solutions in production, project management and distribution/replenishment use buffers to protect the constraint and the customer from variation. These buffers are broken into three zones generally referred to as the green zone, yellow zone and the red zone. These zones help set priorities in reacting to variation.

**Syn.:** region I.

**See:** buffer, buffer management, hole, red zone, yellow zone.

**grounding a flying pig** – Colloquial term used to describe a solution that solves a problem in a win-win manner but, like seeing a flying pig, is highly unlikely to ever happen. Grounding refers to identifying and implementing supporting actions that makes the flying pig solution feasible.

**See:** flying-pig injection.
**half-baked solution** – Colloquial term used to describe a solution or potential solution that is not well-thought-out, i.e., a solution that has significant negative consequences that have not been anticipated and, as a result, no thought has been given to preventing the potential negative consequences.

**hole in the buffer**

*Syn:* buffer hole.

**holistic approach** – The belief that, because change in one place in a system has ramifications in other parts of the system, in order to find the proper place to focus systemic change, it is necessary to give rigorous consideration to the cause-and-effect network that links the system's undesirable effects.

*See:* cause-effect.

**holistic financial measures** – Measures of the financial performance of an entire organization.

**holistic operations measures** – Measures of the operational performance of an entire organization.

*Examples:* Holistic operations measures measure the impact of actions across functional silos. The theory of constraints includes throughput-dollar-days, which measures the extent to which the organization is not doing what should be done; and inventory-dollar-days, which measure the extent to which the organization is doing things that should not be done.

*See:* inventory-dollar-days, local operating expense, throughput-dollar-days.

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

**holistic project management rules** – The rules for managing either single projects or multiple projects from a systems perspective. The rules are categorized as either planning rules or execution rules. The planning rules 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.

The execution rules include:

1. Bad multitasking is eliminated.
2. The road runner work ethic is implemented.
3. Buffer management is used for corrective actions and causes of buffer penetration are reviewed periodically as part of the process of ongoing improvement.

In addition, in multi-project critical chain project management, the execution of an already decided project portfolio includes staggering start times for projects based on the drum or virtual drum (integration point, heavily loaded resource, strategic resource or policy) and releasing projects based on conditions at the drum or virtual drum.

**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.

**how to cause the change?** – The third question in the original change question sequence and the fourth question in the newer change question sequence. The focus of the question is on developing an implementation plan for the change.
**Usage:** Typically, the prerequisite tree and the transition tree are the thinking processes that are used to help determine the plan and detailed actions required to respond to this query. The objective in asking this question is to induce the proper people to invent solutions along the lines of those constructed in answering the preceding question in the change sequence – what to change to?

**Perspective:** How to cause the change includes, but is not limited to, creating a plan for implementing change. It also includes involving the appropriate people at the appropriate times in the other two steps of the change question sequence, as well as facilitating the process of those people creating the solution rather than dictating the required change(s).

**See:** change question sequence, prerequisite tree, transition tree, thinking processes.

**how to measure and sustain the change?** – The fifth question to be answered in the newer change question sequence. The focus of the question is on developing mechanisms to measure the impact of changes (as a reinforcing feedback loop) and achieving and maintaining a process of ongoing improvement.

**Usage:** The three processes of ongoing improvement – the five focusing steps, the change question sequence, and buffer management – provide feedback mechanisms for continuous improvement. For success, sustainability must be a management priority with executive follow-up on sustainability and obstacles to progress.

**See:** buffer management, change question sequence, five focusing steps, process of ongoing improvement.

**I** – Abbreviation for investment. (This was formerly used to refer to inventory.)

**IDD** – Abbreviation for inventory-dollar-days.

**identify** – The key word in the first step of the five focusing steps: identify the system’s constraint(s). The process of determining what factor is currently most limiting attainment of the goal.

**See:** constraint, five focusing steps.

**idle capacity** – The available capacity on non-constraint resources beyond the capacity required to support the constraint. Idle capacity has two components, protective capacity and excess capacity.

**Usage:** In the TOC production and multi-project management solutions, protective capacity is maintained at all non-constraint resources. Increasing protective capacity allows the system to reduce the size of the buffers (thus reducing the lead times of the system) and ensure more reliable on-time performance. Reducing variation in the system reduces the need for protective capacity.

**Perspective:** Traditionally, all idle capacity is viewed as excess capacity or waste that should be trimmed. However, in a system of dependent events and statistical fluctuations, some idle capacity is needed to protect the throughput of the system. TOC refers to this vital part of idle capacity as protective capacity.

**See:** capacity, excess capacity, productive capacity, protective capacity.

**IIP** – Abbreviation for intimately involved person.

**independent multi-project environment** – An environment in which critical resources are not shared across projects. Projects are managed as multiple single-projects.

**Syn.:** multiple single-project environment.

**See:** dependent multi-project environment.
**inherent simplicity** – The concept that nature is simple and harmonious with itself.

*Usage*: The concept of inherent simplicity in TOC is the basis for continually asking “why?” an effect occurs, surfacing the cause, validating the cause existence, asking why again, etc. The structure of a current reality tree makes it clear that relatively few causes at lower levels in the tree result in many effects higher in the tree.

**injection** – 1. A state, condition, or action proposed as a means of converting undesirable effects into desirable effects through a chain of cause-and-effect in a future reality and depicted in a future reality tree (FRT). 2. A state, condition, or action that invalidates one or more assumptions underlying the relationships between the objective and requirements, or between requirements and prerequisites, or between the two prerequisites of an evaporating cloud. 3. A state, condition, or action that is proposed to overcome, or “trim”, a negative branch reservation. 4. An element of a solution that consists of several injections.

*Usage*: Although it may be an action, an injection is usually expressed as a system state or condition. An injection is shown as a square-cornered rectangle on an FRT. An injection may involve a breakthrough idea that resolves the core conflict in an evaporating cloud.

In order to verbalize and evaluate an injection, it is not necessary to prove that it is currently possible to achieve the stated condition, that is, the injection may well be a “flying pig injection.”

*See*: breakthrough injection, desirable effects, entity, future reality tree, evaporating cloud, flying pig injection, negative branch reservation, objective, prerequisite, requirement, trimming injection, undesirable effects.

**injection flower** – A structured graphic representation of the areas to be learned, checked and developed by a TOC implementer to ensure a successful implementation of an injection. The upper part of the injection flower contains the solution design (“What” – the relevant knowledge for the injection), the lower part presents mechanics (“How” – the practicalities of the injection describing the way the injection is integrated into the reality as well as how to make it happen).

*Usage*: For every injection the implementation team has to learn its essence and structure, and check that the injection addresses the relevant undesirable effects, brings about the desirable effects, and does not cause any significant negative branch reservations. For every injection the team builds the implementation plan and develops the procedures.

The role of the TOC leader is to encourage and support the implementation team in doing this work.

**injection map** – A map showing the logical sequence of injections necessary to achieve a full solution.

*Illustration:*
inner dilemma cloud – An evaporating cloud used on a standalone basis (i.e., not as part of a complete thinking processes analysis) when a person feels pressure to make a decision with which he or she does not feel comfortable and the decision maker’s preference has not yet been disclosed, i.e., the conflict is internal.

Illustration: A manager has been told by her supervisor to fire a subordinate. The manager is uncomfortable with the decision because the subordinate performs his job well and the manager believes her supervisor’s opinion is based on factors not related to the subordinate’s job performance.

I-plant – A production environment in which materials generally flow through a direct sequence of operations. The logical flow of materials resembles the letter I in the sense that there are few divergent points, as in a V-plant, and few convergent points, as in an A-plant.

Examples: Transfer or assembly lines such as used to assemble lawn mowers.

integration point – In critical chain project management, the task where major paths in a project converge.

Usage: The integration point is usually near the end of a project where several different paths converge (e.g., subprograms in a large program, assemblies for an aircraft) to produce the finished product. A feeding buffer is inserted at integration points (similar to any convergent point) on the critical chain to protect it from disruptions on the non-critical-chain paths. An integration point may be selected as the virtual drum and then can be used for scheduling projects and as the release mechanism for new projects in a multi-project environment: new projects are released for execution when a project exits the integration point. Managing the integration point is critical to achieving high due date performance and increased flow of projects.

See: ambitious target tree, intermediate objectives map, prerequisite tree.

See: evaporating cloud.

See: evaporating cloud.

See: A-plant, convergent point, divergent point, T-plant, VATI analysis, V-plant.
integration risk

Syn.: merge bias.

interactive constraints – Two or more factors (e.g., highly utilized resources in a production environment or critical chains in a project environment) that interact in a way that results in system throughput being highly unpredictable (chaotic) or difficult to manage. The factors can frequently be identified in the planning stages but execution is still difficult due to dynamic complexity in the timing of the need for capacity, resulting in interactions between the factors and loss of throughput.

Usage: “Interactive constraints” is a broader term than “wandering bottleneck”. Constraints include such things as scarce resources in a production environment, critical chains in a project environment, the market for a given product, etc. while bottlenecks describe scarce resources in a production environment. While studying the project management environment, Dr. Goldratt recognized that the critical chain in a project was the constraint to finishing the project. Shortly thereafter he changed the name of the body of knowledge he created to the “Theory of Constraints”.

See: bottleneck resource, capacity-constrained resource, constraint, wandering bottleneck.

intermediate objective (IO) – A transitional condition or milestone that must be achieved before a main objective can be attained.

Usage: IOs usually appear as entities on IO maps, prerequisite trees and transition trees and are associated with obstacles that must be overcome before an objective is achieved.

Illustration:

![Intermediate Objective Map]

See: entity, IO map, objective, obstacle, prerequisite tree, transition tree.

intermediate objectives map (IO map) – A necessity-based logic diagram containing injections, intermediate objectives, and the final objective or ambitious target.

Usage: The IO map is created from a prerequisite tree by removing all the entities representing obstacles. The IO map is a plan that determines the sequence of intermediate objectives to be achieved in the implementation of the injection. The logic of the sequence is that one intermediate objective has to be in place before the next intermediate objective can be achieved.

The IO map is built by people who have intuition about the area in which the solution (a set of injections) is planned to be implemented. The obstacles are not recorded explicitly on the map and hence it is unlikely that the map will be subject to rigorous logical scrutiny. The IO map has been proven to be effective in collecting relevant opinions of people who are key to the implementation and helps gain their support and collaboration. An IO map is frequently created prior to building a project network or to establish the relationships among a system’s goal, critical success factors, and necessary conditions.

Illustration: [Intermediate Objective Map]
See: intermediate objective, prerequisite tree.

**internal champion** – An individual within an organization that leads the TOC implementation. An internal champion is necessary but not sufficient to cause a successful implementation.

**intimately involved person (IIP)** – Individuals who are directly affected by the problem or its solution because their actions, behavior, measures, responsibilities and authority might change based on the problem solution.

**Usage:** Understanding the roles of individuals in the organization, and who the IIPs are, is essential to constructing the solution and obtaining buy-in.

**See:** directly responsible person, outside person.

**inventory** – Formerly one of the operations measurements of the theory of constraints, now changed to investment.

**See:** investment (I).

**inventory-dollar-days (IDD)** – A measure of the effectiveness of a supply chain that measures whether the supply chain did things that it shouldn’t have done, the result of which is that the supply chain is holding inventory of products customers don’t want. The system should strive for the minimum IDDs necessary to reliably maintain zero throughput-dollar-days.

**Usage:** IDD accounts for the time from when inventory is first put in stock until it is actually needed by a customer and the monetary value of the inventory being held. IDD is calculated by multiplying the monetary value of each inventory unit in stock by the number of days since that inventory entered the responsibility of that link. The resulting unit of measure is “dollar-days”. IDD is neither monetary nor time based. Attempts to compare dollar-days to other monetary measures are invalid. IDDs can be compared only to other IDD levels.

**Example:** Consider the IDD for a Part #A243 which has a throughput value of $33. There are currently 144 parts in stock. Of those 144 units, 50 were added to stock just 2 days ago. Fifty more have been in the bin for 22 days, and the remaining 44 units have been in stock for 42 days. The current IDD for Part #A243 is 100,584. ((50x$33x2) + (50x$33x22) + (44x$33x42)).

**See:** inventory-value-days, throughput-dollar-days.

**inventory profits** – Profits reported by manufacturing companies under traditional cost accounting systems resulting from increases in work-in-process and finished goods inventories from one accounting period to the next.
Perspective: Losses are reported when inventories decrease from one period to the next.

Usage: Inventory profits and losses are a function of the way generally accepted accounting principles (GAAP) require financial results to be stated. Although managers have no control over GAAP, this feature of GAAP provides an incentive for managers to increase work-in-process and finished goods inventories from period to period in order to increase profits. Although financial statements based on throughput accounting do not comply with GAAP, they can be used to demonstrate to managers the extent of the impact of inventory changes on profits reported under GAAP.

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).

inventory-value-days (IVD) – A term used instead of “inventory-dollar-days” in countries where the dollar is not the base currency.

See: inventory-dollar-days.

investment (I) – All the money currently tied up in the system. As used in TOC, investment refers to the equipment, fixtures, buildings, etc. that the system owns as well as inventory in the forms of raw materials, work-in-process and finished goods.

IO – Abbreviation for intermediate objective.

IO map -- Abbreviation for intermediate objectives map.

iteration variability – Variability with respect to how many times a loop in a project has to be performed.

Example: In a product development environment, a product or component may have to go through a test, revise, retest loop a variable number of times before the desired result is achieved.

IVD – Abbreviation for inventory-value-days.

jeopardy – Two of four checks that are performed to test the validity of an evaporating cloud (EC). One check is whether entity D jeopardizes the requirement stated in entity C and the second is whether entity D’ jeopardizes the requirement stated in entity B.

Usage: If jeopardy is not present between the entities, then the wording in one or both entities needs to be revised.

Perspective: A valid EC must also meet the following two conditions: 1. entities D and D’ must be in conflict with each other; 2. entities B and C must not be in conflict with one another and both must be required to achieve the objective A.

Illustration: Does the existence of D Raise the price of Pressure Steam boilers jeopardize the existence of C Increase market for repair parts? The answer is yes because raising the price of boilers will reduce sales of boilers and reduced sales means fewer boilers in use that might require repair parts. Does the existence of D’ Lower the price of Pressure Steam boilers jeopardize the existence of B Increase margins of product line? The answer is yes because, assuming costs have not decreased, margins will go down when the price is lowered. (Reference: It’s Not Luck, Goldratt, 1994).


See: entity, evaporating cloud, requirement.

**just-in-time manufacturing management philosophy** – The success of the Toyota Production System (TPS). When the TPS was introduced into the United States it was renamed just-in-time manufacturing. The focus was on making just the right quantity of an item at just the right time and having it at the right place, hence the name just-in-time was coined. After numerous failures at implementing just-in-time in the US many of the JIT tools were recast into a new management philosophy called lean which focused on the elimination of waste, simplification of operations and the improvement of flow.

See: lean manufacturing management philosophy, Toyota Production System.

**kitting**

*Syn.:* full kitting.

**layers of resistance** – 1. A six-part stratification of the concept in organizational behavior that is often identified as "resistance to change".

The six layers of resistance, as expressed by the person(s) resisting change, are:

1. Disagree on the problem.
2. Disagree on the direction of the solution.
3. Disagree that the solution solves the problem.
4. Yes, but there are potential negative consequences.
5. Yes, but there are obstacles to implementing the solution.
6. Un-verbalized fears.

2. More recently, nine layers of resistance have been identified:

0. “There is no problem.”
1. Disagreement on the problem.
2. “The problem is out of my control.”
3. Disagreement on the direction for the solution.
4. Disagreement on the details of the solution.
5. “Yes, but...” the solution has negative ramifications.
6. “Yes, but...” we can’t implement the solution.
7. Disagreement on the details of the implementation.
8. You know the solution holds risk.
9. “I don’t think so” – Social or psychological barriers.

**Perspective:** These layers are actually sub-categories of disagreement on: why change, what to change, to what to change, how to cause the change, and how to measure and sustain the change and achieve a process on ongoing improvement.

Properly understood, what is thought of as “resistance” actually becomes a force for managing organizational change by using the TOC tools, particularly the thinking processes, to systematically
overcome each layer of resistance and obtain buy-in. Each layer must be successively peeled away by using the change question sequence (either the three- or five-questions sequence) and the thinking processes. The key to overcoming resistance to change is to get ownership of all involved in the change in the answers to the five change questions: why change, what to change, what to change to, how to implement the change and how to measure and sustain change.

See: buy-in.

**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.


**least product cost assumption** – The assumption that local cost savings directly increase organizational profits.

Usage: The least product cost assumption in traditional management results in the use of a number of local performance measures such as minimization of product cost and labor and equipment efficiency and utilization.

See: operating expense.

**leverage point** – A point, either physical or logical, where a specific action would provide significant system improvement.

Usage: A constraint is the leverage point in a physical flow of goal units in a system. The core problem is the leverage point in the cause-and-effect analysis of how to better exploit or elevate the system constraint.

Example: An entity in a positive feedback loop in a future reality tree is a leverage point, since if change can be initiated here it will lead to continuing improvement in results.

See: Archimedes lever point, constraint, feedback loop.

**lieutenant’s cloud** – An evaporating cloud that describes the conflict that employees have relative to the misalignment of their responsibility and authority.
**Usage:** In this story line, the company has experienced problems in the past when multiple people inside the company speak directly to the customer. A policy was established that only the account manager can speak with the customer. It happened, however, that the account manager was not available when the shipping manager needed to ask the customer’s question about an order that needed to ship immediately or it would be late. The shipping manager (the “lieutenant”) was responsible to ship the order on time but lacked the authority to contact the customer in order to get the information needed to fulfill this responsibility. As shown in the cloud below, the injection (as shown in the square-cornered box) to evaporate this cloud is giving the lieutenant the authority to contact the customer when it has a direct impact on his or her ability to fulfill the responsibility of shipping on time.

**Illustration:**

![Diagram](image)

**See:** alignment of responsibility and authority, evaporating cloud, injection.

**light blue order** – A non-priority order that is placed to use protective capacity in make-to-availability and make-to-order environments. The three color priority system of green, yellow and red is used with white used to indicate an order that should not have been released and black used to indicate an order that is late.

**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 items 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:** planned load, prerelease production lead time.

**local operating expense** – Operating expense that is under the control of the manager of a department or other part of an organization or system.
**local optimum** – The maximization or minimization of a measure of a part of a system or organization.  
Example: In traditional cost accounting, actions taken to improve local performance at a work center or in a specific function are viewed as having global impact on performance. Conversely, in TOC actions to improve local performance are seen as not necessarily improving global performance.

**logical ‘and’ connector** – A symbol shaped like an ellipse used in thinking processes sufficiency-based logic diagrams to indicate lateral dependency among contributing causes, i.e., that all entities whose exiting arrows are encompassed by the logical ‘and’ connector must exist in order for the effect to exist. Usage: The logical ‘and’ connector is used in the following logic diagrams: the current reality tree, future reality tree, negative branch reservation, and transition tree. The ellipse is drawn across the arrows from two or three entities to denote that they all must exist if the designated effect is to occur. In other words, removal of any one of the causes covered by the ellipse precludes the indicated effect from occurring.

Illustration 1: The following logic diagram is verbalized: If 10 I eat too much and 20 I don’t exercise then 30 I gain weight.

Illustration 2: If 60 I have fuel and 70 I have a heat source and 80 Oxygen is present then 90 I can create a fire. If any of these three conditions do not exist then the fire cannot be started.

**logical product structure**

Syn.: conceptual ‘and’ connector, ‘and’ connector, ellipse, banana.

See: current reality tree, entity, future reality tree, logic tree, magnitudinal ‘and’ connector, negative branch reservation, sufficiency-based logic, transition tree.

**logic branch** – A thinking processes sufficiency-based logic diagram that illustrates the logical relationship between causes and effects. Perspective: A branch contains twigs, a tree contains branches.

See: entities, logic twig, sufficiency-based logic.

**logic diagram** – A general term used to describe any of the thinking processes diagrams.

See: ambitious target tree, current reality branch, current reality tree, evaporating cloud, future reality branch, future reality tree, intermediate objectives map, logic tree, prerequisite tree, strategy and tactics tree, transition tree, tree diagram.

**logic tree** – A graphical representation of cause-and-effect relationships consisting of several entities connected by arrows and using either sufficiency- or necessity-based logic.
Usage: Logic trees can be based on either sufficiency-based logic (e.g., current reality tree) or necessity-based logic (e.g., prerequisite tree). Small logic trees that use sufficiency-based logic are sometimes referred to as logic branches or logic twigs, especially when excerpted from a larger sufficiency-based logic tree.

Syn.: tree diagram.

See: current reality tree, entity, future reality tree, logic branch, logic twig, necessity-based logic, negative branch reservation, prerequisite tree, sufficiency-based logic, transition tree.

logic twig – A few entities connected together using sufficiency-based logic relationships.

Perspective: Generally, a logic twig is a subset or selected portion of a logic branch that includes additional entities.

See: entities, logic branch, sufficiency-based logic.

long arrow – 1. A term used when scrutinizing a logic diagram to indicate that there appears to be a gap in the logic (i.e., one or more intermediate steps is missing) that makes it unclear how a cause and an effect are related.

Usage: A wet tree will typically contain many long arrows, whereas a dry tree has few.

2. A technique used in building or presenting a CRT in which the details of some cause-and-effect relationships are not shown in the tree.

Usage: This type of long arrow should only be used where all participants fully understand the underlying logic.

Illustration: When seeing the following two entities, the scrutinizer might say “I don’t see how implementing drum-buffer-rope successfully causes the organization to drop the use of TOC. That is a ‘long arrow’ for me.” The scrutinizer is saying that there must be additional entities between 10 and 30 before he/she can understand the cause-and-effect logic.

Syn.: trans-Atlantic arrow.

See: scrutiny, wet tree.

mafia offer

Syn.: unrefusable offer.

magnitudinal ‘and’ connector – A connector used in sufficiency-based logic diagrams to indicate that two or more entities are independent causes that contribute in an additive way to a total effect. Each additional cause contributes incrementally to an increasing (or decreasing) effect. No symbol or a bow-tie shaped symbol is used to represent the magnitudinal ‘and’ relationship.

Usage: Generally, independent causes accounting for at least 70% of the magnitude of an effect should be identified. When this is the case, an effect or problem is reduced significantly if those major causes are eliminated.

The magnitudinal ‘and’ connector is used in current reality trees, future reality trees, and negative branches. If the bow tie is used it is drawn to overlap the arrows originating from all additive causes and indicates that the removal of any one cause will degrade the effect by some amount. To eliminate
all of a graduated effect, all of the additive causes must be eliminated. Causes may be selectively
eliminated or retained to achieve an acceptable level of effect.
Frequently, independent arrows entering an entity are interpreted to mean that the entities at the
bases of the arrows are independent additive causes. In logic diagrams in which the magnitudinal
‗and‘ connector is used, two or more independent arrows entering an entity are interpreted to mean that
each of the cause entities can account for the entire effect.
Illustration: The following diagram is verbalized: If 10 We sell our products at a premium
domestically and 20 We license production in other countries and 30 We export our products to other
countries then 40 We make more money, now and in the future.

Illustration:

See: ‘and’ connector, conceptual ‗and‘ connector.

**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.
**Usage:** 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. 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.
**Illustration.** 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. Simplified
drum-buffer-rope for planning and buffer management to maintain priorities in execution are used.
Downstream supply chain links (wholesalers, distributors, and retailers) maintain small inventories of
each SKU, order daily and replenish frequently from an upstream centralized manufacturing facility
(preceding link in each chain). 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. Raw materials buffers are generally kept at the
manufacturing facility to reduce supplier lead times with frequent replenishments from suppliers.
See: make-to-availability injections, make-to-order, make-to-stock.

**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 ongoing 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** (MTO) – A manufacturing strategy where an product (good or service) is produced after the customer order is placed.

*Usage 1:* When the manufacturing facility has an internal constraint, drum-buffer-rope scheduling is used and buffer management is used to control execution. The raw materials release date and estimated shipping date are determined by placing the order constraint process at the first open date on the constraint schedule and subtracting the constraint schedule to determine raw material release and adding the shipping buffer to the constraint schedule for the product to determine the shipping date.

*Illustration 1:* MTO with an internal constraint:

*Usage 2:* When the manufacturing facility has no internal constraint a production buffer is used for planning with the plant capacity-constrained resource used to plan raw materials release by subtracting one-half of the production buffer from the planned load date for processing the order and by determining customer shipping date by adding one-half the production buffer to the planned load date. Long lead time raw materials and common (across products) raw materials buffers are commonly used as strategic buffers to reduce lead time.

*Illustration 2:* MTO with a market constraint:
See: make-to-availability, make-to-order injections, make-to-stock.

**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 ongoing 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.

**make-to-stock** (MTS) – A push manufacturing strategy where stock is made ahead of time and held awaiting customer orders. The amount of stock produced/ordered is generally based on a forecast of demand and modified by lot sizing to reduce inventory costs (ordering, carrying and shipping costs).

See: make-to-availability, make-to-order.

**management constraint** – 1. A common misnomer. Management is not really the constraint, rather poor management hinders effective constraint management by inhibiting the ability to fully exploit or subordinate to the constraint.

**Example**: Management may punish engineers for not finishing their project tasks on time. The effect is that engineers put more “safety” in their estimates of task times, and early finishes are rarely reported. The unintended negative consequence is that the project’s critical chain is not exploited and projects almost always finish late in spite of all the safety built into every task estimate. Bad actions by management that punish project engineers are not the constraint, but it hinders the engineers’ ability to exploit the constraint of the project.

**Note**: In the past poor management was commonly referred to as a type of constraint.

See: constraint, exploit, subordinate.

2. Top management time available to devote to a given area, decision, etc.
Usage: Management time is a constraint under the traditional management philosophy under which managers attempt to focus on everything instead of focusing on the organization’s leverage points. See: leverage points.

management core conflict cloud – Management’s core problem is the dilemma of how to judge the performance of local parts of the organization (e.g., people, departments, functions). For a manager to be viewed as performing well (objective A) the manager must control costs (requirement B) and at the same time the manager must protect organization throughput (requirement C). In order for a manager to control costs the manager must judge according to local impact (prerequisite D) of the “improvement.” In order for the manager to protect throughput the manager must not judge according to local impact (prerequisite D’). See the evaporating cloud below.

market constraint – The condition wherein the market demand is less than the organization's capacity to deliver its product(s) or service(s). Insufficient customer demand is the constraint of the organization. See: constraint.

marketing core conflict cloud – One of marketing’s core problems is the dilemma of how to make the decision of pricing products for the market. Marketing has to set the price so that enough product volume is sold and at the same time a reasonable profit margin is made on the product. In order to set the price so that sales volume will be high enough, marketing must ensure that the price reflects the consumers’ perception of the product’s value to the consumer. In order to have reasonable profit margins marketing must set the price based on the supplier’s perception of value, which is based on the cost of providing the product or service to the client. The pricing conflict revolves what to use as the basis of setting the price of the product or service. See the evaporating cloud below.
One TOC solution is based upon the recognition that requirement C is incorrect and should be restated to:
C The company covers the company’s operating expense and investment. Marketing sets the base or minimum price as the truly variable cost and recognizes that market segmentation is required. In segmentation, a market segment is defined as a portion of the market where the price and quantity offered has no impact on the price and quantity offered in other markets. A market segment might be defined as the federal or state government. Marketing then can segment the market charging different prices based on the client’s perception of value while ensuring that the base price is always exceeded.

See: core conflict cloud.

**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.

**Material constraint** – Usually a misnomer. Material shortages are rarely the constraint, rather temporary material shortages hinder effective constraint management by inhibiting the ability to fully exploit or subordinate to the constraint.

*Perspective:* Material does, at times, become difficult or impossible to get, such as the world-wide steel shortages in the early 21st century. In that situation, steel was the constraint for a period of time. But, in most cases, material shortages are temporary – or material is available from another supplier or at a higher price. So material shortage is rarely considered to be the constraint, rather it hinders effective constraint management by inhibiting the ability to fully exploit and/or subordinate to the constraint.

See: constraint, exploit, subordinate.

**Material requirements planning (MRP)** – A method for determining materials and capacity needs based on a master schedule of quantity and time needed of end items. The item bills of materials, parts routings, and parts inventory available are used to determine the net requirements, capacity requirements and their timing to produce the master schedule.

See: traditional manufacturing philosophy.

**Measures constraint** – A common misnomer. Bad measures are not the constraint. Rather, bad measures hinder effective constraint management by inhibiting the ability to fully exploit or subordinate to the constraint.

*Usage:* In the past measurements were commonly referred to as a type of constraint.

*Example:* Measuring efficiency at all resources drives overproduction at non-bottleneck resources and leads to starvation of the bottleneck. The efficiency measures are not the constraint, they are not what should be exploited and subordinated to; rather, they are blocking the system’s ability to exploit and subordinate properly to the constraint.

See: constraint, exploit, subordinate.

**Merge bias** – The potential for delay that results when multiple chains of work are integrated, due to the need for all chains to be completed before the integration work can start.

*Syn:* integration risk.

See: integration point.
**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.

**minus-minus buy-in process** – An approach based on the change analogy (See figure below: the pot-of-gold, the mermaid, the crocodile, and falling from the cliff) to gaining approval based on the level of problems or issues that a person/group is currently experiencing (the crocodile) – this “minus” of “not changing” is the prime motivator for the change. The two assumptions that block the person or group from buying in to the proposed change is that either they under-estimate the severity and urgency of the crocodiles (minus of not-changing) or they over-estimate the risks of falling from the cliff (the minus of changing).

If in the buy-in process, the person/group does not recognize and/or the presenter cannot get agreement on the severity / urgency of the current problems/issues (the crocodile), the change will not happen. Also, unless the presenter shows that either the perceived risks of the change are over-estimated or that the proposed change includes elements to prevent or reduce the risks of the change (crutches), the change will
not happen.
See: change analogy, plus-plus buy-in process.

**most penetrating chain** – The chain of work that, although not on the original critical chain, currently extends farther into the project buffer than any other chain of work. The most penetrating chain includes the non-critical chain work and the remaining work on the critical chain once the chain intersects the original critical chain.

Usage: When a feeding chain penetrates the original critical chain the feeding chain becomes the most penetrating chain and therefore the new critical chain.
See: buffer burn rate, critical chain, critical chain project management.

**MRP** – Abbreviation for material requirements planning.

**MTA** – Abbreviation for make-to-availability.

**MTO** – Abbreviation for make-to-order.

**MTS** – Abbreviation for make-to-stock.

**multiple single project environment**

Syn.: independent multi-project environment.

**multitasking** – Stopping work on a task before it is completed in order to start work on another task.

Usage: Multitasking itself is neither bad nor good. Bad multitasking occurs when switching tasks does not help any project finish earlier.

Example: In a multi-project environment it is common for resources to be required to switch between tasks on various projects (or within the same project) in order to show progress. Such multitasking usually extends the duration of all projects and, therefore, is bad multitasking. If, however, a resource is forced to stop a task on one project in order to complete a task that is delaying the critical chain or the most penetrating chain on another project, thereby helping that project to finish earlier, it is usually considered good multitasking.

**Murphy** – A reference to unplanned variation in a system. Murphy’s Law states that if anything can go wrong it will.

Usage: Murphy includes unplanned variation caused by machine breakdowns, poor quality, materials delayed due to a transportation problem, etc. Buffers are used to protect against Murphy.

See: assembly buffer, buffer, capacity buffer, drum buffer, feeding buffer, project buffer, shipping buffer, space buffer, statistical fluctuations and dependent events, stock buffer, time buffer.

**NBR** – Abbreviation for negative branch reservation.

**necessary assumption** – An entity in a strategy and tactics tree; a statement of why a strategy is needed in order to achieve the associated higher-level step in the S&T tree. A necessary assumption could be the assumption of existing undesirable effect(s) and/or un-achieved desirable effect(s) which creates the need for the proposed change.

Syn.: necessity assumption.
See: parallel assumption, strategy and tactics tree, sufficiency assumption.

**necessary condition** – A requirement which (by itself is not sufficient) and therefore must exist with one or more other requirements in order to achieve the goal or critical success factor, or reach an intermediate objective.
Usage: Necessary conditions are found on prerequisite trees, evaporating clouds and strategy and tactics trees. Necessary conditions are also found in intermediate objectives maps used for strategy development or system-level problem solving.

Example: The goal of most for-profit companies is to make more money now and in the future. In order to reach that goal it is absolutely necessary that the company simultaneously satisfy its customers and provide a secure and satisfying environment for its employees.

Perspective: A sufficient condition is something that by itself can be sufficient (i.e. there is a probability that it can work but also that it might not work) to achieve an objective. Since there is probability involved by definition a sufficient condition cannot be a necessary condition and vice versa.

An example is a new product like the iPod that was a sufficient condition for creating a turn-around at Apple, but we cannot claim it was a necessary condition (i.e. the turn-around could have been created by other means especially if the iPod failed to capture a significant market).

See: evaporating cloud, intermediate objective, prerequisite tree, requirement, strategy and tactics tree, sufficiency-based logic.

necessity assumption
Syn.: necessary assumption.

necessity-based logic – A type of logic in which each entity at the tail of an arrow must exist in order for the entity at the head of the arrow to exist.

Usage: The thinking processes diagrams that use this type of logic are the evaporating cloud and the prerequisite tree. The validity of the connections is scrutinized by questioning the validity of the assumptions underlying the relationship between the two entities.

Illustration: Necessity-based logic diagrams are read beginning with the entity at the point of the arrow. The generic necessity-based logic diagram on the left is verbalized, “In order to have B Requirement, D We must have Prerequisite.” The example on the right is verbalized, “B In order to buy food, D I must have money.”

See: assumption, entity, evaporating cloud, prerequisite tree, scrutiny.

need
Syn.: requirement.

See: necessary condition, necessity-based logic, want.

negative branch – A sufficiency-based logic diagram that describes through cause-and-effect relationships how an action or idea leads to negative consequences. The negative branch is created by using the negative branch reservation process.

See: negative branch reservation process.

negative branch reservation (NBR) – An unintended negative consequence (i.e., new undesirable effect) of a proposed problem solution or injection.

Usage: NBRs require a secondary or trimming injection at the point where the tree branch starts turning negative in order to eliminate the negative outcome. The process of adding a trimming injection is called “trimming the negative branch.” If the new UDE is significant, and a satisfactory trimming injection cannot be developed, the proposed primary injection must be reconsidered.
See: injection, negative branch reservation process, secondary injection, trimming injection, undesirable effect.

**negative branch reservation process** – A method that uses sufficiency logic to show that implementing a proposed injection may lead to one or more new undesirable effects.

**Usage:** The negative branch reservation process involves the creation of one or more future reality branches with the purpose surfacing and eliminating new UDEs.

**Illustration:** The figure on the left shows the negative branch. Using if-then logic the developer tries to eliminate the undesirable effect by developing additional supporting injections. The figure on the right shows the ideal state with only desirable effects.

![Neg Branch Diagram](image)

See: negative branch reservation.

**nested conflict**

**Syn.:** embedded conflict

**negative feedback loop** – A set of logical cause-and-effect relationships that is connected in such a way that it produces a decreasing (negative) condition or behavior within a system.

**Usage:** A negative feedback loop is always a reinforcing feedback and is present in a system having problems that are getting worse, steadily deteriorating. In general, feedback involves both the transmission and the return of information. Since feedback loops exist in all real systems, it is important to actively identify and record them in any current reality tree, both for correct diagnosis and breaking the causality in a number of places to ensure improvement in the future reality tree. Entities in a feedback loop are good candidates for leverage points.
10 We reduce the number of set-ups to increase efficiency.

20 We run larger batches and group like parts together.

30 We release materials that are not yet needed.

40 We reduce the protective capacity of the work center.

50 Reducing protective capacity reinforces running larger batches.

Negative feedback loop

Illustration: If 10 We reduce the number of set-ups to increase efficiency then 20 We run larger batches and group like parts together. If 20 We run larger batches and group like parts together then 30 We release materials that are not yet needed. And if 30 We release materials that are not yet needed then 40 We reduce the protective capacity of the work center. Cause-and-effect loops back from 40 to 20 because reducing protective capacity reinforces running larger batches.

Syn.: reinforcing loop.
See: cause-effect, current reality tree, feedback loop, future reality tree, leverage point, positive feedback loop.

net profit (NP) – An absolute, global, measure of financial performance which is calculated as the difference between revenues and expenses or, in throughput accounting, as throughput minus operating expense.

Caution: In Generally Accepted Accounting Principles (GAAP) accounting changes in net profit can be the result of changes in inventory levels.
See: inventory profit, operating expense, throughput, throughput accounting.

non-bottleneck resource – Any resource whose capacity is greater than the demand placed on it.
Usage: TOC claims that providing non-bottleneck resources with sufficient protective capacity is necessary to protect the throughput of the system.
See: bottleneck resource, protective capacity, throughput.

NP – Abbreviation for net profit.

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.

obstacle – Something that blocks or prevents a desirable system condition, state of being, or desired action from occurring.
Usage: Obstacles are usually determined by builders of a prerequisite tree as they anticipate possible blockages or complications in implementing an injection to reach a desired effect or ambitious target. Overcoming an obstacle requires the identification and achievement of an intermediate objective.
Illustration:

See: ambitious target, desirable effect, injection, prerequisite tree, intermediate objective, thinking processes.

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.

See: fundamental assumptions (of TOC).

OE – Abbreviation for operating expense.

one-UDE cloud

Syn.: UDE cloud.

OP – Abbreviation for outside person.

operating expense (OE) – All the money the organization spends in generating "goal units".

Perspective: In the throughput-world paradigm of TOC, operating expenses include items such as salaries, rent, insurance, and other expenses that would be paid even if operations stopped for awhile.

OE does not include expenses that vary directly with production or service volume, such as cost of raw material, commissions, etc. These expenses are considered to be totally variable costs, not OE.

Syn.: operational expense.

See: global measures, throughput-world paradigm, totally variable costs.

operational expense

Syn.: operating expense.

operational measurements – Those measures that correctly link the impact of decisions made in day-to-day operations to global impact.

Usage: In the throughput-world paradigm of TOC, the global measures of throughput, investment, and operating expense also serve as effective operational measures. This is because local decisions that have a positive impact on T, I, or OE will also have a positive impact on net profit, return on investment, or cash flow.

See: global measures, investment, operating expense, throughput, throughput-world paradigm.

operations manager core conflict – The core conflict created by the traditional rules for operations managers. The conflict is between judging the operations manager’s performance according to the local impact of decisions and judging the manager’s performance according to the global impact of the manager’s actions.
Illustration: 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 local efficiency is used to measure resources. 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 maximizing efficiencies results in increased work-in-process, which increases lead times and inhibits flow, thereby jeopardizing 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.

See: traditional manufacturing management philosophy.

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:

\[
\text{Order quantity} = \text{buffer target} - (\text{current on-hand inventory} + \text{in-transit inventory})
\]

\[
= 300 - (225 + 20) = 55 \text{ units}
\]

See: buffer status, buffer target, replenishment lead time.

organization strategy and tactics tree – A strategy and tactics tree designed to eliminate the engines of disharmony in an organization.

Usage: The organization strategy and tactics tree differs from a transformation strategy and tactics tree in that the levels of the tree correspond to levels of people in the organization. For example, level 1 is the CEO, level 2 includes everyone who reports to the CEO, and so on. See: engines of disharmony.
outside person (OP) – Individuals not directly affected by a problem or its solution but who have some interaction with the area being changed. The change is largely neutral from their standpoint but their involvement is essential to the success of the change initiative.

Usage: Understanding the role of the individual in the organization is essential in constructing and presenting the buy-in of the solution.

See: directly responsible person, intimately involved person.

over activation – Activating a resource more than is required to keep pace with the constraint under normal circumstances, or, after a system disturbance, more than is required to rebuild the bank of materials in front of the constraint.

Example: If a resource that has a capacity of 7 hours a shift and normally has to produce 5.5 hours of output to keep up with the constraint, producing more than the required 5.5 hours of output is usually over activation. The exception is when a disruption has occurred and more than 5.5 hours of output are required to rebuild the bank of materials in a downstream buffer.

See: activation, buffer, constraint, utilization.

oxygen – An assumption that is usually not documented on a thinking processes sufficiency-based diagram because it is known by all to exist and accepted as an element of reality everywhere.

Illustration: The following logic diagram is verbalized: If 60 I have fuel and 70 I have a heat source then 90 I can create a fire. Oxygen must also be present, but oxygen is everywhere we are, so we usually assume oxygen is available and it is not necessary to document it on our sufficiency-based logic diagram.

See: assumption, fact of life, sufficiency-based logic, thinking processes.

parallel assumption – An entity in a strategy and tactics tree; a statement that answers the questions of why the strategy is possible or under what conditions the strategy is possible, and why the tactic is the best way to achieve the strategy, i.e., what specific risks, constraints and obstacles were considered in selecting the tactic as the best or only way to achieve the strategy?

See: necessary assumption, strategy and tactics tree, sufficiency assumption.

Pareto principle – A principle that states that for many phenomena approximately 80% of the effects result from 20% of the causes.

Perspective: An Italian economist, Vilfredo Pareto, studied the distribution of wealth in Italy and found that less than 20% of the population owned 80% of the country’s wealth. It has been found that this principle holds in many environments: for example 20% of inventory items account for 80% of inventory investment and 80% of defects are due to 20% of causes. Goldratt states that although the Pareto principle applies to independent items, dependency exists in most situations. For dependent items he believes that the ratio of effects to causes is much higher than 80 to 20. For example, .1% of items may cause 99.9% of effects when there is a high degree of dependency.

Parkinson’s Law – C. Northcote Parkinson, a British naval historian and author, identified this almost universal law: work expands so as to fill the time available for its completion.
Usage: Parkinson’s Law is widely considered to apply to project tasks. Critical chain project management attempts to reduce its impact by using significantly reduced task time estimates and getting frequent estimates of time remaining until completion.
See: student syndrome.

Pay-per-click strategy and tactics tree (PPC S&T) – A strategy and tactics tree designed for companies that sell products, for example equipment, to customers who pay for the product based on how much is used rather than purchasing the product outright.
See: transformation strategy and tactics tree.

PBCR – Abbreviation for project buffer consumption rate.

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.

Piece buffer
Syn.: stock buffer.

Pipeline management – In multi-project critical chain project management, the management of the execution of an already decided project portfolio, including setting starting times for the projects based on staggering projects according to the drum or virtual drum (integration point, heavily loaded resource, strategic resource or policy) and managing the release of projects based on conditions at the drum or virtual drum.
Usage: Pipeline management differs from the business management process and the portfolio management process. Pipeline management does not involve the selection of which projects to execute.
See: drum, staggering, virtual drum.

Pipeline planning – In multi-project critical chain project management, the process of determining the drum or virtual drum (a heavily loaded resource, a strategic resource, an integration point or a policy on releasing projects) and, in the event the drum or portfolio changes, the process of resetting project priorities and revising due-date commitments as appropriate.

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 (S-DBR) 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.

Planning conflict
Syn.: systemic conflict cloud.
plateau curve

**Syn.:** good enough curve.
**See:** u-curve.

**PLT** – Abbreviation for production lead time.

**plus-plus buy-in process** – The steps in the process for achieving buy-in include:
1. Agree on the ambitious objective to be achieved.
2. Agree that reaching the objective is much more difficult than it was originally thought.
3. Agree that there is a direction for a solution.
4. Agree on the solution details.
5. Overcome unverbalized fears, such as the potential negative consequences of success.
6. Agree to the change and its implementation.

**Usage:** The above figure describing the change analogy is useful in understanding the plus-plus buy-in process. The plus-plus buy-in process involves the following steps:
1. Get agreement on the pot-of-gold and how much better their situation will be with the pot-of-gold. Show that we recognize that there is also a plus of “not-changing” (mermaid) but that this is either small in comparison to the pot-of-gold or that under the right conditions, the pot-of-gold can be achieved without having to give up the mermaid.
2. Get agreement that achieving the desired benefits is exceedingly more difficult than they may expect than any past change previously attempted. (Show that the mountain is much higher and the
cliff is steeper than we could imagine).

3. Get agreement that there is a process that can take us from our current place to achieving the potential benefits (some way to build a ladder over the cliff). There is a leverage point to which we can connect a climbing mechanism. There is a direction of the solution. Potentially there is a way.

4. Get agreement that there is a specific solution for their situation (our proposed change) that will get them all the potential benefits (pot-of-gold) without the risk of the crutches (the ladder).

5. Introduce the risks of making the required change (breaking your head or leg when falling off the ladder). Verbalize for the one that needs to change their unverbalized fears as they are by definition not able to verbalize them. It is our role to show them how they can avoid these risks. (Show where they can break their leg/head and how they can avoid it). They know it exists but not what it is. They cannot contribute and will only introduce garbage to the discussion. If allowed to contribute, I cannot disregard it.

6. We get them to agree to the change. Agree it can be done. The cliff can be scaled.

See: change analogy, minus-minus buy-in process.

PMBs – Abbreviation for policies, measurements, and behaviors.

policies, measurements and behaviors (PMBs) – A series of three entities documenting the cause-and-effect relationship between a system’s policy, its measurement, and the resulting organizational behavior.

Perspective: Frequently, an obsolete or ineffective policy and associated metrics for monitoring its enforcement results in dysfunctional behavior within a system. Since this sequence of entities often is responsible for one or more undesirable effects, it is important to document it in the current reality tree for the organization.

Example: Based on the assumption that increased local efficiency is desirable, the (informal) policy exists which seeks to keep employees busy all the time because it is believed that will reduce product costs. The metrics involved are local efficiencies and resource utilization. The behavior created is that work is released early to production, and the resulting undesirable effects include excess work-in-process and finished goods inventories, diluted priorities, poor due date performance, low cash position, etc.

See: cause-effect, current reality tree, entity, undesirable effect.

policy constraint – A common misnomer. Bad policies are not the constraint, rather they hinder effective constraint management by inhibiting the ability to fully exploit or subordinate to the constraint.

Example: Many manufacturers have a policy of building parts in an "economic order quantity", which results in larger than necessary production batches and higher than necessary work-in-process inventories. In addition, building in large batches can cause periodic starvation of the constraint. The bad policy (of using EOQ) is not the constraint, rather the policy hinders the ability to fully exploit the constraint.

Note: In the past policies were commonly referred to as a type of constraint.

See: constraint, exploit, subordination.

POOGI – Acronym for process of ongoing improvement.

positive branch – A set of cause-and-effect entities that are diagramed as a future reality branch showing how an injection leads to a new desirable effect.

Perspective: A positive branch may be contrasted with a current reality branch or a negative branch.

See: current reality branch, desirable effect, entity, future reality branch, injection, negative branch reservation, negative branch reservation process, undesirable effect.

positive feedback loop – A set of logical cause-and-effect relationships that is connected in such a way that it produces an increasing (positive) condition or behavior within a system.
**Usage:** A positive feedback loop is always a reinforcing feedback loop depending on the starting situation. Positive reinforcing loops are active in a well-performing system; that is they are steadily improving over time. In general, feedback involves both the transmission and the return of information. Since feedback loops exist in all real systems, it is important to actively identify and record negative feedback loops in any current reality and replace them with positive feedback loops in future reality tree diagrams, both for correct diagnosis and to utilize for effecting an improvement. Entities in a feedback loop are good candidates for leverage points.

**Illustration:** If 10 We continually reduce the time per set-up and 15 We increase the number of setups to increase flow then 20 We run smaller batches and sequence them by due date. If 20 We run smaller batches and sequence them by due date then 30 We release materials that support orders. And if 30 We release materials that support orders then 40 We maintain the protective capacity of the work center. Cause-and-effect loops back from 40 and 10 to 20 because maintaining protective capacity reinforces running smaller batches.

**Syn.:** reinforcing loop.

**PPC S&T** – Abbreviation for pay-per-click strategy and tactics tree.

**PQ problem** – A simple production case study used to illustrate the impact of financial measures on decision making. In this case study the company produces only two products and demand exceeds capacity so that there is one active internal constraint. Conventional per-unit financial measures of sales revenue, labor costs, and gross margin all favor product Q. Yet if management, relying on these measures, decides to favor product Q in the market, the company will lose money; whereas if they favor product P they will make money. This problem illustrates that failure to identify and properly exploit a constraint can have a significant negative impact on the bottom line.

**Predicted effect reservation** – A level III reservation in the categories of legitimate reservation that is used to challenge either an entity's existence or the existence of a causal relationship on the basis of the absence of an inevitable effect that would have to exist if the entity or the proposed causal relationship really existed.

**Usage:** The predicted effect reservation can be used to prove or disprove the existence of an entity or a cause-effect relationship that is very difficult, perhaps even impossible to prove by direct observation. Predicted effect existence is useful when a hypothesized cause is surfaced for an effect and the cause cannot be proved by direct observation. However, for the hypothesized cause to exist some other
effect must be present. If the predicted effect is present it validates the existence of the hypothesized cause.

Illustration: The existing effect is 30 My car won’t start. The hypothesized cause is 20 My car battery charge is low. The predicted effect of a low battery charge is 40 The car lights are very dim. If testing the lights shows that 100 The car lights are bright then the car battery charge must not be low. Conversely, if the lights were indeed very dim, then support would be given to the existence of the cause that the car battery charge is low.

### First effect | Second (validating) effect
---|---
30 My car won’t start. | 40 The car lights are very dim.
20 My car battery charge is low. | 100 The car lights are bright.

Possible cause

See: categories of legitimate reservation, cause-effect, entity, scrutiny.

**predicted undesirable effect** (PUDE) – An undesirable effect that is expected to result from implementation of an injection or from moving to the other side of a conflict.

Usage: One of the main purposes of the future reality tree is to identify predicted undesirable effects and additional injections necessary to prevent them from occurring. The negative branch reservation process is used to surface the causal linkages to predicted and unpredicted undesirable effects.

See: future reality tree, negative branch reservation process.

**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, the queue in prerelease 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.

Perspective: Traditional push projection and project philosophies do not use this mechanism. When the administrative processing is completed the manufacturing order (project) is released to execution immediately regardless of the current load on the resources.

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

**prerequisite** – In an evaporating cloud a state, condition or action (D or D’) that is believed necessary to achieve its corresponding requirement (B or C).

Usage: A prerequisite or want exists because of some set of assumptions that may or may not be either known or valid. Relative to an evaporating cloud, the existence of a prerequisite to satisfy a requirement is analogous to a want existing to satisfy a need.
prerequisite-obstacle link – The building block for the prerequisite tree. The first step in building the prerequisite tree is to identify obstacles that are blocking or preventing a desirable system objective, condition, state of being, or desired action from occurring. Second, an intermediate objective that overcomes each obstacle is identified. These two entities comprise the prerequisite-obstacle link.

Usage: Obstacles are usually determined by builders of a prerequisite tree as they anticipate possible blockages or complications in implementing an injection to reach a desired effect or ambitious target. Overcoming an obstacle requires the identification and achievement of an intermediate objective. The prerequisite-obstacle links are placed on index cards or post-it notes and sequenced as to what intermediate objectives go first, second, in parallel, etc. starting from the present to the accomplishment of the ultimate system objective, condition, etc.

prerequisite tree (PRT) – A necessity-based logic diagram that facilitates answering the question (in the change question sequence) “how to cause the change?” by showing the relationships between an injection or ambitious target to be implemented, obstacles that block the implementation, and the intermediate objectives that overcome the obstacles.

Usage: A prerequisite tree shows the sequence in which the intermediate objectives must be achieved for successful implementation of an injection or ambitious target.

Perspective: Both the prerequisite tree and intermediate objectives map focus on the major blockages to the full implementation of the injections in the reality under study. These tools do not cover all the other activities and intermediate objectives that are needed for the complete solution (that do not appear in the analysis as they do not present any threat to the implementation). These additional intermediate objectives and activities necessary for the complete implementation must be a part of the implementation plan.

Illustration: The following prerequisite tree is read from the overall objective down: “In order to achieve our overall objective, we must achieve intermediate objective 4 in order to overcome obstacle 4. In order to achieve intermediate objective 4 we must achieve intermediate objectives 6 and 9 in order to overcome obstacle 6/9.” The other arrows are read in the same way.
prevailing rule of project management – In traditional project management, the belief that the way to ensure that a project will finish on time is to ensure that every task finishes on time.

Example: This rule of project management causes a common core conflict for the resource. The evaporating cloud is:

A. The resource is considered a reliable person.
B. The resource meets task commitments.
C. The resource does not exaggerate.
D. The resource chooses task estimates greater than 80%.

Every resource manager and resource in a project is pressured to complete tasks within the time estimate he or she provided. However, a project by its very nature has high uncertainty, which means that the right tail of the task time distribution is very long. A task time estimate that has an 80% chance of being achieved (an 80% task time estimate) may be twice as long as an estimate with a 50% chance of being achieved (a 50% task time estimate probability). Once accepted, the task time estimate becomes a commitment to the resource and at the same time creates a conflict for the resource: Should the resource provide a high estimate to ensure that the task time commitment is met or should the resource provide an estimate close to 50% to avoid being seen as providing exaggerated task times? The resource usually gives a high estimate to provide local protection for hitting the
commitment. Once a high estimate of task time is accepted by management, one of two things happens: either the resource falls victim to the student syndrome and delays starting work on the task until the local protection built into the estimate is gone, or the resource finishes the task early and continues to “improve” or find other things to do until the task time is consumed (Parkinson’s Law). The TOC solution to this core conflict is to:
1. Have resources provide 50% task time estimates and not hold them responsible for achieving the estimates, and
2. Place protection strategically, in the form of feeding and project buffers, in the project.

Syn: resource manager core conflict.
See: 50% task time estimate, feeding buffer, Parkinson’s Law, project buffer, student syndrome.

primary injection – The injection that breaks the conflict in the evaporating cloud. The injection is tested for sufficiency using the negative branch reservation process. In this testing the primary injection may not be enough by itself to solve the conflict. Other negative effects are surfaced and secondary injections must be identified to trim these negative branches.

See: injection.

problem – An unresolved conflict that prevents a system from achieving more of its goal units or desirable objectives..

process batch – The quantity or volume of output that is to be completed at a workstation before switching to a different type of work or changing an equipment set-up.

Usage: In batch and queue environments production lead time can often be shortened significantly by setting the transfer batch size smaller than the process batch.

See: production lead time, transfer batch.

process of ongoing improvement (POOGI) – Methods used to achieve continuous improvement with respect to one’s goal. Three processes of ongoing improvement exist: the five focusing steps, the change question sequence, and buffer management.

See: buffer management, change question sequence, five focusing steps.

product flow diagram – 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-ropes, a liberal estimate of the amount of time required to reliably complete production of a work order.

Usage: Due to the unavoidable existence of disruptions in production environments, the time required to reliably complete production 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. On average, orders will be completed in about half the length of the production buffer, so an order enters the red zone if it requires more than 33% longer than the average production lead time.

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.

**Illustration:**

[Diagram of production buffer]

**Syn.:** reliable production lead time.

**See:** buffer management, make-to-availability.

**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). PLT is comprised of:

1. Queue time for a machine to be available for the work order (the resource that is needed for the next operation is occupied and there is a queue of work orders to be processed);
2. Setup time for the assigned machine to get ready to process the specific work order;
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, i.e., “Murphy.”

**Usage:** 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.

**Illustration:** The first diagram below shows TOC production lead time and the second shows lead time in a traditional production environment. In traditional production, once order processing is complete the manufacturing order is released to the shop floor regardless of the current load on the shop. Thus queues, and therefore production lead times, are significantly longer.
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.

profit center – An organizational unit that has responsibility for both generating revenues and controlling costs.

Perspective: Profit is a measure of the financial performance of a whole organization. Attempting to apply it to units or parts of the organization requires that some operating expenses, and in some cases revenues, be allocated among organizational units. Because there is no theoretically correct way to allocate operating expenses to parts of the organization, the “profits” calculated for profit centers are frequently misleading measures of the units’ performance. In addition, if profit center profit is used as a local performance measure, unit management is frequently motivated to make decisions that maximize local “profit” but result in reducing the organization’s profit.

project buffer – A time buffer placed at the end of a project to protect against variation in the time it takes to complete tasks on the critical chain.
Usage: The project buffer is not formed by simply adding time to the end of the existing project network. Rather, safety time is removed from individual task time estimates of the activities on the critical chain. Half of this removed safety time is placed strategically at the end of the critical chain in a project schedule to protect the overall schedule. The project buffer will be penetrated, or depleted, when tasks on the critical chain take longer than estimated or after a feeding buffer has been used up and there is still time required to complete some task(s) on the associated non-critical chain.

A rule of thumb is that the project buffer is one-half the length of the critical chain thus making the project buffer one third of the total project duration.

Perspective: In critical chain project management, 50% task time estimates are used to determine the length of the critical chain and the project buffer is established at just 50% of the length of the critical chain. This buffer size represents only one half of the contingency or safety time removed from the individual task estimates. The combination of using 50% task time estimates and a project buffer that is 50% of the length of the critical chain reduces the estimated duration of the overall project by approximately 25% of what it would have been under traditional project management, while at the same time providing a visible buffer for use by management to protect the project.

Syn.: completion buffer.

See: 50% task time estimates, buffer, critical chain, feeding buffer.

**Project buffer consumption rate** (PBCR) – A measure of project progress for the most recent reporting period. The third measure of a set of three measures in buffer management for single- and multi-project critical chain project management.

\[
\text{Project buffer consumption rate} = \frac{\text{Increase in } \% \text{ of buffer consumed this reporting period}}{\text{Increase in } \% \text{ of critical chain completed this reporting period}}
\]

Usage: The first two measures of critical chain project management, critical chain completion (%) and buffer burn rate, are overall measures of the project to date. PBCR, the third measure, provides information about project progress in the most recent reporting period. The PBCR tells the project manager whether progress on the critical chain in the most recent reporting period was adequate in relation to the amount of project buffer consumed. PBCR tells the manager whether critical chain tasks during the period are in trouble and whether any corrective actions taken at the beginning of the period (based on the prior period’s PBCR) were effective.
Example: In the project network below, the project has 12 tasks of one week each. The shaded tasks have already been completed. The un-shaded tasks have not been completed. The bold outline indicates the tasks on the critical chain and the X indicates a resource that is stuck on a particularly difficult task. At the end of week 3, the first two measures for this project are critical chain complete, which is 33% (two weeks of the six weeks critical chain has been completed); and the buffer burn rate, which is 1 (one-third of the project buffer has been consumed and one-third of the critical chain has been completed).

At the end of week 4 (figure below), the next reporting period, the critical chain resource is still having problems on task X and only made two days of progress on the five-day critical chain task. Although two days of progress has been made on the critical chain, five days have elapsed on the calendar, so the project has penetrated the project buffer an additional three days. The PBCR for week 4 is 3.0 calculated as follows: three days represents a 20% increase in the buffer (3 days/15 days total project buffer) and the two days of progress on the critical chain represents 6.67% of the critical chain (2 days/30 days). The PBCR is then 20/6.67 = 3.0.

PBCR shows that in the most recent reporting period the project consumed project buffer faster than the critical chain was being completed. Values of the PBCR greater than 1.0, as in this example, are an indication that the project manager needs to devote attention or resources to the critical chain activity that is causing the elevated PBCR. If the project buffer is being consumed at the same rate as the critical chain is being completed, the PBCR will be 1.0. Values of the PBCR of less than 1.0 indicate that the critical chain is being completed faster than the project buffer is being consumed, and a value of zero for the PBCR for a period indicates that the critical chain tasks were completed in the time originally estimated. Negative values occur in periods in which project buffer is recovered. (Note however, that negative values of the PBCR can also occur in periods in which the remaining duration of the critical chain increases due to changes in task time estimates.)
See: buffer burn rate, critical chain completed (%), project management measures.

**project completion (%)** – 1. An alternative measure of project progress. The percentage by which the longest chain in a project has decreased:

\[
\text{Project completed (%) } = 100\% \times (1 - \frac{\text{longest chain remaining}}{\text{total # of days on critical chain}})
\]

**Usage:** The percent project completed is more useful than critical chain completed (%) in cases where feeding chain progress lags behind the critical chain.

**Example:** Suppose the initial critical chain duration is 40 days and the longest remaining chain in the project is 28 days long; the percent project completed is 30%.

See: critical chain completed (%), project status.

2. A traditional project management measure of project progress:

\[
\text{Project completion (%) } = 100\% \times \frac{\text{Amount of work completed on a project}}{\text{Estimated total amount of work for the project}}
\]

**Usage:** In the project network below, the project has 15 tasks of one week each. The shaded tasks have already been completed. The un-shaded tasks have not been completed. The bold outline indicates the tasks on the critical chain and the X indicates a resource that is stuck on a particularly difficult task. The project completion percentage is calculated as (10 tasks completed)/(15 tasks in the project) = 67%. In critical chain project management, however, the critical chain completed (%) would be calculated instead of the project completion percentage. Because only two of the six tasks on the critical chain are complete, the project is considered only 33% complete and there appears to be a significant probability that the project is going to be late.

**Illustration:**

![Project Network](image)

Caution: The use of the project completion percentage as a measure of project progress encourages resources that encounter problems or delays to move to other tasks on which progress can be made rather than solve the problem. This results in multitasking, extended project lead times and increased probability that the project will be late.

See: project management measures.
**Project Management Measures** – In buffer management for single- and multi-project critical chain project management, three measures are used to judge the execution of projects individually and with respect to other projects. The measures are:

1. **Critical chain completed (%)** – The percentage of the critical chain that is already completed. It is used to measure project progress.
2. **Buffer burn rate** – The percentage of the project buffer consumed relative to the percentage of the critical chain completed for the project to date. It is used to measure project status.
3. **Project buffer consumption rate** – The rate of consumption of the project buffer relative to the rate of completion of the critical chain for a single reporting period. It indicates whether a problem is developing and whether corrective action was effective in bringing the project back on schedule.

**Usage:** The three measures provide a clear picture of a project or a number of projects and indicate where management attention and resources should be directed. The measures help to quickly identify whether a problem exists and where it is on the critical chain.

**See:** buffer burn rate, critical chain completed (%), project buffer consumption rate.

**Project Manager’s Core Conflict** – In most traditional multi-project management environments, the project manager is faced with a core conflict of D We must compensate for early mis-estimations in the current project versus D’ We must not compensate for early mis-estimations on the current project. The requirement the project manager is trying to satisfy by compensating for early mis-estimations is B Do whatever it takes to meet the original commitment. On the other hand, the requirement driving D’ is C Not jeopardize any other original commitment.

**Illustration:** The evaporating cloud is given below:

**Project Pacing**

*Syn.:* Staggering.

**Projects Strategy and Tactics Tree** – A strategy and tactics tree designed for firms that perform projects for their customers or whose goods or services are the result of projects.

*See:* Transformation strategy and tactics tree.

**Protected Critical Chain** – The tasks on the critical chain plus the project buffer.

*Usage:* The protected critical chain is used as the basis for computing project completion dates.

*See:* Critical chain.

**Protective Capacity** – Resource capacity needed to protect the throughput of the system by ensuring that some capacity above the capacity required to exploit the constraint is available to catch up when disruptions inevitably occur. Non-constraint resources need protective capacity to rebuild the bank in
front of the constraint or capacity-constrained resource (CCR) to protect throughput and/or on the
shipping dock to protect due date performance.

**Usage:** Disruptions are the result of such things as normal variation in process times, unplanned
downtime, late deliveries from suppliers, etc. Protective capacity is also called “sprint” capacity. Some
practitioners believe that constraints and CCRs also need protective capacity so that “positive”
uncertainty in the form of unexpected demand for more product or service by a key customer or
market can be accommodated in the short term. Protective capacity is also required for the same
reasons in a multi-project environment. If there is not enough protective capacity within a multi-
project environment, variation can have a significant impact on the ability to complete the critical
chain on time and keep the project on time. Lack of protective capacity can also disrupt the ability to
maintain the drum schedule.

**Syn.**: sprint capacity

**See:** capacity, capacity-constrained resource, constraint, critical chain, drum schedule, excess capacity,
exploit, idle capacity, productive capacity, throughput.

**PRT** – Abbreviation for prerequisite tree.

**PUDE** – Abbreviation for predicted undesirable effect.

**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.

**See:** push management philosophy, TOC manufacturing management philosophy, TOC supply chain
management philosophy.

**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:** pull seasonality.

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

**See:** distribution requirements planning, material requirements planning, pull management
philosophy.

**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.

**red curve - green curve** – 1. A set of curves representing two mindsets, that of “diminishing returns” (the green curve) versus the mindset of “increasing returns” (the red curve) with respect to an organization achieving its goal. 2. More recently, the green curve has been used to represent the goal of stability while the red curve has come to represent the goal of growth.

**Illustration 1:**

![Graph showing diminishing and increasing returns over time]

**Perspective 1:** The green curve represents a local implementation effort where an area such as production is the organization constraint; the constraining resource is identified and exploited effectively. The constraint then moves to another function and action is taken. The improved area now has more capacity than needed. Eventually cost-world thinking is applied and layoffs ensue in the production area, thus killing the TOC implementation and the organizational performance decreases. The red curve represents a holistic implementation in which the five focusing steps are used to ensure that the organization’s constraint is what it should be from a strategic point of view.

**Illustration 2:**

![Graph showing red and green growth over time]

**Perspective 2:** It is current thought that an organization needs both stability (the green curve) and growth (the red curve). Companies should strive to ensure that their financial performance (red curve) continues to grow while ensuring that the financial growth doesn’t jeopardize company stability. The strategy and tactics tree provides guidance for achieving both necessary conditions.

**red zone (of the buffer)** – The buffer management term for region III, the most critical region, of the buffer.

**Usage:** Generally, parts are supposed to arrive or work is supposed to be completed before the red zone. Red, a sign of danger or urgency, is used to refer to this region because any hole in region III
signifies that future throughput is in jeopardy as there is a risk that the part will not be available when needed. A hole in this region requires immediate action as determined by the buffer management process.

**Perspective:** TOC logistical solutions in production, project management and distribution/replenishment use buffers to protect the constraint and the customer due dates from variation. These buffers are broken into three zones generally referred to as the green zone, yellow zone and the red zone. These zones help set priorities in reacting to variation.

*Syn.:* region III.

*See:* buffer, buffer management, green zone, hole, yellow zone.

**region I**

*Syn.:* green zone (of the buffer).

**region II**

*Syn.:* yellow zone (of the buffer).

**region III**

*Syn.:* red zone (of the buffer).

**reinforcing loop**

*Syn.:* feedback loop.

**relay runner work ethic** – In critical chain project management, the process of applying a focused effort (i.e., no multitasking) to complete a task and handing it off immediately to a resource waiting and prepared to take the hand-off.

*Caution:* Some people use relay runner interchangeably with road runner in an operations environment. The road runner analogy relates to working when you have work and not working when you don't have work.

*See:* road runner work ethic.

**reliability** – A measure of repeatability. A process that has been repeated successfully consistently is highly reliable.

*Illustration:* An organization is reliable when it has high due date performance, which is measured by throughput-dollar-days. The throughput-dollar-day target is zero. When an organization’s actual throughput-dollar-day measure is consistently zero its due date performance is highly reliable. Throughput-dollar-days collect for each day an order is late and disappear when the order is shipped.

*See:* throughput-dollar-days.

**reliable production lead time (RPLT)**

*Syn.:* production buffer.

**reliable rapid response strategy and tactics tree (RRR S&T)** – A strategy and tactics tree designed for manufacturers that sell products to other manufacturers for use in their products.

*Usage:* The reliable rapid response strategy and tactics tree is for use in a business-to-business environment.

*See:* transformation strategy and tactics tree.

**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.
**remaining duration** – In critical chain project management, a measure reported regularly by resources and resource managers indicating the estimated time remaining until the completion of a task.

Usage: The remaining task duration is used to measure task progress and determining project status and progress. While the remaining duration is collected and reviewed on each task, it becomes significant only when buffer penetration (feeder and, more importantly, project buffer) is significant.

**replenishment for services** (R_S) – In some multi-project critical chain environments (such as professional, scientific and technical services), a resource management method (based on the TOC replenishment solution) used to manage different skill groups for the benefit of all projects without specifying how individual project plans use resources.

**replenishment frequency** – The number of times a product is replenished per time-unit, for example, once a day, or twice a week.

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

\[
RLT = \text{order lead time} + \text{prerelease lead time} + \text{production lead time} + \text{transportation lead time}
\]

where:
1. order lead time is the time it takes the client to place the order;
2. 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;
3. production lead time is the time to manufacture including setup, queue, processing, post operation wait, and move times; and
4. transportation lead time is the shipment time from manufacturing facility to customer location.

Illustration: Components of replenishment lead time:

[Diagram of replenishment lead time]

See: order lead time.

**requirement** – In an evaporating cloud conditions (B and C) that must be in place in order to achieve the objective of the cloud. Both requirements must be achieved to achieve A.

**resource alert**

Syn.: resource buffer.

**resource buffer** – A warning mechanism used in single project environments to ensure that resources working on a critical chain task are available when needed.

Usage: A resource buffer is sized based on the level of warning that is needed in the environment. The resource buffer not only prevents delays in the critical chain that would occur if a resource were not available when needed, it improves the chances of taking advantages of early finishes. Resource buffers do not add time to the project lead time.

Syn.: resource alert.
See: critical chain.

**resource contention** – 1. In production, a situation in which two or more work orders require the same resource at the same time.

*Usage 1:* In production, resource contention can be identified during the planning phase in drum-buffer-rope and during the execution phase of the production solutions, either drum-buffer-rope or simplified drum-buffer-rope.

*Perspective 1:* If a given work center utilization is 80% then approximately 80% of the time when a work order enters that work center the resource will be busy on another part.

2. In project management, a situation in which two or more tasks, either in the same project or across projects, have to be performed by the same resource and there is an overlap in the timing of the tasks.

*Usage 2:* In project management, resource contention can be highlighted during the planning phase when determining the critical chain as well as after inserting feeding buffers, which potentially creates contention among feeding tasks and between feeding tasks and critical chain tasks. Contention can occur within one project, across projects or when a project task conflicts with day-to-day tasks. In the project execution phase resource contention can occur when several tasks are waiting to be performed by the same resource at the same time.

*Illustration 2:* In the project network shown below, tasks M16 and M10 require resource M at the same time. Diagram A shows the project network before elimination of resource contention and diagram B shows the same project after elimination of resource contention:

A. Project network before elimination of resource contention and addition of project buffer:

```
B14  O4  M16
       C20
M11  Y4  O6  M10

Resource contention: M16 and M10
```

B. Project network after elimination of resource contention and addition of project buffer:

```
B14  O4  M16  C20
       PB 33
M11  Y4  O6  M10

Critical chain marked by bold outline.
Critical chain duration = 100 days
```

**resource manager core conflict**

*Syn.:* prevailing rule of project management

**resource skill matrix** – A document listing the resources available, their skills and skill levels, and their suitability for various tasks and projects.

*Usage:* A resource skill matrix is useful in determining capacity available for project task assignments.

**resource-to-resource variability** – In a project environment, variability in the time required to perform a task between resources with different skills.
**retailer strategy and tactics tree** – A strategy and tactics tree designed for firms that sell end products to consumers from their shelves. The decisive competitive edge provides a ‘partnership’ that delivers superior inventory turns (better product availability with substantially reduced inventories). A second decisive competitive edge is achieved by securing an increase in throughput per shelf.

Usage: The retailer strategy and tactics tree is for a business-to-consumer environment.
See: transformation strategy and tactics tree.

**return on investment (ROI)** – A relative measure of financial performance which provides a means to compare various investments by calculating the profits returned over a specified time period. In TOC, ROI is calculated as throughput minus operating expense divided by investment.
See: investment, operating expense, throughput.

**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:

\[
\text{ROI}_{SKU} = \frac{\text{Annual T of SKU}}{(\text{TVC/unit} \times \text{buffer size for SKU})} \times 100%
\]

where TVC are the truly variable costs per unit of the item.
See: black hole return on investment, star return on investment.

**roadrunner work ethic** – The work rules in the drum-buffer-rope or critical chain project management systems. The rules are: if there is work available start it immediately; if there is more than one work-order or task in queue choose the one with the highest system-priority; work at full speed without stopping until the work is completed; produce zero defects and pass the work on immediately; if there is no work available stay idle.

Perspective: The name roadrunner comes from a popular cartoon character that had only one speed: the roadrunner would move at full speed until he reached his objective, then he came to a full stop and be ready to start again.
See: relay runner.

**ROI** – Abbreviation for return on investment.

**ROI SKU** – Abbreviation for return on investment SKU.

**root cause** – An entity usually appearing at the lowest level of causality within a current reality tree for which there are no postulated causes. It is a starting point for a reality branch that leads to one or more undesirable effects (UDEs).

Usage: If a root cause results in the majority of the UDEs including the most significant ones, it may be labeled as the core problem. When a root cause is eliminated, the recurrence of one or more UDEs will be prevented. In contrast to a core driver, a root cause is a state or condition over which a manager has some degree of influence or the capability to change.
Perspective: Root cause, as used here, is different from the identical term when associated with the TQM paradigm where brainstorming and creating a fishbone diagram or producing an interrelationship digraph yield the cause responsible for a defined problem within a process being improved.
See: causality, core driver, core problem, current reality tree, entity, undesirable effect.

**rope** – One of the three devices required for proper management of operations. (The other two are the drum and the buffer.) The information flow from the drum to the beginning of the process that restricts the release of materials to match the flow though the constraint.
See: buffer, drum, drum-buffer-rope, simplified drum-buffer-rope.
RPLT – Abbreviation for reliable production lead time.

RRR S&T – Abbreviation for reliable rapid response strategy and tactics tree.

Rs – Abbreviation for replenishment for services.

**sales core conflict cloud** – A sales person’s core problem is how to convince a buyer to purchase the product or service. Should the sales person present the features of the product or not present? Presenting the product is the traditional approach to selling and most buyers are turned off by listening to a prepared presentation that she feels does not meet her company’s needs. In response to the presentation the buyer usually objects by saying that there is little difference between this product and competitors or this product and the product they currently use. The sales person’s objective A is bring the buyer to see the product as the best value by meeting requirements B sales person shows the value to the buyer and C sales person doesn’t cause the buyer to object. In order to B show value to the buyer, D the sales person must present the product. In order to C not cause the buyer to object, D’ the sales person must not present the product. See the evaporating cloud below:

The TOC solution uses the layers of resistance to change to focus of the presentation. The buy-in process is used to peel each layer of resistance back one layer at a time in the correct sequence. The presentation focuses on the identification and solution to the buyer’s biggest problem(s) created by our product or service.

See: buy-in process, change analogy, layers of resistance to change.

**sales funnel management** – Management of the selling process of an organization. The number of prospects entering the sales process is limited with more attention directed at selling opportunities with prospects within the funnel. A simplified drum-buffer-rope procedure is used where when one customer exits the sales process another prospect enters the sales process. Perspective: The conversion rate from prospect to customer is much higher when more attention is paid to a limited number of clients.

**S&T tree** – Abbreviation for strategy and tactics tree.

**science** – The search for a minimum number of assumptions that will enable one to explain, by direct logical deduction, the maximum number of natural phenomena. These assumptions—like the gravitational law—can never be proven. Even when they can explain an infinite number of phenomena this does not make them true. It simply makes them valid. They can still be disproved. One phenomenon that cannot be explained makes the assumption false, but in doing so it does not detract from its validity. It simply puts the boundaries on the circumstances where the assumption is valid and exposes the opportunity to find another assumption that is even more valid. Science does not concern itself with
truths but with validity. That’s the reason everything in science is open for constant checks and challenges.

See: stages of a science.

**scrutiny** – The process of conducting a rigorous inspection of a thinking processes logic tree or diagram using the categories of legitimate reservation as a framework for raising questions about the cause-and-effect relationships and the content of the entities.

**Usage**: A person who scrutinizes a logic diagram is called a scrutinizer.

See: categories of legitimate reservation, entity, logic diagram, logic tree, thinking processes.

**S-DBR** – Abbreviation for simplified drum-buffer-rope.

**secondary injection**

**Syn.**: trimming injection.

See: injection.

**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.

**Usage**: 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 ongoing improvement, throughput.

**shipping buffer** – In drum-buffer-rope (DBR), one of the time buffers used to protect the shipping date of finished goods.

**Usage**: In DBR, the shipping buffer is used to establish the order delivery date and is added to the constraint schedule for the order. The release schedule for raw materials is based on the constraint schedule. For parts that do not go through the constraint or assembly buffers, the shipping buffer is used to determine raw materials release and shipping date for the item. Buffer management is used to identify the holes in the shipping buffer and the cause(s) of these holes as part of the process of ongoing improvement. In simplified drum-buffer-rope, the shipping buffer is the only buffer used and is called the production buffer.

**Illustration**:  

See: buffer, drum-buffer-rope, process of ongoing improvement, simplified drum-buffer-rope.
**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-constrained resource(s). The capacity control in S-DBR 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.

**single-UDE cloud**

*Syn.:* UDE cloud.

**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.

**sprint capacity**

*Syn.:* protective capacity.

**stages of a science** – Scientific knowledge of a subject evolves over time. The stages of development are classification, correlation, and effect-cause-effect. Classification is the drive to answer the question: “What is this item?” The answer to the question is the development of a classification scheme and definitions of its classes. Correlation is the drive to answer the question: “How is this item related to other items?” The answer to the question is the statement of the relationship. Effect-cause-effect is the drive to answer the question: “Why is this item occurring?” The answer to this question provides a logical explanation of why the relationship exists between items.

*Example*: In the logistics function of an organization, manufacturing resource planning is viewed as the classification stage, just-in-time is viewed as the correlation stage; and theory of constraints is viewed as the effect-cause-effect stage of development.

*See*: science.

**staggering** – In multi-project critical chain project management, the process of releasing projects based on the availability and capability or capacity of the drum or virtual drum.

*Usage*: Once the drum resource has completed the last task on one project, another comparable project is released to execution. Staggering limits the number of projects being worked on at one time.

*See*: project pacing, virtual drum.

**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, return on investment (sku), star 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: blockage, breakage.

**static lead time** – Project, task or operation lead times that are fixed in duration such as heat treat,
outsourced processes, testing, etc.

**statistical fluctuations** – The TOC term for random variation.
Usage: The term statistical fluctuations is frequently used in conjunction with dependent events.
See: critical chain project management, dependent events, drum-buffer-rope.

**statistical fluctuations and dependent events** – Two factors present in any operations or project
management system that has at least one component feeding another.
Usage: The co-existence of these two factors is what necessitates the elements of the drum-buffer-rope
or critical chain project management solutions for managing these systems.
See: critical chain project management, drum-buffer-rope.

**stock buffer** – A quantity of material held at a point in the supply chain to decouple demand from supply.
Stock buffers can be held at the raw material stage, at intermediate production stages (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 and due date performance.
Illustration: A stock buffer for an SKU:

Perspective: Stock buffers are used in both make-to-availability and make-to-order environments for
raw materials and in-process items. In ASR, strategically replenished buffers are applied to strategic
part positions buffering both upstream and downstream variability and reducing product lead time. In
make-to-availability, 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, raw material buffer, time buffer.

**strategic buffer** -- Amounts of time, stock, or capacity effectively located at leverage points in the
production, supply chain, or critical chain to protect the system from disruption.
Perspective 1: In lean manufacturing buffers are located between each pair of sequential workstations.
In TOC buffers are located at leverage points (raw materials, constraint, after major divergent points,
convergent points, shipping (central warehouse). Smaller buffers are located at regional
warehouses/distributors and retailers where frequent replenishment occurs.
Perspective 2: In traditional project management buffers are included in each task time estimate. In critical chain protection is stripped from the tasks and strategically inserted at feeding and project completion locations.

See: capacity buffer, control point, project buffer, stock buffer, time buffer.

**strategic constraint** – The five focusing steps are not intended to be used as an infinite loop whereby an organization identifies and eliminates the current constraint over and over again. Rather, top management should determine where to move and hold the constraint with the intent of optimizing the organization’s long-term ability to achieve its goal. Over time, of course, changes in markets, technology, etc. may cause organizational leaders to redefine the strategic constraint. A strategic constraint is usually selected based on its scarcity i.e., 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.

See: constraint, five focusing steps.

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

See: tactical gating.

**strategic inventory positioning** – The first step in demand driven requirements planning (DDMRP) is applying six positioning factors to determine where inventory should be placed. The factors are 1) customer tolerance time, 2) market potential lead time, 3) variability in rate of demand, 4) variability in rates of supply, 5) inventory leverage and flexibility and 6) the protection of key operational areas. Under DDMRP these six factors are applied across the entire bill of material, routing structure, manufacturing facilities, and supply chain to determine the best positions for purchased, work-in-process, manufactured and finished items.

Perspective: Traditional MRP systems are push systems based on forecasts of demand for finished products and generally focus on local optima throughout the supply chain. In contrast, DDMRP is a pull system based on strategic placement of inventories across the supply chain with strategic buffers positioned for critical raw materials, work-in-process, finished goods and possibly distribution inventories. The system is based on measures such as buffer status that better reflect both a firm’s and a supply chain’s ability to respond effectively to customer demand.

**strategy** – The answer to the question: “What for?”; the objective of the tactic. The strategy of any proposed change is simply the objective of that proposed change in a strategy and tactics tree.

See: strategy and tactics tree, tactic.

**strategy and tactic node** – A grouping in a strategy and tactic tree; the grouping consists of five entities defining a proposed change. Each S&T node should answer:

1. Why the change is needed (necessary assumption)?
2. What the specific measurable objective of the change is (strategy)?
3. Why we claim the strategy is possible and what specific requirements, potential negative branches, or obstacles must be considered when selecting from the alternative ways (tactic) for achieving the strategy (parallel assumptions linking strategy with tactic)?
4. How to best achieve the objective of the change (tactic); for example, what changes should be made to processes, policy, IT systems or measurement?
5. What advice or warning should be given to subordinates, which, if ignored, will likely jeopardize the sufficiency of the steps they would take to implement this tactic and which is likely to be ignored (without the warning) (sufficiency assumption)?

See: necessity assumption, parallel assumption, strategy, sufficiency assumption, tactic.

**strategy and tactics tree** (S&T tree) – 1. A thinking process (a logic tree) to define and communicate all the necessary and sufficient changes required to synchronize actions for the achievement of any ambitious
target (or achieve more goal units), as well as the implementation sequence (from left to right and bottom to top). 2. A hierarchical framework guiding the processes required to cause holistic planned changes in an organization to convert it to an ever-flourishing organization by focusing on the questions of what to change, what to change to and how to cause the change, with emphasis on the third question.

Usage: The S&T tree can be built using the thinking processes or by using the plus-plus buy-in process. The S&T tree is the organizer of all the knowledge gained by analyzing an organization using the other thinking processes. The logical structure of the S&T tree guides organizational focus – starting from the highest objective, the S&T tree logically derives which actions must be taken in which order at all levels of the organization. An S&T tree provides the roadmap to build, capitalize, and sustain a decisive competitive edge. The S&T tree provides not only the necessary and sufficient conditions for achieving the strategy but also defines the specific changes in focus, measurements, processes, policies and behaviors required at each level and in each function of the organization.

Example: The diagram below provides the general framework of an S&T tree. The level 1 (L1) strategy defines the change in measures and focus that must occur for the CEO. The L1 tactic defines the change in modes of behavior and rules for the CEO. Level 2 strategies and tactics address the same issues for VPs and directors. Level 3 strategies and tactics are for functional managers and Level 4 strategies and tactics are for employees. S&T trees may contain a Level 5 which provides more details on sequencing and actions.

See: necessary assumption, parallel assumption, strategy, strategy and tactics node, sufficiency assumption, tactic.

L1

L2

L3

L4

L5 ....

**strategy core conflict cloud** – Top management’s core problem is how to develop a strategy to lead the company on a process of ongoing improvement (POOGI). A successful strategy must achieve three necessary conditions: 1. Make money now and in the future. 2. Provide a secure and satisfying environment for employees now and in the future. 3. Provide satisfaction to the market now and in the future. Top management must identify and implement a strategy that achieves all three necessary conditions. See the cloud below. Note that the objective A ensures that the company achieves necessary condition 1 (money now and in the future); side BD relates to necessary condition 2 (secure and satisfying
environment for employees now and in the future; and requirement C relates to necessary condition 3 (provide satisfaction to the market now and in the future). The conflict arises in that to achieve requirement B Managers must not lay workers off but to achieve bottom line results managers must lay workers off.

One TOC solution is based upon the recognition of the assumption underlying CD’. There is an external limit to throughput (which causes the focus on laying people off). The POOGI should focus on constantly growing the market by initiating improvements that provide the customer true benefits i.e., that overcome customers’ problems. This strategy achieves the three necessary conditions by providing the company a decision competitive edge.

See: decisive competitive edge, strategy and tactics tree.

**Student Syndrome** – Failing to start a task, even though the start date has passed, because there appears to be plenty of time before the seemingly distant due date.

*Usage:* The name is derived from the fact that most students tend to behave in this manner when given long range assignments. Typically other things appear to be more important, leading resources to delay starting or finishing work on a task. Once the due date becomes near, the effort increases to complete the task on time, however, any variation causes the task to be late. The student syndrome is one of the behaviors that critical chain project management seeks to eliminate.

*Perspective:* This behavior wastes any protection the task had available and accounts for the fact that in a conventional project environment, tasks - even though they typically contain lots of safety - tend to be completed rarely before, often close to, and frequently after the due date.

See: critical chain project management, multitasking, Parkinson’s Law.

**Subordinate** – The key word in the third of the five focusing steps: subordinate everything else to the above decision. Subordination is vital to achieve full exploitation of the constraint. Subordination has two major components: 1. all non-constraint resources must be managed to ensure that the constraint always has exactly what it needs when it needs it; and, 2. all non-constraint resources are not allowed to process work beyond what is required for the constraint.

*Example:* In the case of an internal resource constraint, non-bottleneck resources should ignore such things as local efficiency and run smaller batches in order to ensure that the constraint does not starve.

See: bottleneck, constraint, five focusing steps.

**Sufficiency Assumption** – An entity in a strategy and tactics (S&T) tree that states what has to be considered to ensure that the group of strategy and tactics entities at a lower level is sufficient to cause the tactic at the next higher level.

*Usage:* Sufficiency assumptions are facts of life that are common sense that, if ignored, will result in the steps below being insufficient to achieve the step above them. A sufficiency assumption is typically expressed as a warning or set of warnings when the level of detail in a tactic is likely to be insufficient to ensure that its strategy will be achieved effectively and efficiently. These warnings can
include assumptions about the governing laws of business, economics, human behavior etc. Sufficiency assumptions point out what we should keep in mind when evaluating the next level of the S&T tree. Sufficiency assumptions are required at each level in the strategy and tactics tree except the lowest level. See: necessary assumption, parallel assumption, strategy, strategy and tactic node, tactic.

**sufficiency-based logic** – A type of cause-and-effect reasoning in which the existence of one or more causes leads unavoidably to the existence of the effect. **Usage:** The thinking processes diagrams that use this type of “if…then…” (cause and effect) logic are the current reality tree, future reality tree, negative branch reservation, transition tree, and strategy and tactic tree. **Illustration 1:** Sufficiency-based logic diagrams are read beginning with the entity at the beginning of the arrow. The following logic diagram is verbalized: If 10 I default on a loan then 20 My credit rating goes down.

![Diagram](image1)

**Illustration 2:** Sometimes one cause is not sufficient to explain the existence of the observed effect. In such cases two or more causes are diagramed and linked with a logical ‘and’ connector (or ellipse). The following logic diagram is verbalized: If 10 I turn the ignition key to my car and 20 My car has a dead battery then 30 My car won't start.

![Diagram](image2)

See: cause, cause-effect, effect, entity, logical ‘and’ connector, thinking processes.

**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.

**sustaining (S&T tree)** – The third major segment of the S&T tree: knowing how to identify, implement and maintain a decisive competitive edge. See: building (S&T tree), capitalizing (S&T tree), strategy and tactics tree.

**symptomatic conflict** – An unresolved conflict in a system resulting from pressure to deal with an undesirable effect, or a conflict related to having to deal (in the execution of a plan) with UDEs caused either by problems in the creation of the plan or by changes in the starting conditions not accounted for in the plan. **Usage:** A symptomatic or consequence conflict cloud is of the form: D Action/rule needed to remove the UDE versus D’ Opposite action in conflict with D. A symptomatic conflict is identified as part of
the dual cloud process and is contrasted with a systemic conflict. An indication of a symptomatic conflict in department B of an organization is that department B is blaming department A for creating UDEs that department B must deal with.

**Syn.:** consequence conflict, consequence conflict cloud.

**See:** systemic conflict, dual cloud process.

**synchronized production**

**Syn.:** drum-buffer-rope.

**synchronized supply chain** – A supply chain in which each link invests all the resources necessary (and only the amount of resources necessary) to maintain and properly protect the throughput of the system.

**systemic conflict** – An unresolved conflict in a system that causes undesirable effects (symptoms) in other parts of the system, or a conflict related to the planning in a system that causes problems in the execution of the plan. Systemic conflicts create undesirable effects that in turn cause symptomatic conflicts.

**Usage:** A systemic conflict is of the form: D Action/rule that causes (most of) the undesirable effect versus D’ Opposite action that could prevent (most of) the undesirable effect.

A systemic conflict is identified as part of the dual cloud process and is contrasted with a symptomatic conflict. An indication of a systemic conflict created by department A of the organization is department B is blaming department A for creating undesirable effects that department B must deal with.

**Syn.:** causal conflict cloud, planning cloud.

**See:** symptomatic conflict, dual cloud process.

T – Abbreviation for throughput.

**T-plant** – A production environment characterized by initial straight line flow followed by divergent final assembly points. The logical network of material flow resembles the letter T in the sense that all materials go through similar processing until the final steps diverge to create a relatively large number of different end products assembled from common components.

**Perspective:** In a T-plant the main problem is the stealing of common part/subassemblies across products.

**Examples:** Car assembly, and faucet manufacturing.

**See:** VATI analysis, divergent point.

TA – Abbreviation for throughput accounting.

**tactic** – The answer to the question: “How?”; the action needed to accomplish a strategy.

**Usage:** The tactic is the ‘how to’ of achieving the strategy or objective of any proposed change in a strategy and tactics (S&T) tree. The tactics and sufficiency assumptions at one level of an S&T tree guide the strategies at the next lower level.

**See:** strategy, strategy and tactics tree.

**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.

**See:** 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 the 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.

**task** – An activity or series of activities, performed by one or more resources, represented as a single entity in a critical chain network.

*Usage:* When networks have thousands of activities, the project manager is operating within the noise of the task distributions. Some managers work with the large network while others use a rule of thumb to reduce its size. A rule of thumb that many project managers use is that no network should exceed 300 tasks; when a network exceeds this limit, a number of activities or a sub-network may be called a task in the larger network. Many times a task is defined by a deliverable which then becomes the starting point for the next task.

*See:* zooming.

**task safety** – The difference between a task time estimate and the mean task time (the 50% task time estimate).

*Usage:* Many times a task estimate is twice or more the mean task time; this is the origin of the suggestion to cut estimated task times in half before using them in the critical chain schedule until resources and resource managers start giving challenging but achievable durations (i.e., approximately 50% task time estimates).

*Caution:* Some tasks have a static or fixed time and cannot be reduced significantly.

*See:* 50% task time estimate, touch time.

**T/CU** – Abbreviation for throughput per constraint unit.

**TDD** – Abbreviation for throughput-dollar-days.

**technology questions** – A set of six questions used to evaluate the potential and impact of new technology:
1. What is the power of the new technology?
2. What current limitation or barrier does the new technology reduce or eliminate?
3. What usage rules, patterns and behaviors exist today that consider the limitation?
4. What rules, patterns and behaviors need to be changed to realize the benefits of the new technology?
5. What is the application of the new technology that will enable the above change without causing resistance?
6. How can the technology be used to build, capitalize and sustain the business?

*Usage:* The ideas stemming from answering the six technology questions can help focus development of the product’s features and the marketing approach and help developers of the new technology reach a better understanding of the required match between the new technology and the way the user should use the technology.

*Example:* electronic book reader

1. The ability to store and display books in electronic format on a screen that is similar to the page format in a book, coupled with full navigation and the ability to download additional books.
2. Two different limitations overcome by current book readers. One limitation is large space requirement for books at home. The second limitation is the difficulty of carrying a wide choice of books when traveling or in another location.

3. The current “solutions” to the limitations are books in “pocket” or paperback format that makes it easier to carry or store several books. The general limitations force a process of choosing books based on recommendations and then feeling compelled to finish reading even when the book is not particularly interesting.

4. The new rules are to purchase and store many books on the reader and carrying the reader with us any place we go. In some cases, one can download one or a few chapters to read prior to buying the electronic book.

5. The book reader itself should be very light, not easily breakable and fit easily into a briefcase. The price of the books should be low enough to be able to create a whole library. Reading should be possible even in bright sunlight.

6. The big problem, which still exists, is to get people to try it to overcome the resistance to reading from a screen. Making the book reader itself very affordable, thereby making it possible for more people to try it, is a move that might be worthwhile. Of course, managing a fast growing inventory of books in electronic format is a must.

temporary bottleneck – A situation created when the demand for a resource exceeds its capacity for a short period of time.

theory of constraints (TOC) – A holistic management philosophy developed by Dr. Eliyahu M. Goldratt that is based on the principle that complex systems exhibit inherent simplicity, i.e., even a very complex system made up of thousands of people and pieces of equipment can have at any given time only a very, very small number of variables – perhaps only one (known as a constraint) – that actually limit the system's ability to generate more goal units.

theory of constraints accounting

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.

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.
Illustration: In the diagram below, links in the supply chain are represented by ellipses:


theory of constraints project management philosophy
Syn.: critical chain project management.

thinking processes (TP) – A set of logic tools that can be used independently or in combination to address the questions in the change question sequence for managing ongoing improvement. The thinking processes are the: current reality tree (branch, twig), evaporating cloud, future reality tree (branch, twig), negative branch reservation, prerequisite tree, intermediate objectives map, transition tree, and strategy and tactics tree.

Usage: The thinking processes can be used to analyze both simple and complex systems, identify and solve system problems, and overcome the layers of resistance and achieve buy-in from individuals and various stakeholder groups as required. In addition they can be used to construct an organization strategy.

three-cloud approach – A relatively fast method of developing a current reality tree (CRT) wherein the developer identifies three seemingly independent undesirable effects (UDEs), creates an evaporating cloud (EC) for each, and synthesizes the three ECs into a single generic cloud called the core conflict cloud (CCC).

Usage: The three-cloud approach uses assumptions underlying each of the entity pair relationships (A-B, A-C, B-D, C-D' and D-D') in the CCC together with the CCC itself to form the base for a CRT by: 1. rotating the CCC 90 degrees counter-clockwise, 2. modifying the wording of the entities slightly, 3. reversing the direction of the arrows, 4. adding any necessary assumptions to provide sufficiency to the logic, 5. including transitional, fact-of-life entities as necessary, and 6. building upward to the UDEs for the system being analyzed.

Illustration: The base of a CRT created using the three-cloud approach is shown below:
Caution: Some critics feel that using the three cloud approach may not lead to a core problem while other feel that this criticism is overcome by the proper selection of UDEs (from diverse functions).
See: core conflict cloud, core driver, current reality tree, evaporating clouds, fact of life, logic diagram, transitional entity, undesirable effects.

three-minute egg rule – An expression applied to a task that has no variation in its task duration and must take the full scheduled time to be of high quality or meet a time requirement.
Usage: This is typical of certain tasks in both production and project environments. For example, a 1,000-hour run-time test is not complete until it has been run for 1,000 hours.

throughput (T) – The rate at which the system generates "goal units".
Usage: Because throughput is a rate, it is always expressed as goal units per unit of time (e.g., hour, day, month or year) or unit of product. If the goal units are money, throughput will be an amount of money per time period or per unit of product. In the case of throughput per time period, throughput is calculated as (revenues received for the period minus totally variable costs) divided by the chosen time period. In the case of throughput per unit of product, throughput is calculated as the selling price of the product minus totally variable costs per unit.
Example: Suppose a company produces only one product, and it sells for $100 and has totally variable costs of $35 per unit. If, in a week, the company produces 500 units but only sells 450, throughput would be $29,250 per week ((100 - 35) x 450). It should be noted that product produced but not sold does not generate throughput, it increases inventory.
See: inventory, throughput, totally variable costs.

throughput accounting (TA) – A management accounting method that is based on the belief that because every system has a constraint which limits global performance, the most effective way to evaluate the impact that any proposed action will have on the system as a whole is to look at the expected changes in the global measures of throughput, investment and operating expense.
Syn.: constraints accounting.
See: constraint, global measures, investment, operating expense, throughput.

throughput-dollar-days (TDD) – A measure of the reliability of a supply chain, that is, did the supply chain deliver everything it said it would.
Usage: TDD considers the monetary value of the things a link is committed to deliver but doesn’t, and the number of days by which the link misses the commitment. The system should strive for zero throughput-dollar-days. TDD is the summation of the commitments not delivered on time during the chosen time period. The TDD value of individual missed commitments is calculated by multiplying the dollar value of the end product times the number of days the commitment is/was overdue. The unit of measure "dollar-days" is neither monetary nor time based. Attempts to compare dollar-days to other monetary measures are invalid. TDDs can be compared only to other TDD levels.

Example: Suppose in the month of January a certain supplier was late delivering two orders. The first was 10 units of Part #1234 each having $45 of throughput; the order was delivered two days late. The second late order was for five units of Part #562 each having $70 of throughput; that order was eight days late. The TDD for that supplier for January was 3700. ((10 x 45 x 2) + (5 x 70 x 8)).

Caution: Great care is needed when using TDD to evaluate a local area as it might cause such areas to minimize TDDs rather than take more appropriate actions (for example, according to buffer management requirements).

See: buffer management, inventory-dollar-days, throughput-value-days.

throughput per constraint unit (T/CU) – A ratio that quantifies the rate a specific product or service will, if sold, contribute to the throughput of the company, calculated as the unit selling price minus the totally variable cost per unit of product or service, divided by the system constraint’s capacity consumed, expressed in the appropriate unit of measure.

Usage: This ratio is most often used to estimate the impact a decision regarding a possible change in product mix will have on the company’s throughput. T/CU is also used to quantify the true “cost” of unavailability of a system constraint.

T/CU should never be used alone. It is recommended to always calculate the impact that any change in product mix will have on throughput, investment, and operating expense before making a final decision.

Cautions: 1) T/CU should not be used to make decisions about product mix when there is no active capacity-constrained resource.
2) T/CU should not be used to make decisions about product mix when a system has interactive constraints; in such cases, the decision should be based on the cumulative change in system throughput, investment, and operating expenses.
3) When there is insufficient protective capacity on non-bottleneck resources, changing product mix based on the T/CU calculation can cause the constraint to shift, and thus invalidate the T/CU analysis.

Background: T/CU is derived from the economic principle known as the law of optimal allocation of scarce resources. This principle states that “A scarce resource is best used to produce and sell those products with the highest contribution margin per unit of scarce resource”. The relevant unit of scarce resource or constraint capacity is usually processing time on the capacity-constrained resource, but may also be a unit of storage space (e.g. if shelf space is the scarce resource as it usually is for a retailer), etc.

Example: If the relevant constraint unit is minutes, and it takes 2 minutes of constraint time to process a product that sells for $55 and has totally variable costs of $30, the T/CU = $12.50/min. ((55-30) ÷ 2).

See: capacity-constrained resource, constraint, investment, operating expense, throughput, totally variable costs.

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

throughput-value-days (TVD) – A term used instead of throughput-dollar-days in countries where the dollar is not the base currency.

See: throughput-dollar-days.
**throughput-world paradigm** – The view that a system consists of a series of dependent variables that must work together to achieve the goal and whose ability to do so is limited by some system constraint. The unavoidable conclusion is that global improvement is the direct result of improvement at the constraint, and cost allocation is unnecessary and misleading. This paradigm is in conflict with the cost-world paradigm.

*See*: constraint, cost-world paradigm.

**throughput-world thinking**

*Syn.:* throughput-world paradigm.

**time buffer** – Protection against uncertainty that takes the form of time. The Constraint, assembly and shipping buffers used in drum-buffer-rope scheduling and the production buffer used in simplified drum-buffer-rope are examples of time buffers.

*Illustration:* A time buffer for a work order:

```
+-------------------+-------------------+-------------------+
|      MATERIAL     |      CONSTRAINT   |      ASSEMBLY     |
|      FLOW         |        ,          |      OR SHIPING   |
| Green            | Yellow           | Red              |
| Buffer penetration | Hole in buffer and buffer status |
```

*See:* assembly buffer, buffer, capacity buffer, drum-buffer-rope, drum buffer, feeding buffer, project buffer, shipping buffer.

**time to reliably replenish** (TRR)

*Syn.:* reliable replenishment time.

**TOC** – Abbreviation for theory of constraints.

**TOC_6** – Original TOC applications are used in the design, production, distribution, measurement, marketing, and sales of physical products and highly repetitive services. These applications focus on effective inventory management and on efficient production of goods and services.

**TOC_8** – TOC applications adapted for use in the design, resourcing, delivery, measurement, marketing, and sales of highly customized services, particularly professional, scientific and technical services. These applications focus on effective resource management, because there is virtually no physical inventory, and on flexible service delivery.

**tolerance time** – The time a customer is willing to wait from when they place an order until they receive the product.

*Usage:* In many cases, the customer tolerance time is less than the replenishment time. In that situation it is often necessary to hold a stock buffer in order to not lose the sale.

*See:* replenishment time, stock buffer.

**too much green** – A condition in which the buffer status has remained in the green zone for too long (usually three consecutive replenishments from the green region), 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 consecutive replenishments from the red region), indicating that the buffer target is too low. The buffer target is usually raised one third.

totally variable cost (TVC) – Those costs that vary 1-to-1 for every increase or decrease in the number of units produced.
   Usage: In most manufacturing cases, the majority of totally variable cost is raw materials. Commissions, outsourced heat treating, powder coating, and galvanizing are other common examples of TVCs. In almost all conventional manufacturing cases, labor is not a totally variable cost. TVC is subtracted from sales revenue as part of the throughput calculation.
   See: throughput.

touch time – The time actually spent working on a task.
   Usage: In traditional project organizations touch time is typically much less than the time allowed for a task or the elapsed taken to complete the task. In implementing critical chain project management touch times or 50% task time estimates are typically used as a basis for determining task durations in critical chain networks. Once resources become comfortable with the critical chain approach touch times frequently become the basis for estimating task duration. In all situations buffer management should be used to reduce the variability of task times.
   Syn.: focused duration.

to what to change? – The second question in the original change question sequence and the third question in the newer change question sequence. The question focuses on determining a set of injections that will eliminate the undesirable effects in the system or convert the majority of them to desirable effects. The objective of answering this question is to construct simple practical solutions.
   Usage: Typically, the evaporating cloud, future reality tree, and negative branch reservation are the thinking processes that are used to help answer this question. The answer to this question logically describes a desirable future state of the system.
   Syn.: what to change to?
   See: change question sequence, evaporating cloud, future reality tree, injection, negative branch reservation, thinking processes.

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.

TP – Abbreviation for thinking processes.

TPS – Abbreviation for Toyota Production System.

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, material requirements planning, theory of constraints manufacturing philosophy, theory of constraints supply chain management philosophy.

**Traditional Project Management** – A philosophy of managing a project organization that focuses on local optimization (i.e., maximizing resource utilization) to achieve maximum short-term organizational profits. Multi-tasking within and across projects is rampant and extends both task times and project times, leading to the release of new projects into the system in hopes of starting projects early enough that they will be completed on time. Resources and resource managers add safety to their task time estimates to ensure on-time task completion as they are responsible for achieving their task time estimates.

See: critical chain project management.

**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 with a small central warehouse and inventories located throughout the supply chain (based on forecasts of item demand and 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 “the sum of the local optima is equal to the global optima.”

Syn.: distribution requirements planning.


**Trans-Atlantic Arrow**

Syn.: long arrow.

**Transfer Batch** – The quantity or volume of output that is to be completed at a workstation before that output is transferred to the next workstation.

Usage: In many cases, setting the transfer batch size less than the process batch makes it possible to dramatically reduce production lead time.

See: process batch, production lead time.

**Transformation Strategy and Tactics Tree** – A category of strategy and tactics tree designed to manage the transformation of an organization from its current reality to a future reality.

Usage: The transformation S&T tree answers the three fundamental change questions: what to change, to what to change and how to cause the change. To develop the S&T content, the other TP are used to provide answers in the following manner:

1. What to change? – Undesirable effects and current reality tree
2. To what to change? – Cloud, injections and future reality tree (to get additional sufficiency
3. How to cause the change? – Obstacles, intermediate objectives, prerequisite tree and transition tree. There are currently five generic transformation S&T trees in the public domain: consumer goods, pay-per-click, projects, reliable rapid response, and retailer.

**transitional entity** – An entity on the current reality tree (CRT), often a result of the conflict between entities D and D’ of the core conflict cloud (CCC), that logically facilitates the linkage of the CCC at the CRT base upward toward the various undesirable effects.

**Usage:** A transitional entity is often a root cause or core driver for the undesirable effects characterized in the CRT.

**See:** core conflict cloud, core driver, current reality tree, entity, root cause, three-cloud approach, undesirable effects.

**transition tree** (TRT) – A thinking processes sufficiency-based logic diagram that facilitates answering the question (from the change question sequence) "how to cause the change?" by providing a detailed, step-by-step set of actions that are needed to implement the desired change within an organization. In creating a TRT, “if…then…” sufficiency logic is used to map the sequence of detailed actions and their rationales that are required to move an organization from its current reality to the desired future reality as specified in the future reality tree. In particular, the TRT is formed by expanding the elements identified in the prerequisite tree into a more detailed set of needs, current states and future states or intermediate objectives expected, and actions required along with their respective rationales to address or overcome any anticipated obstacles. Two approaches and structures to construct the TRT are used. The second approach was developed to overcome some of the shortcoming in determining the logical sequence in the first approach.

**Usage 1:** The general structure of the TRT is given in Illustration 1 below. Actions are indicated by square-cornered boxes and all other entities are in rounded-corner boxes. At the base of the spine of the TRT is the present situation; at the top of the spine is the objective to be achieved. The entities in the column between the present and desired objective (bottom to top of diagram) are the transition states (or stages) required to achieve the objective, alternating with the need for the next transition state that the environment should go through in moving from the present to the desired state. The entities to the right of the transition column gives the logic of why the next transition state is needed, alternating with the logic of why the action will move the environment to that state. The actions required to move the environment to the next state are on the left of the spine. The TRT is read as “I want to achieve the desired objective. Given that the current state exists and that I want to move to the next transition state because the logic of the next transition state, if action is taken the transition will result because the logic of the action.” The next state is read similarly and all others until the desired objective is achieved.

**Illustration 1:**
Usage 2: In the newer approach, the spine of the transition tree leads from the present situation though the need to take a given action, to taking that action, to the need for a second action, to taking that action, etc. until we achieve our objective, intermediate objective, injection or desirable state. At each transition the need for the action and the working assumption of why this action is needed to move to the next state is provided. The tree is read: if (action 1) then (appropriate state to take action 2). If (appropriate state to take action 2) and (need plus working assumption for action 2) then action 2. These logical steps are followed until the objective is achieved.

Illustration 2:
See: change sequence, how to cause the change?, intermediate objective, obstacle, prerequisite tree, sufficiency-based logic, thinking processes.

**transportation lead time** – The time it takes to transport orders from the supply point to the next link in the supply chain.

*Usage:* Transportation lead time is one of the components of replenishment time, along with order lead time and production lead time.

*See:* order lead time, production lead time, replenishment time, supply lead time.

**tree diagram**

*Syn.:* logic tree.

*See:* current reality tree, future reality tree, logic tree, prerequisite tree, transition tree.

**trimming injection** – A state or condition that has been specifically designed to eliminate a negative branch that surfaces in a future reality tree.

*Syn.:* secondary injection.

*See:* future reality tree, injection, negative branch reservation.

**trimming the negative branch**

*Syn.:* trimming injection.

**TRR** – Abbreviation for time to reliably replenish.
**TRT** – Abbreviation for transition tree.

**TVC** – Abbreviation for totally variable costs.

**U-curve** – A convex curve depicting the relationship between the size of time buffers and the required level of management attention.

**Usage**: When buffers are too small significant management attention is required. If management doesn't have enough time to respond to orders penetrating the red zone of the buffer, capacity is lost due to starvation of the constraint or capacity-constrained resource. As buffer size increases less management attention is required because fewer orders penetrate the red zone. But as buffer size continues to increase, more orders are released and compete for resources causing work-in-process increases (and a decrease in management), therefore priorities are missed which causes lead times to increase. All of these require significant management attention. The bottom of the U-curve (the valley) represents a wide range of buffer sizes over which little management attention is required. This wide range provides safety when implementing theory of constraints. Most organizations operate on the right side of the U-curve.

![U-curve diagram](image)

**See**: good enough curve.

**UDE** – Abbreviation for undesirable effect.

**UDE cloud** – An evaporating cloud used on a standalone basis (i.e., not as part of a complete thinking processes analysis) that addresses a single undesirable effect.

**Usage**: The UDE cloud is used to address undesirable effects that have a negative impact on the performance of a system, that have been in existence for a period of time, and that have resisted other attempts at solutions. UDE clouds can also be used to address customer undesirable effects.

**Illustration**: A cloud for the undesirable effect “We have too many shortages of parts for assembly” is shown below:
undesirable effect (UDE) – A negative aspect of current reality, defined in relation to the organization’s or system's goal or its necessary conditions; a visible symptom of an underlying root cause, core problem, or core conflict.

Usage 1: Some characteristics of a well-articulated UDE include:
1. It is a complaint about an ongoing problem that exists in reality and because of this problem, you cannot perform better.
2. It should be a complete sentence written in the present tense.
3. It is a description of the state of the system, not an action.
4. It is within your area of responsibility or influence.
5. Something can be done about it.
6. It must not blame someone.
7. It must not be a speculated cause.
8. It must not be a hidden solution to the problem.
9. It must contain only one entity.
10. It should not include its cause in its verbalization.
11. It should be factual and not subjective.

Usage 2: There are two types of UDEs. A “gap existence” UDE and a “difficulty to close the gap” UDE. As soon as we ask people to identify “what is the problem” or “what bothers you” we can get answers of both types. There is a cause-and-effect relationship between these two types and it is therefore useful to get UDEs of both types to ensure a good analysis.

For example, “Our project due date performance is 60%” is a gap existence UDE while “Resources are frequently not available” or “Priorities frequently change” are both “difficulty to close the gap” type UDEs. These are the “problems” stakeholders currently blame for their expectation gaps. Of course, we should ask the person doing the analysis to validate whether the second type actually exists in their reality, whether it exists to an extent that it can explain most if not all of the expectation gap. See: core problem, current reality tree, entity, necessary condition, root cause.

unrefusable offer (URO) – A combined marketing and sales initiative that addresses the customer's core problem and creates a win-win solution for the supplier and customer.

Usage: An unrefusable offer is so called because, if constructed properly, the offer is too good to be refused by the customer and competitors can't or won't make the same offer to customers. An unrefusable offer addresses the customers’ core problem as it relates to doing business with our
industry. It typically requires that a supplier do something different (e.g., make operational improvements to establish a decisive competitive edge) to address the customer’s core problem.

Many people confuse an unrefusable offer with a unique selling proposition (USP), customer value proposition (CVP), or a sustainable competitive advantage (SCA). USPs, CVPs, and SCAs take what you already do and state it succinctly (or emphasize a certain part) and with more specificity aimed at one or a few of their customers’ problems or gaps in current market offerings. These alternatives can be UROs, but generally are not.

**Perspective:** Most companies offer solutions that solve their customers’ various problems or symptoms. UROs solve the industry and customer’s core problem. Unrefusable offers are not based on innovation. An unrefusable offer is a starting point for companies that have a market constraint, and is not based solely on price.

**Syn.:** mafia offer.

**See:** core problem, decisive competitive edge.

**unreported early finishes** – The practice of not reporting that a task is finished early based on the belief to do so would cause negative side effects.

**Illustration:** A common negative side effect of reporting the early completion of a task is that the boss will demand that, in the future, similar tasks must be estimated at this shorter duration. Or, the worker may lose credibility if the boss concludes the original estimate of task duration was wrong and therefore the worker must not know his/her job very well. For these reasons, workers frequently do not report an early finish.

**See:** Parkinson’s Law.

**URO** – Abbreviation for unrefusable offer.

**U-shape** – A diagram illustrating TOC entities involved in the analysis of current reality and the construction and use of the solution to create an improved future reality.

**Usage:** The U-shape was established to organize, store and easily retrieve TOC knowledge. The U-shape is used for generic TOC solutions such as make-to-order, make-to-availability, critical chain project management, and distribution as well as developing marketing offers. The U-shape can also be used to facilitate discussion of the questions in the change question sequence.
utilization – In TOC, activation of a resource that productively contributes to reaching the goal. Over activation of a resource does not productively utilize a resource. See: activation, over activation.

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.

V-plant – A production environment characterized by a small number of raw material items being converted through a common series of diverging operations into a large number of end items. The logical network of material flow (not the physical flow) resembles the letter V in that it is narrow at the bottom (few raw materials), and diverges at the top (many end products).

Examples: Steel making, plastic extrusion, and oil processing are examples of a V-plant.

VATI analysis – The stratification of operations environments into four generic types referred to as: V, A, T, and I. Each type is named for the letter that resembles a diagram of the logical flow (not the physical flow) of raw materials (based on its routings) to finished products. Each production environment has an inherent set of undesirable effects that, properly understood, make operations management easier.

Usage: A single plant may be a combination of more than one type.

vicious cycle – A situation in which an undesirable effect (UDE) intensifies its cause, thereby making the UDE more and more undesirable.
Example: A situation in which projects are late and the organization releases new projects earlier and earlier in hopes of completing them by the due date. As the number of projects in execution increases, competition for resources increases, resulting in projects being completed later and later. The late completions result in more pressure to release subsequent projects even earlier.

See: feedback loop, reinforcing loop.

**virtual drum** – In multi-project critical chain project management, a means of staggering projects that does not involve leveling the load on a resource.

**Usage:** The virtual drum could be a policy such as limiting the number of projects in execution at one time or limiting the number of projects being worked at a particular integration point, or a rule such as “release a new project each week.” An integration point or integration function can be also be used as a virtual drum. Capacity generally is not the issue causing delays at integration; the major problem at integration points is generally multitasking across activities. Once staggering is implemented and a number of projects have been completed, multitasking is significantly decreased and the number of projects flowing through the process increases. At this point capacity of the integration function may become an issue if further growth in throughput is desired.

See: critical chain project management, drum, staggering.

**wake-up call**

**Syn.:** resource buffer.

**wandering bottleneck** – An undesirable effect in which the bottleneck moves relatively frequently from one resource to another.

**Usage:** “Interactive constraints” is a broader term than “wandering bottleneck”. Constraints include such things as scarce resources in a production environment, critical chains in a project environment, the market for a given product, etc. while bottlenecks describe scarce resources in a production environment. While studying the project management environment for a client, Dr. Goldratt recognized that the critical chain in a project was the constraint to finishing the project. Shortly thereafter he changed the name of the body of knowledge he created to the “Theory of Constraints”.

**Syn.:** floating bottleneck.

See: bottleneck resource, capacity-constrained resource, interactive constraints.

**want**

**Syn.:** prerequisite.

**waste** – Anything that does not contribute to reaching the goal.
wet tree – Colloquial term used to describe a thinking processes logic diagram that is not very tight from a logical perspective.

Usage: A wet tree has long arrows (i.e., gaps in logic), errors in logic, or both. The process of scrutiny is used to improve the logic and produce what is then referred to as a dry tree, i.e., one with tight logic.

Ant.: dry tree.

See: categories of legitimate reservation, dry tree, long arrow, scrutiny, thinking processes.

what to change? – The first question in the original change question sequence and the second question in the newer change question sequence. The question focuses on identifying the system’s or organization’s core conflict and core problem(s).

Usage: Typically, the evaporating cloud and current reality tree are the two thinking processes that are used to answer this question.

See: change question sequence, core conflict, core problem, current reality tree, evaporating cloud, thinking processes.

what to change to?

Syn.: to what to change?

white buffer status – In general, an indication that a manufacturing order was released earlier than required.

Usage: 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 work-in-process) 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.

white zone (of the buffer) – In some buffer management applications, a white zone is identified in addition to the three standard zones (green, yellow and red) and orders that are released early are shown in the white zone.

See: buffer, buffer management, green zone, hole, red zone, yellow zone.

why change? – The first question in the new change question sequence. The question focuses on determining why a change to the system is necessary.

Usage: There are two bases for answering this question: 1. The strong belief that the system can perform significantly better and achieve higher levels of its performance measurements, or 2. The recognition of undesirable effects (UDEs) in the current environment that demonstrate either the gap between what is and what should be the environment, or the gap between where the organization is and where it should be with respect to its goal. Typically, a gap analysis of where the organization is versus where it wants to be, or a listing of UDEs versus the desirable effect is used to help determine the answer to this question.

See: change question sequence.

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.

X-Y syndrome – A problem that often occurs when TOC is not implemented holistically. It involves a power struggle between two functional areas of the organization and can result in the stagnation or
complete disappearance of TOC in spite of an incredibly successful implementation in one of the functional areas.

Example: Implementing TOC in department/function “X” (often in operations by implementing DBR) has two effects: 1. it changes the people in department/function “X” so their thinking aligns with the throughput-world paradigm, and, 2. as department/function “X” goes through the five focusing steps, improvement is so significant that the constraint shifts outside, let’s say to department/function "Y" (often sales or distribution or product development). "X" then puts pressure on "Y" to improve by adopting TOC but "Y" resists because they still operate in the cost-world paradigm. Usually “Y” wins the internal battle because the rest of the organization is still looking at business using the cost-world paradigm. The result is that TOC does not spread throughout the organization and may even disappear completely if the TOC “champion” in department/function “X” gets frustrated and leaves the company.

Perspective: To avoid the X-Y syndrome, implement TOC holistically.
See: cost-world paradigm, holistic approach, throughput-world paradigm.

yellow zone (of the buffer) – The buffer management term for region II of the buffer.

Usage: Generally, parts are supposed to arrive, or a task should be completed, in some portion of the yellow zone. Yellow, a sign of warning, is used to refer to this region because any hole in region II should be checked to assess the potential for penetrating the red zone, and a plan of possible corrective action that may be taken if the hole penetrates the red zone should be developed.

Perspective: TOC logistical solutions in production, project management and distribution/replenishment use buffers to protect the constraint utilization and the customer due date from variation. These buffers are broken into three zones generally referred to as the green zone, the yellow zone and the red zone. These zones help set priorities in reacting to variation.

Syn.: region II.
See: buffer, buffer management, green zone, hole, red zone.

zooming – The process of defining a series of tasks or subproject as a single task in a larger network.

Usage: Zooming reduces the details presented in a project and allows for better control. The task or subproject can then be managed as a project and its completion marks the end of that task in the larger network.
See: task.