
“What is Theory of Constraints (TOC)?”

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A generic Management Problem

How do we achieve ongoing improvement within an organization?

Every manager, and especially every company owner, wants to ensure that their organization becomes an Ever-flourishing organization – an organization that is continuously improving performance and stability, while increasing value to all stakeholders, without ever exhausting resources and without taking significant risks.

However, even though it is almost always possible (with the right resources and funding) to improve every part of an organization, even the largest and most prosperous organizations have limited resources and time available to invest in making changes needed to improve their organizations.

How do managers know where and when to invest the scarcest resources of their organization (including their own time) to achieve an ever-flourishing organization?

To answer this question, managers need a reliable method/mechanism to differentiate between all the MANY parts (processes, policies, skills, capacity) that CAN be improved, from the FEW that MUST be improved in order to achieve more goal units for the organization, now and in the future.

The extent of the Problem

Every improvement in performance and value to stakeholders results from a change to the organization. However, not every change in the organization will result in an improvement in performance and value.

In fact, research shows that the majority of changes (typically 60 – 80%) initiated by management and owners to improve their organizations do not result in a measureable improvement in the “bottom line” and a significant percentage of these changes actually deteriorate the organizational performance. These statistics are true for every type of change including mergers & acquisitions, the introduction of new products or services, the implementation of new IT systems, new incentive schemes as well as organizational transformation projects.

With such a low success rate, it is no wonder that there is such high resistance in most organizations to new change initiatives and also why there is so much skepticism from owners resulting in most changes not receiving the full investment and/or resource allocation needed.

The (major underlying) Cause of the Problem

Is it the inherent complexity or not capitalizing on the inherent simplicity?

There are typically two opposing views on what the underlying cause(s) of the low success rate of change initiatives are within organizations.

The first view relates to an acknowledgement that organizations are very complex and that there are high levels of uncertainty related to identifying the underlying root causes of poor performance or necessary conditions for success and to predicting the impact of such changes on the performance of the organization as a whole. Those managers that ascribe to this view will focus mainly on reducing the complexity and uncertainty by breaking the organization or problem up into simpler parts (where the cause-effect relations are more known/certain) and then aiming to improve or optimize each of the parts. The assumption being that the sum of these local improvements will equal the improvement for the organization as a whole. i.e. they assume that *More (performance in each part and more initiatives) are always better, especially considering the uncertainty in success rate.*

The second view acknowledges that all complex systems (like organizations) are governed by inherent simplicity – that the majority of problems/poor performances are caused by very few underlying causes (Pareto principle) – the leverage points in the system. This theory acknowledges that a system's performance improvement is not equal to the sum of ALL local improvement, but simply the result of improvements of only those FEW parts not performing at the level of "good enough" to support the current target for win:win:win goal units.

The second view (based on an holistic approach) acknowledges that in the same way that the strength of any chain is limited by the strength of the *weakest link*, the performance of any organization is limited by the performance of the "system constraint" (the organization's *weakest link*). Improving any of non-weakest links will not improve the organization while improving the weakest link will always result in an improvement to the organization as a whole.

This holistic approach also acknowledges that people only resist change when a change is considered a "lose" for them or other stakeholders and also that a win:lose between stakeholders in an organization, will always deteriorate to a lose:lose. Ensuring that changes will be a win for all stakeholders is the key to turning resistance to change, into active contribution and commitment to successfully implement the right changes.

Need for a Holistic Focusing Process

How do we know where to focus our efforts to improve?

In the 1980's, an Israeli physicist, Dr Eli Goldratt, started applying the mindsets and methods of the hard sciences to the "soft" science of managing and improving organizations. He realized that the performance of

organizations are limited by a system constraint (the weakest link) and that this (insight) can provide the necessary focusing mechanism for all levels of management to differentiate between the MANY parts within their area of responsibility that CAN be improved from the FEW that MUST be improved to help the organization achieve more goal units for all stakeholders.

This focusing process should enable each part of an organization to identify not only what that part must START doing to contribute to the improvement of the whole organization but also (more importantly) what that part must STOP doing that is not contributing to or in some cases, in conflict and therefore damaging the performance of the organization as a whole.

Goldratt also realized that such a focusing process needs to be supplemented with the necessary holistic thinking tools (TOC Thinking Processes) and decision support system (Throughput Accounting) to develop and capitalize on the cause-effect relationships between the constraint and non-constraints, which govern the system.

Dr Goldratt called this new body of knowledge the “Theory of Constraints” or TOC. TOC’s five focusing steps to analyze and improve any organization holistically included:

Step 1: **Identify** the System Constraint (to achieving more Goal units for the organization)

Step 2: Decide how to **exploit** (not waste) the system constraint

Step 3: **Subordinate** everything to the above decision

Step 4: **Elevate** the System Constraint

Step 5: If in a previous step a constraint was broken, don't let inertia become the system constraint, **go back** to step 1.

Over the past 30 years, Dr. Eli Goldratt, the creator of Theory of Constraints, together with an increasing pool of TOC practitioners, implementers and academics have created a vast body of knowledge of how to apply the five focusing steps to different types of organizations from different industries and to different parts of the organization (operations, finance, supply chain, projects, sales, marketing and managing people), and also developed a holistic decision support framework (Throughput Accounting) and a set of logical Thinking Processes and Management Skills that can be applied when organizations are stuck on one or more of the above steps.

The 5 focusing steps can be applied to a function within an organization (e.g. managing operations, sales, finance, logistic etc), to a total organization or even to a whole supply chain.

Where to Start?

Should we start with the low hanging fruit or highest leverage points?

The application of TOC's 5 focusing steps will sustainably unlock the most inherent potential when applied to an organization as a whole (i.e. what is the constraint to profitable growth for the company) and even more so when applied to a whole supply chain

The example that follows illustrates the order of magnitude of inherent potential that can be unlocked with the TOC's 5 focusing steps when applied to only one part of the organization vs. to the whole organization.

Consider a company with \$100m in Sales, Variable Cost of \$50m, Operating Expenses of \$45m and Net Profit of \$5m and with Inventory of \$25m.

From time to time, the organization's internal capacity is insufficient to meet demand, resulting in higher operating expenses (overtime etc) and even lost sales (which can be minimized by increasing inventory with excess capacity during low demand periods).

Applying the TOC 5 Focusing steps to improving planning and execution management of operations (called Drum-Buffer-Rope and Buffer Management), it will reduce the main causes of low throughput, long lead times, poor due date performance and higher operating expenses and inventory due to internal bottleneck(s). These causes include overproduction, unsynchronized priorities, ineffective and inefficient buffering against variability in demand and/or supply, unfocused improvement initiatives and local optima/efficiency metrics.

Such an implementation will typically expose 10-50% of protective capacity, reduce lead times (and therefore inventory) by between 10 and 50%, while significantly reducing the need for overtime or expediting costs. Unless this "unlocked" capacity is sold or sold at higher prices (based on higher due date performance or shorter lead times), the only benefit that will flow to the bottom line will be the reduction in overtime and other related expediting costs and/or the reduction interest paid on the higher than necessary inventory. It is common that these will easily add up to around a \$1m to \$2m cost saving per annum or the equivalent of a 20% to 40% increase in Net Profit.

But what will happen if TOC's 5 focusing steps are applied to the organization as a whole – to develop a business strategy that aims to grow sales by turning the operational improvements from a TOC implementation to build, capitalize on and sustain a decisive competitive edge within its target markets.

Such a strategy is developed with the assumption that the Market is the system constraint to which the whole organization should be subordinated to and that "deciding how to exploit the system constraint" means identifying those customer significant needs, that if satisfied, will get *existing* customers to buy more or pay more (better exploiting the system constraint) and to finally get more *new* customers to buy more or pay more (elevating the system

constraint).

	Current		% Change	Future	
Sales Revenue	\$100.00	100%	+10%	\$110.00	100%
Variable Cost	\$ 50.00	50%	+10%	\$ 55.00	50%
Throughput	\$ 50.00	50%	+10%	\$ 55.00	50%
Operating Expenses	\$ 45.00	45%	0%	\$ 45.00	41%
Net Profit	\$ 5.00	5%	+100%	\$ 10.00	9%
Investment	\$ 25.00	25%	-20%	\$20	18%
ROI	20%		+125%	45%	

Figure 1: High leverage impact of a 10% increase in Sales on Net Profit and ROI

Considering the previous case, what will be the bottom line impact if the company can capitalize on the improved operational performance (higher throughput with shorter lead times) by turning these improvements into more sales volume and/or higher prices:

- 11% increase in Sales Volume (selling the 10% capacity which was previously hidden) without increasing Operating Expenses will increase Net Profit by \$6.5m or more than 100% increase (\$11m increase in Sales less 50% Variable Cost).
- 100% increase in Sales Volume (selling the 50% capacity which was previously hidden) without increasing (or at least significantly increasing) Operating Expenses will increase Net Profit by \$50m or 1000% (\$100m increase in Sales less 50% increase in Variable Cost).
- 10% increase in the average selling price (capitalizing on better reliability or lead times and simply reducing unnecessary discounts) will result in an increase in Net Profit of \$10m or 200% (\$10m increase in Sales Revenue within increase Variable Cost or Operating Expenses).

The order of magnitude increase in bottom line provides a good business case of why TOC should always be implemented holistically as part of a business strategy focused on *building, capitalizing on, and sustaining a decisive competitive edge within a large enough market and without exhausting resources and or without taking high risks* - both of which could jeopardize sustainable growth towards becoming an ever-flourishing company.

Developing and Communicating Harmonious Strategies & Tactics

One of the major challenges in organizations is defining and communicating the necessary and sufficient changes and the required sequences of these

changes and related contributions to all functions within the organization and all levels within these functions. Managers and employees that do not know their contribution to the goal of the organization (both what to focus on and what not), question the contribution of others in the organization, feel disempowered due to gaps between authority and responsibility, face conflicts between local vs. global or short vs. long term optima, or are paralyzed by fear of failure can result in disharmony that will jeopardize the achievement of the organizational goal.

In recent years, Dr Eli Goldratt has started using what is considered by many as the most powerful TOC Thinking Processes called “Strategy and Tactic Tree” to overcome these “engines of disharmony”. This thinking process is used not only to capture the specific objective (strategy or “what for”) and required actions (tactic or “how to”) for every recommended change, but also all the assumptions related to this change.

These include assumptions about why this change is necessary to achieve the higher level objectives (necessary assumptions), the assumptions about why the strategy is possible and why the tactic is the best or even the only way for achieving this objective (parallel assumptions) and lastly assumptions or warnings about why this level of detail is still not actionable information for the level below to ensure sufficiency and correct sequencing for achieving the higher level objectives (sufficiency assumptions).

Figure 2 below shows an example of such a Strategy and Tactic tree for a Manufacturing company. The tree structure shows the first three levels of the S&T with the second level typically defined as the “decisive competitive edges” needed to grow the sales and profitability at the desired growth rate or can include four blocks for “2.1: Exploiting market constraint”, “2.2 Improving efficiency/productivity”, “2.3: Elevation market constraint” and “2.4 Exceeding Social Responsibility”. The third level typically defines the necessary changes to build, capitalize on and sustain decisive competitive edges needed to achieve profitable growth.

Each of the blocks on this S&T is defined to the level of detailed showed for block 3.1.1 which details the logic for building a decisive competitive edge of reliability by achieving remarkable due date performance.

More are more organizations are now using their S&T to also provide a technology roadmap to ensure their ERP systems, not only provide the critical functionality and enablers needed (as specified in the Tactic of each of the necessary changes on the S&T) to successfully grow their organizations, but that it does not contain any unnecessary add-ons or legacy systems that add complexity but no value.

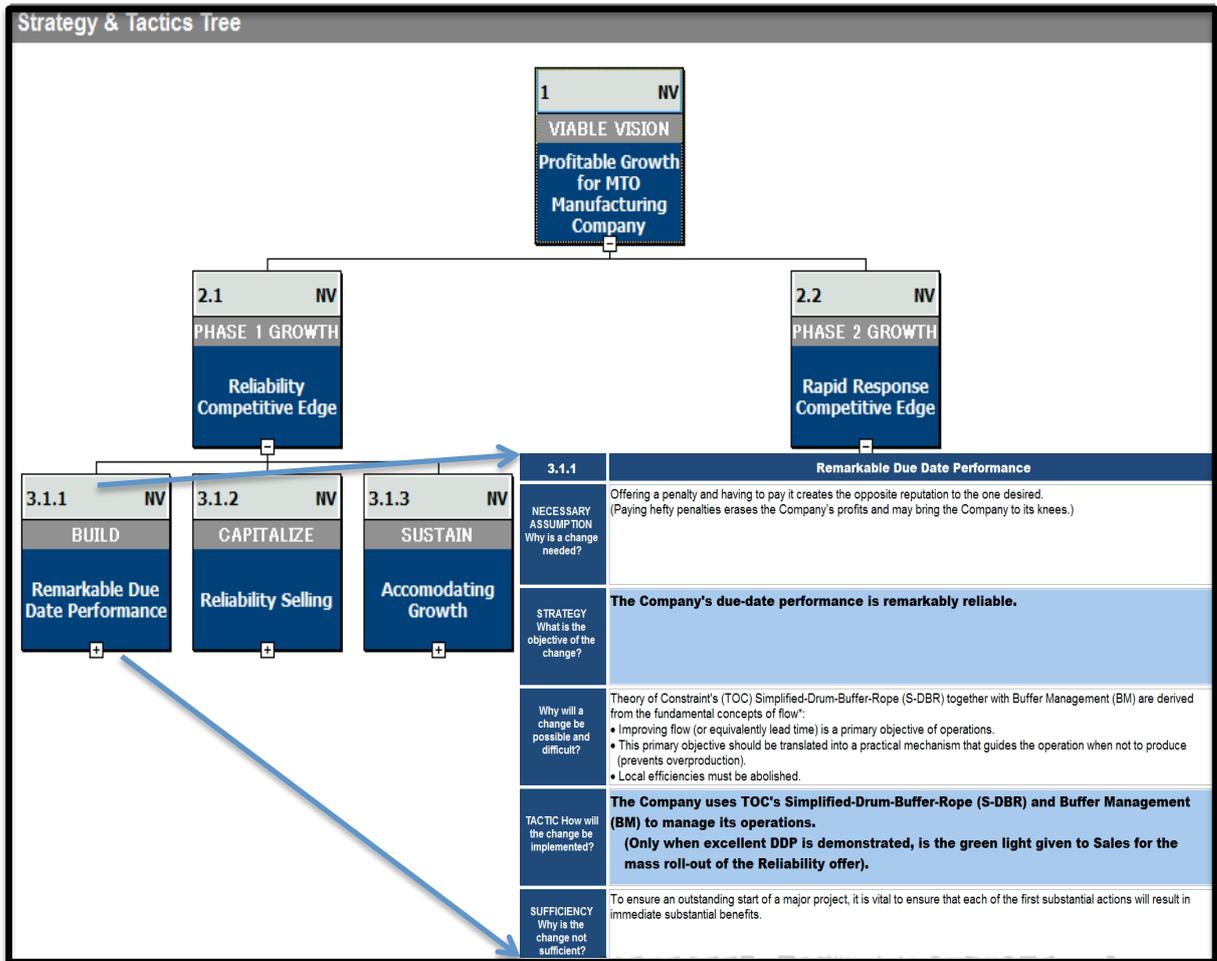


Figure 2: Example of Strategy & Tactic Tree for Manufacturing Company

Conclusion

The bottleneck, is always at the TOP of the bottle...

It is possible to “improve” all parts of an organization or system. However, the key to achieving ongoing growth and stability for any organization is finding a way to focus their scarcest resource (management time and attention) on only that part that are currently limiting or blocking further improvement – the system constraint, leverage point or weakest link. Better exploiting and or elevating a system constraint will improve the performance of the whole system.

In its essence, TOC aims to show that the core problem to ongoing growth and stability for any organization (and for individuals) is our erroneous assumptions about what to focus on (and what not). TOC provides a practical mechanism, proven logistical solutions and thinking processes to help differentiate between all the parts that can be improved and those few that must be improved to achieve more with less in less time.

Over the past 30 years, TOC have been successfully applied to almost every

type of organization imaginable. Each of these success stories has shown that when management tried previously to improve all parts of their organizations... the possible became impossible. When they started focusing their time on identifying and improving only those parts that currently constrain performance (the highest leverage points), suddenly the impossible becomes possible...achieving more with less in less time.

For those readers that are interested to learn more about TOC and how organizations are applying the various solutions and thinking processes within TOC to analyze and holistically improve both private and public sector organizations with either market demand, supply capacity or cash constraints, please review the appendices to this article or contact Dr Alan Barnard, CEO of Goldratt Research Labs at alan@goldrattresearchlabs.com

Appendices

Theory of Constraint (TOC) Reference Bank

A number of websites contain listings of organizations that have successfully implemented TOC. Most notable is www.toc-goldratt.com which contain a listing of over 200 such organizations from both the public and private sector that have published their TOC implementation results, many of which can be viewed on www.toc.Tv

One of the most comprehensive studies on TOC implementations was done by Professors Victoria Mabin and Steven Balderston. The survey included documented implementation case studies and results from over 300 publications and 30 books. The findings of the survey showed mean improvements achieved with TOC implementations as:

- Lead-Times: Mean Reduction 69%
- Cycle-Times: Mean Reduction 66%
- Due-Date-Performance: Mean Improvement 60%
- Inventory Levels: Mean Reduction 50%
- Revenue / Throughput: Mean Increase 68% (outlier exclusive)
- Combined Financial Variable: Mean Increase 82%

TOC Publications

Since Dr Eli Goldratt wrote THE GOAL which first appeared in 1984, over 100 TOC books (books with Theory of Constraints in their titles or dedicated to TOC) have been published. The largest ever TOC publishing initiative was initiated two years ago by two professors, Dr Jim Cox and John Slayer and McGraw-Hill Publishing. The result was the Theory of Constraints Handbook launched in June 2010. The handbook contains 38 Chapters written by 42 of the leading TOC academics, practitioners and implementers in the world. The handbook's table of contents provides a good overview of the scope of the TOC applications and body of knowledge after 30 years of continuous development and evolution.

Interesting facts related to TOC publications include:

- The Goal, published first in 1984 has sold more than 3 million copies and still rank within the top 500 books in sales on Amazon at any time
- "Theory of Constraints" generates over 180,000 hits on Google and "Goldratt" more than 220,000.

TOCICO (www.tocico.org) Certification

The Theory of Constraints International Certification Organization (TOCICO) was founded in 2001 and is the organization responsible for the certification of Theory of Constraints practitioners, implementers and academics. It has certification in TOC Fundamentals, TOC for Supply Chain Logistics, TOC for Finance, TOC for Projects, TOC Thinking Processes and TOC for Business Strategy. There are currently around 550 TOCICO certified members at the practitioner and implementer level.

Many universities and other education organizations teach TOC in graduate and post-graduate programs and a significant % of these are using / evaluating the use of the TOCICO certification exams as the way to test and certify their students.

Goldratt Group

Shortly after Dr Eli Goldratt retired in 1995 he founded the Goldratt Group with representation in over 20 countries. Goldratt Group consists of Goldratt Consulting - GC (www.goldrattconsulting.com), Goldratt Schools - GS (www.goldrattschools.com), Goldratt Marketing Group - GMG (www.toc-goldratt) and Goldratt Research Labs - GRL (www.goldrattresearchlabs.com).

Geographic Spread: Goldratt Consulting currently has around 40 Viable Vision (Holistic TOC implementation where at least 70% of the total fees are conditional on actual financial improvements) projects in 10 countries including India, Japan, China, South Africa, USA, Columbia, Ecuador, Brazil and Mexico. In addition to this, there are a large number of clients partnering with GC on pre-VV contract analysis (that lead to VV contracts) within the above 10 countries as well as in the UK, Taiwan and Korea. GC is currently also starting up operations (most will "go-live" during last quarter in 2010) in Chile, Peru, Ukraine, Germany, Italy and Turkey.

Published Results on VV projects: Five of the current VV projects have presented their exceptional performance improvement results at TOCICO over the past 3 years. These include Tata Steel (India, Steel), Neuland (India, Pharmaceutical), Decor (Canada, Cabinets), Cartmont (Mexico, Packaging) and Plastigomez (Equador, Plastics). Each of these presentations are available from www.tocico.org

TOC Software

Goldratt Consulting have partnered with three companies that exclusively provide the TOC support software used on GC's Viable Vision projects.

These include:

Realization (www.realization.com) that provide **CONCERTO**, a Critical Chain based Planning and Execution Management system used on large complex multi-project environment TOC implementation

Inherent Simplicity (www.inherentsimplicity.com) that provide **SYMPHONY**, software that supports the TOC planning and execution management rules for Production and Distribution environments

Goldratt Research Labs (www.goldrattresearchlabs.com) that provide **HARMONY**, software that supports the design, validation, communication, planning and execution monitoring of TOC's Strategy & Tactic Trees used to achieve ever-flourishing organizations

ERP Systems

On request of a few large global companies using TOC (ABB, Daiwa House, African Explosives, Ditch Witch, Tata Steel etc.) , it is has been shown that a standard ERP system such as SAP, can be configured with the minimum number of enhancements, to fully support most of the logistical and decision support applications of Theory of Constraints. For more information, readers can visit www.goldrattresearchlabs.com which include research papers on a few of these case studies.