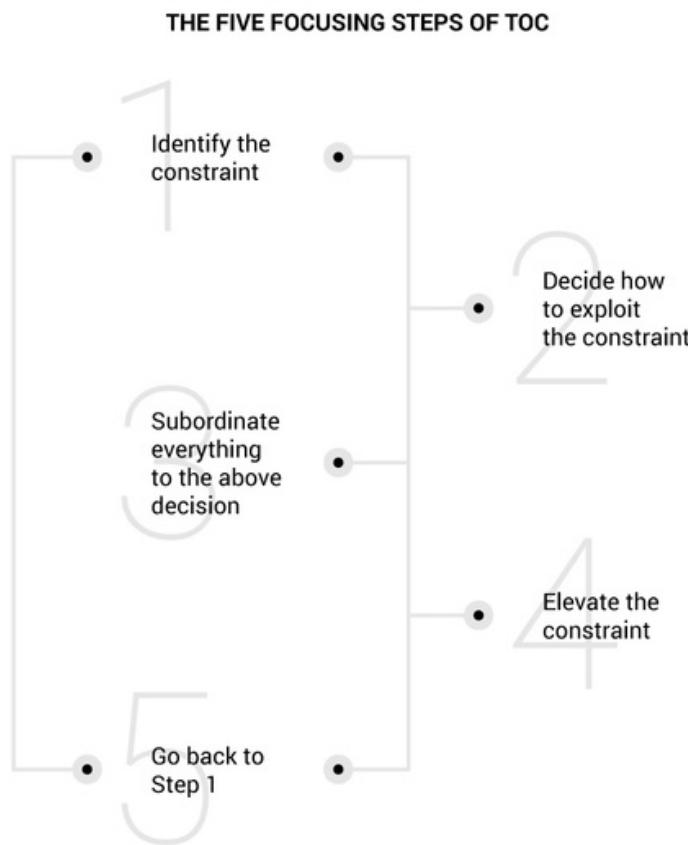


The Scientific Basis of Theory of Constraints



What is Theory of Constraints?

Theory of Constraints (TOC) proposed by Eliyahu Goldratt is often defined a powerful yet simple management philosophy that suggests that system constraints limit the performance of an organization and proposes five “focusing steps” to identify and manage these constraints so that organizations can improve continuously and move closer towards its goal.



Though accurate, this description of TOC does not capture the true essence of the theory, the origins of which are derived from principles of hard sciences. Even as there is an ongoing debate about whether managing an organization is an art or science, Theory of Constraints (TOC) assumes that it is possible to apply the principles underlying the development of hard sciences, like physics, in area of management of organizations.

Theory of constraints and the hard sciences

The two principles which have led to development of hard sciences are

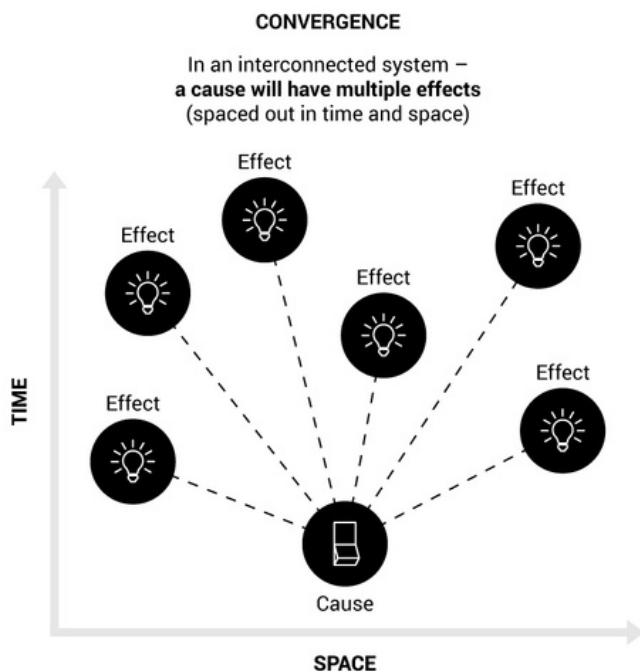
1. the principle of inherent convergence and
2. the principle of inherent harmony

No scientist can ever prove the veracity of these principles. They only strongly believe in them because it has not been proved wrong yet. These beliefs have fueled the growth of the hard sciences in last few centuries.

As Eli Goldratt says “*Science isn't a matter of believing only what you see. Science is a matter of believing and seeing by believing. If you believe only what you see, you won't see very much...*”

Principle of Convergence (The Inherent Simplicity)

Hard science (like physics or chemistry) believe in principle of convergence. Why? If we have everything in nature connected to everything else, then an effect can never be in isolation. It has to have a cause. Physicists assume, at a fundamental level, there is a convergence of know-how which explains all other application knowledge. The history of development of fundamental physics (and application physics) is motivated by this quest for finding the unified theory which can explain all the forces and particles in universe. This unrelenting quest for unification over the years has lead to many inventions and discoveries along the way. For example, the electro-magnetic theory helped converge the electrical field theory with the magnetic field theory and we got inventions like the Television, X-Ray etc.



Similarly in organizations, there are interactions between various departments. An effect (positive or negative) in one department is because of an action in same or another department. Due to the complex relationships between entities, an action or a decision (a cause) also leads to multiple effects cross time periods and departments.

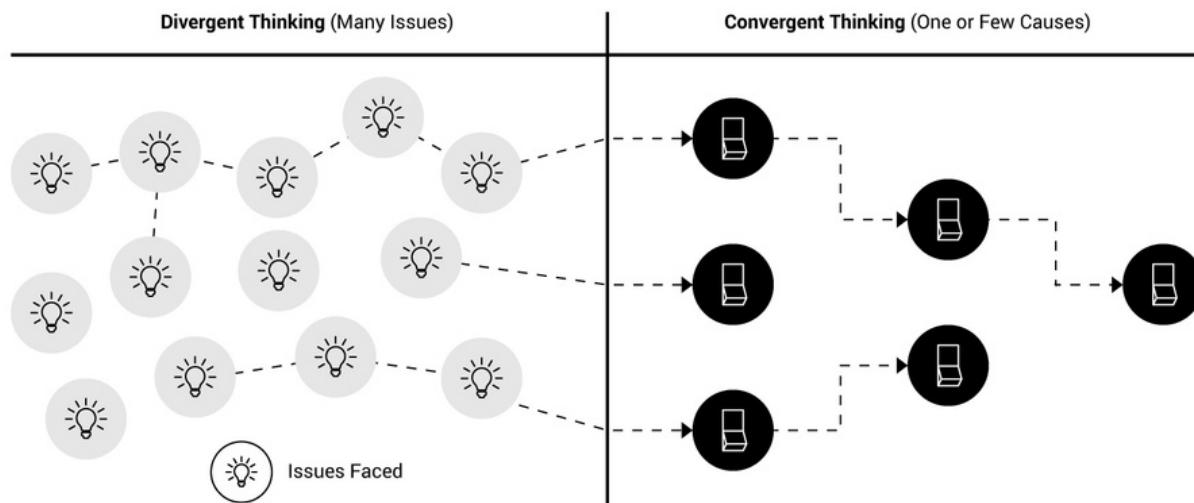
Examples of interdepartmental dependencies:

1. dispatches going down because finance department has decided to put a cap on overtime
2. breakdown time going up because maintenance department has cut the spares inventory to meet their cost reduction targets

Hence problems in organizations cannot be seen in isolation unless we want to just deal with symptoms. We should solve the root cause. We all know that. What is the difference? The approach of TOC towards finding the root cause is the search for convergence. As we try and dive deeper to look at causality behind the effects, and think cause-effect-cause then we will see convergence (few causes) rather than divergence (many causes). With such rigorous logical analysis, we should arrive at a single core problem for an organizational system (a system of interacting departments with one common goal of making more money), which can be solved to get the next level of improvement.

This shows that, at any point of time, we need to just focus on one initiative on the leverage point (or the core problem) to get the next level of improvement. Since the core problem or the leverage point is connected to many issues across departments, any improvement will give rise to a quantum jump in performance of the organization.

DIFFERENCE BETWEEN DIVERGENT THINKING & CONVERGENT THINKING



DRAWING PARALLELS BETWEEN THE PRINCIPLE OF CONVERGENCE IN SCIENCE & INHERENT SIMPLICITY OF THEORY OF CONSTRAINTS

Principle of Convergence (Science)	Inherent Simplicity of Theory of Constraints
Everything in nature is connected to everything else (e.g. an interdependent ecosystem)	Organizations are interconnected systems
No cause can be without effect and no effect be without cause	All actions and decisions in a company have consequences; the currently experienced effects are the results of past decisions
Causes can have effect/s across time and space (e.g. Butterfly effect)	Actions or decisions in one department can have multiple effects across time periods and departments (e.g. increase in breakdown time because maintenance has decided to cut inventory of spares)
It is possible for a unified theory to explain everything in the universe	The problems experienced by an organization can be drilled down to a root cause
A high leverage point is a place in a system where a small amount of force causes large amount of predictable favorable response	Businesses have leverage points i.e. have problems which when addressed with relatively small amount of investment yield a disproportionately high level of return

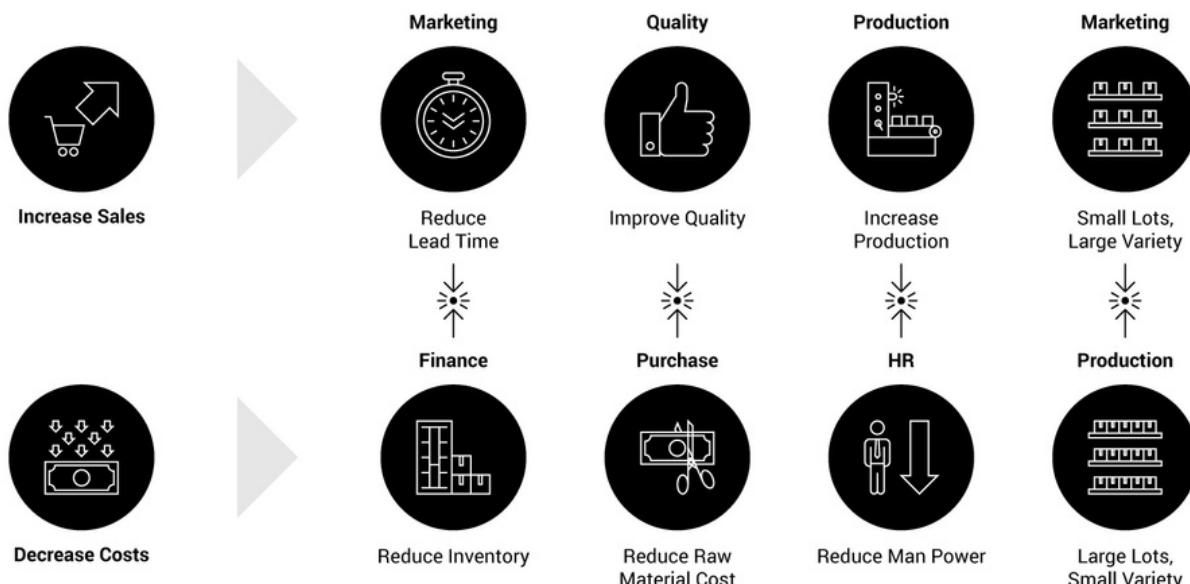
Principle of Harmony (Inherent Win-Win)

Hard sciences believe that nature is inherently harmonious which means contradictions do not exist. So when two physicists differ on a hypothesis, they analyse the inherent assumptions and try to invalidate them to reconcile the contradiction.

Organizations are full of chronic conflicts between departments and key managers. Conflicts manifest as heated inter-personal acrimonious debates in various meetings. While seen in isolation, each action or decision of a department looks good for that department point of view, but the same action creates a conflict with objectives of the other department. While the objectives are good and widely accepted, it is the actions which create the conflict.

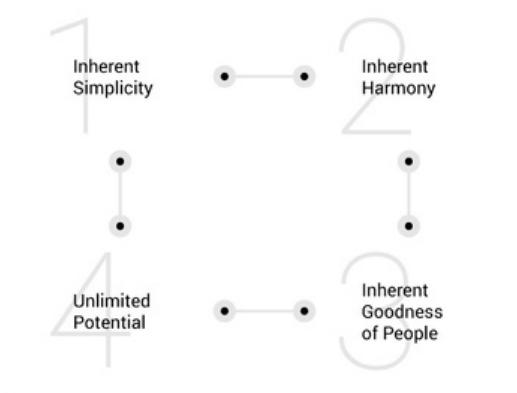
(For example, too much focus on improving machine efficiencies everywhere with aim of reducing costs can lead to too much WIP in the shop floor and increase in production lead time, which in turn can affect the sales opportunities). These conflicts can be treated like the way physicists treat contradictions. It is possible to remove the conflict by analyzing the inherent assumptions behind the actions. In all situations, there is always an assumption which is erroneous (or can be invalidated), as organizations can be made inherently harmonious like the nature around us. (For example, improving machine efficiencies everywhere does not reduce costs because the assumption "resource standing idle is a waste" is invalid for non-bottleneck machines).

EXAMPLES OF EVERYDAY CONFLICTS IN ORGANIZATIONS WHICH ARISE FROM THE VALID OBJECTIVES OF INCREASING SALES & REDUCING COSTS



However simple the above principles may look like, they are difficult to apply when we are dealing with human based systems like an organization. There are mental obstacles to applying these two principles.

THE PRINCIPLES OF TOC



"I smile and start to count on my fingers;
One, people are good.
Two, every conflict can be removed.
Three, every situation, no matter how complex it initially looks, is exceedingly simple.
Four, every situation can be substantially improved; even the sky is not the limit..."

- Eli Goldratt

The Obstacles and Additional Beliefs

The mental obstacle to applying the principle of harmony is the tendency to blame people. This tendency to blame people in organization comes in the way of objective evaluation of the erroneous assumptions underlying the conflict. At times when we are in a conflict, we tend to believe that the reason for the conflict is the other person himself.

With this thinking, there is no way to go forward because other person also reciprocates with similar perception. The conflict stays on as there is no way we can reach a situation where both involved parties will objectively look for an assumption which can be invalidated.

So, the only way we can apply the principle of harmony is when we also accept the principle that human beings in an organization are inherently good. This principle is the third principle of Theory of Constraints.

Similarly, there is an obstacle to applying the principle of inherent simplicity. The principle of inherent simplicity shows that every organization has a leverage point which can give a quantum jump in improvement, vis-à-vis its goal, but we should be very rigorous in our analysis. The belief of stagnation or a belief that we can only have minor benefits comes in the way of applying the principle. Minor benefits come only when dealing with minor issues and not the core issue. Most cost reduction initiatives across departments come from this belief of stagnation. Many times, such cost reduction initiatives provide only temporary benefits and costs go back to original level within no time. When we deal with core problem, we end up not only reducing costs on a sustainable basis but also exploit the loss sales opportunities. Usually getting additional sales from the same operating expense has more dramatic effect on profits than multiple cost reduction initiatives.

So, the **fourth principle** is the principle of infinite potential or in other words a belief that in every situation substantial improvement is possible. The fourth principle helps in overcoming the mental obstacle towards the application of the principle of inherent simplicity.

Industry specific, organization wide applications of TOC

Logical thinking process tools were invented by Eli to apply the above core principles, analyze organizations in a holistic manner, solve the chronic conflicts and develop robust solutions.

As discussed, at any point of time, an organization can have one constraining area (or core issue) which limits the ability of the organization to make more money. This constraining area can be in manufacturing (not able to deliver despite having a good backlog) or distribution (not able to make right product available at right place) or new product development (a faster pace of development will increase rate of sales) or the market (sales is stagnant and price reduction appears as the only way to increase sales).

So, over the last several years, the functional area solutions have been evolved in areas like Operations, Distribution, Projects, Sales process, Finance & Measurement and Decision making.

Vector Consulting Group (www.vectorconsulting.in), is the largest Theory of Constraints (TOC) consulting firm in Asia. The firm has been working closely with well-known companies across industries to help them build unique operations and supply chain capabilities that can be leveraged as a competitive edge in the market. Vector now has the highest number of success stories in Theory of Constraints Consulting and has also won several national and international awards for their work.