
HOW TO IDENTIFY AND UNLOCK INHERENT POTENTIAL WITHIN ORGANIZATIONS AND INDIVIDUALS USING A SYSTEMS APPROACH

*Developing and testing a new simplified Theory of Constraints based
5 –Day Constraint Analysis Workshop with special focus on the
application to the Public Sector*

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Declaration

I declare that the research project, **How to Identify and Unlock Inherent Potential within organizations and individuals using a Systems Approach**, is my own, unaided work and that each source of information used has been acknowledged by means of a complete reference. It is submitted in fulfilment of the degree of Doctor of Philosophy – MOTI, at the Da Vinci Institute of Technology Management. This dissertation has not been submitted before for any other research project, degree or examination at any university.

A handwritten signature in black ink, appearing to be "A. Barnard".

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Abstract

Almost every organization and person today, more than at any other time in history, face the challenge of achieving more (goal units) with the same or even less (resources) in less time due to large and sometimes growing gaps between stakeholder expectations and the actual level of performance. For Private Sector organizations, this challenge manifests in the continuous pressure to close the growing gap between actual and expected returns for shareholders. For Public Sector organizations, the challenge manifests itself in the growing demand for services such as in education, energy, health and safety and the (in)ability of most of the Public Sector, especially in developing countries, to meet this growing demand. For individuals, the challenge manifests itself in the difficulty and gap in achieving and maintaining a balanced and fulfilling life.

Organizations and individuals respond to such gaps by investing their limited resources and time in making changes to those parts of their "systems" where there are major gaps or opportunities for improvement, with the expectation that most, if not all of these changes would be successful in contributing to achieving more "goal units" for their systems. Unfortunately, studies published since the early 1990's (e.g. The Chaos Report on IT project failure rates, McKinsey Study on TQM Program failure rates, CSC Study on Merger failure rates and Linton, Matysiak & Wilkes study on new product failures) confirm that, regardless of the type of change or type of system being changed, a failure rate of between 50 % and 70 % is common and the situation at schools, healthcare institutions, governmental and non-profit organizations are not any better (Senge, 1990). The same research studies also hint at a vicious cycle – the major consequences of these high failure rates on people are higher resistance to change and lower expectations for future changes. But these two factors are also reported as two of the major causes of the high failure rate. The resulting vicious cycle trapped a significant amount of inherent potential within systems, making it appear as if it is not possible to achieve more goal units (at least not without a major investment in resources and time). As long as this inherent potential is hidden, it is unlikely that the large and sometimes even growing gaps between expectations and reality can be closed.

The question this research study aimed to answer is “How can we identify and unlock inherent potential within organizations and individuals?”, especially considering the challenge of differentiating between the many parts and processes of a system that can be improved on (low-leverage) and the few (high-leverage) parts or processes that must be improved to get more goal units.

My Research Hypothesis was that “It is it possible to develop a generic approach to identify and unlock inherent potential that is simpler, faster and better (than prevailing practices) to at least ensure that the majority of the changes we make within organizations and to our own lives succeed to help us achieve more goal units. This Research Hypothesis is based on three initial premises that, together with the Research Hypothesis, were validated with the proposed Research Method. These premises included that “Any system or situation can always be improved” (Ford, 1926), that “Every complex problem always has a simple solution” (Goldratt, 2000) and lastly that “It is our limiting assumptions about reality and the resulting actions or non-actions, rather than limiting conditions within reality, that limit or block us from seeing and/or unlocking inherent potential” (Senge, 1990).

The Research Method selected to validate (or invalidate) this hypothesis involved a literature review to validate the extent, consequences and causes of the Research Problem as well as to review past initiatives to solve the problem in order to identify remaining gaps in theory and/or implementation. The next step of the Research Method was to review all the latest insights and developments on General System Theory and specifically within Theory of Constraints, one of the most successful “Systems Approach” based management philosophies over the past 30 years (Mabin & Balderstone, 1999). From this review I could then develop a new conceptual model and associated process that could be validated first with my peers in the Theory of Constraints (TOC) expert community, then tested within the Private Sector, then with individuals and finally within the Public Sector.

In this PhD Research Thesis, I present the justification and design of a new simplified conceptual model as well as a simple 5-day step-by-step “constraint analysis process” that have been proven, through rigorous logical and field tests, to be simple, universal and scalable enough to be successfully used in both Private and Public Sector

organizations as well as with individuals to help them identify and unlock inherent potential

My new conceptual model reveals how it is the "limiting paradigms" held by many managers and individuals related to how best to deal with the common challenges they face - the challenges of inherent constraints, complexity, conflicts, uncertainty and undesirable behavior of people (bad choices) - rather than inherent limitations within the organizations or individual themselves, that are blocking them from "seeing" and unlocking inherent potential. The new conceptual model shows that it is possible to get individuals and groups of stakeholders within even the most complex type of organizations to replace these "limiting paradigms" with a set of "enabling paradigms" that, when combined with the practical, and inclusive 5 day constraint focused improvement process I developed and tested during this research, enable all stakeholders to contribute and reach consensus on the five questions related to any change: "Why Change?", "What to Change?", "What to Change to?", "How to cause the change?" and "How to measure the change to drive ongoing improvement?".

The Research Problem and the new conceptual model and process were first validated with the leading experts from the TOC community at the 2003 Annual TOCICO (Theory of Constraints International Certification Organization) Conference in Cambridge and was then successfully tested within the Private Sector, initially within large South African organizations such as Renwick Recruitment, African Explosives and SAB Miller and then within large international organizations such as Seagate, Ditch Witch, Cisco Systems and Tata Steel.

The next test was with individuals where I tested the 5 day process on young adults from around the world in a program called "The Odyssey Program" where participants use the conceptual model and a simplified version of the TOC Thinking Processes that I develop to help to set and identify how to achieve ambitious goals and/or make important life decisions. The program has been a resounding success and has become an annual event with requests to roll the program out, especially to developing countries, to be hosted as regional programs with facilitators that were trained on the new conceptual model and processes.

The final test of simplicity, repeatability and scalability was the test within the Public Sector, which was done in partnership with InWEnt (Capacity Building International, Germany) and the UN Development Program to improve "Solid Waste Management" within four large African cities. The results achieved, after only 5 days with representatives of each of the major stakeholders that included national government, local government, private contractors, and the community and enforcement agencies, have surprised even the biggest skeptics and is now being rolled out to be tested in other areas by InWEnt and the UN DP.

The new conceptual model and new TOC Thinking Processes that I developed as part of this research has been formally adopted as part of the published TOC Body of Knowledge and is being used by more and more companies globally, especially by early adopters in Japan, after the methods I developed were included in a book titled "Introduction to Holistic Problem Solving" that became the best selling business book in Japan in 2008.

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LIST OF ABBREVIATIONS

CCPM:	Critical Chain Project Management
CW:	Cost World
DE:	Desirable Effect (used in TOC)
ERP:	Enterprise Resource Planning
GST:	General Systems Theory
IO:	Intermediate Objective (related to what is needed to overcome an Implementation Obstacle as used in TOC)
OBS:	Obstacle (related to implementation of a specific change)
PM:	Project Management
PUDE:	Potential Undesirable Effect
SWM:	Solid Waste Management
ST:	Systems Thinking
S&T:	Strategy and Tactics
TA:	Throughput Accounting
TOC:	Theory of Constraints
TOCICO:	Theory of Constraints International Certification Organization.
TP:	Thinking Processes (of Theory of Constraints)
TQM:	Total Quality Management
UDE:	Undesirable Effect (used in TOC)
UN DP:	United Nations Development Program
5FS:	Five Focusing Steps (of Theory of Constraints)

Chapter 1 **Introduction**

This chapter provides an overview of the background to the research problem, the specific research questions, the main hypothesis of the research, the method used for formulating, validating and improving the hypothesis, a listing of the research laboratories (organizations) where the new process was tested, definitions of key concepts and terminology used in the research and ends with a summary of how the rest of this research dissertation is structured.

1.1 Research Background – A personal perspective

All my life I have been passionate about finding new, innovative ways to identify and unlock inherent potential within individuals and, later on, within organizations around the globe. This goal played a large role in my selection of which direction I studied and later, which organizations I joined and worked with to gain the experience I believed necessary to move me closer to my goal.

Once you make a decision about your life's goal, it is a double edged sword. On the one side, it provides you with great focus in life and provides a simple way to validate each of your actions, decisions and experiences in your life. Is it or can it move me closer to my goal? If yes, it is great and you go for it. If not, then simply stop doing it. Considering that the real constraint in all our lives – the one thing that, if we had more of it, we could achieve more of our own goal units – is time. Having a way to focus our limited time on what really matters is, I believe, a necessary condition for living a full life. On the other hand, having a clear goal puts a major burden and responsibility on your shoulders. You do literally start judging every action, decision and experience based on whether it will move you closer or further away from your goal in life. When you realize you are busy with an activity, or you are within a job or even a relationship that is not helping, it can cause frustration and stress unless you consciously decide that even such situations can be learned from. How and why did I get here? Can I turn it into a learning experience? How do I get out of the situation without hurting anyone? So, why specifically is my goal in life stated as "finding ways to help myself and others see and unlock inherent potential"?

Some people complain they don't have enough opportunities in life. Others complain they don't have the means or ability to capitalize on opportunities even if they did receive or create them. Both are necessary conditions for a full and happy life, but one without the other leads to frustration, stress and even resentment and blame.

My goal and the objective of my PhD thesis is to show that we can all SEE or CREATE enough opportunities (we just need to learn where and how to look) and that we all (individuals and organizations) already have the MEANS and ABILITY (or can normally relative easily and quickly acquire these) to capitalize on enough of these opportunities to be happy and successful.

In Dr. Eli Goldratt's latest book, "THE CHOICE", he mentions a viscous cycle of how we develop intuition about things we are passionate about - we get the energy and courage to act and develop intuition from our goals in life like being a great father, being the best within our field or coming up with an original idea/invention. It is this intuition that allows us to develop and test viable hypothesis to gain a deeper understanding of the underlying cause-effect patterns which, in turn, as we discover more and more (sometimes what works and more frequently what does not work), makes us more passionate (emotional) about our goal. This again provides us with the energy and courage to act to develop even more intuition. This was exactly the viscous cycle I have experienced in my own life. And every time I catch myself drifting off, I find ways to learn from the experience and to get back on track.

1.2 Research Background – A business perspective

There are many differences between Private and Public Sector organizations and also between organizations and individuals, but there are at least two common factors (Clegg, Hardy & Nord, 1996). Firstly, organizations and individuals are both complex adaptive systems (social systems) that are very difficult to analyze, improve, manage and predict the impact of change on their performance and both share two fundamental needs – survival (stability) and growth. Secondly, both organizations and individuals, now more than any other time in history, are under continuous pressure to find innovative ways to "achieve more (goal units) with less (resources) in less time".

For Private Sector organizations, this challenge manifests in the continuous pressure to close the gap between actual and expected short and long term returns for shareholders, while, for Public Sector organizations, the challenge manifests itself in the

ongoing pressure to close the large and frequently growing gap between the deteriorating levels of service delivery and infrastructure and a growing demand for such services in the areas of health, safety, education, energy and telecommunications - especially in the developing countries around the world. For individuals, the challenge manifests itself in the difficulty to maintain a balance within the various aspects of our lives – some struggle with gaps in their self-confidence, others with gap within their health, some with gaps in their relationships and others, gaps between their expenses and income.

It is these gaps between an individual's or organization's expectation and their reality that can result in vicious cycles of over- and under-reactions (becoming paralyzed when the gaps become so big or there are so many of them that we don't know how and where to start). However, it is also these gaps that serve as a constant reminder that there must be a simpler, faster and more reliable way to identify where and how to improve our lives or organizations.

"Innovate or Evaporate". This dramatic call for action was initially directed at Western Manufacturers by Robert Tucker (Tucker, 2003) and recently renewed in his best seller "Driving Growth through innovation" (Tucker, 2008) to include all organizations and individuals (all social systems). Tucker argued in his original article, like so many before him, that, with a growing gap, small incremental improvements in internal efficiencies and productivity is simply not sufficient to secure survival and prosperity.

Organizations (and individuals) that want to "survive" and prosper need frequent breakthrough innovations to achieve sustainable growth. Prof. Larry E. Greiner, in his Harvard Business Review article of 1972 titled "Evolution and Revolution as Organizations Grow" (Greiner, 1972) was the first to coin the terms "Evolutionary" and "Revolutionary" to depict the nature of changes organizations make as they grow. He argued that incremental improvements come from "evolutionary changes" but that breakthrough improvements (step changes in performance) come only from revolutionary changes. However, revolutionary changes always carry with them the risk of causing instability and even performance decay that could threaten a system's survival. At the same time, it is important for organizations and individuals keep making small incremental improvements in all areas to establish a culture of continuous improvement.

Figure 1 shows the uncertainties within a growth cycle of a social system in relation to when they should make changes (and more importantly when not to), also the uncertainties around the possible consequences of what type of change to make (or not to make) – growth (large improvement), continued stability (small improvement or decay in performance) or rapid decay (catastrophic failure that can kill the system).

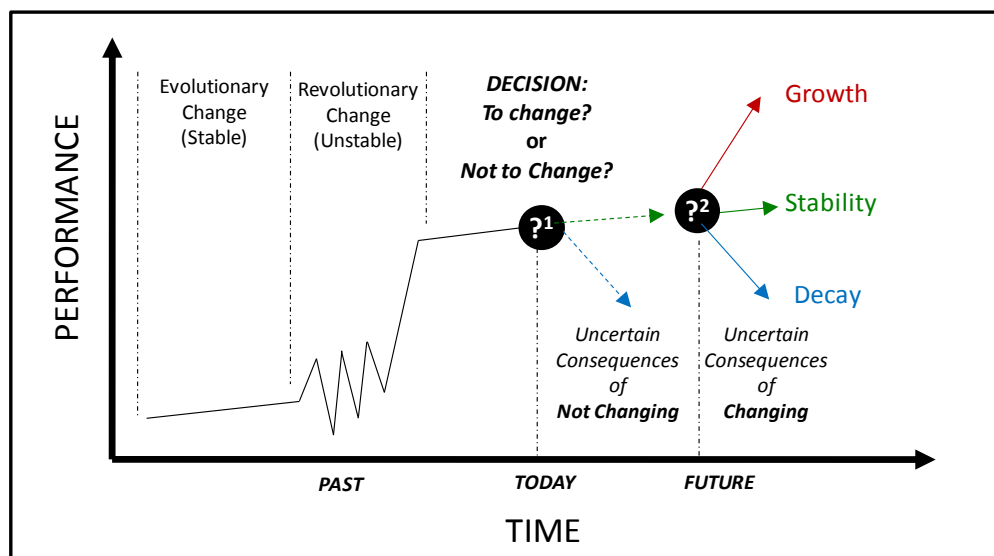


Figure 1 Evolutionary vs. Revolutionary Change and the related uncertainties

Source: Adapted by Barnard from graph by Larry E. Greiner (Greiner: 1972)

So managers and individuals know that to continuously improve they have to make changes, sometimes even revolutionary changes. However, those with experience also know that most changes do not result in improvement. In fact, research studies across many different types of change initiatives (1995 Chaos Report on IT projects, 1990 McKinsey Report on TQM projects, 1995 John Kotter Study on Organizational Transformation projects) share a common conclusion. Firstly changes are more likely to fail (or be stopped before completion) than they are to succeed (making it a safer option to say “*It will never work*” than to embrace a proposed change as people are encouraged to do). Secondly, these studies found that the larger the change the higher the probability of failure (or being stopped before completion). This means if you say “It will never work” you are more likely to be correct.

The literature review conducted as part of this research identified an interesting paradox.

- Considering the high failure rate of most changes, it is no surprise that most of the studies identified two major consequences of the high failure rate – firstly most people resist change (especially the “revolutionary type of change that can result in either rapid growth or rapid decay) and secondly, those who do not resist the change (over time) have a significantly lower expectation about both the likely success rate and impact of changes.
- Many of the studies did not only qualify or quantify the extent and consequences of the high failure rate of change, but also analysed the most likely causes. Again, there is a remarkable consistency in their findings. Most of the studies list two main causes: “Resistance to change” (especially by middle managers) and “Lack of active support and/or under-resourcing by top managers”, frequently because of relatively low expectations of the likely benefit of the proposed change.

When a specific behaviour is both a consequence and a cause, it means we are stuck in a vicious cycle (Senge, 1990). The higher the failure rate, the higher the resistance and the lower the expectations become. And the higher the resistance and the lower the expectations, the more likely those necessary changes will be blocked and/or that necessary changes will not receive the full support and resource needed to make them a success, which again increases the probability for failure. Over time, a vicious cycle such as these stabilizes (research studies conducted in 1990, 1995, 2000 and 2005 all show similar failure rates) and soon those trapped within the cycle concludes that, considering the complexity and uncertainties within their system, this (high failure rate) is probably the best they can do.

But how do we know that a system (whether the system is an organization or a single person) whose performance has stabilized cannot achieve a much higher level of performance with the same starting conditions (i.e. without any significant investment of time or capital)? And even if we knew that such inherent potential did exist, how would we go about “unlocking” this inherent potential effectively and efficiently, without triggering “resistance to change” and without exposing the system to a potential decay in performance?

The aim of this Research is to find and test a generic solution for these two challenges. In honour of the work done by Dr. Eli Goldratt, inventor of the Theory of Constraints (TOC), that aims to provide simple and practical thinking processes and generic

constraint focused solutions to put organizations and individuals on a “red curve” of continuous improvement, I have called this “The Red Curve Challenge” (Figure 2).



Figure 2 The Challenge to identify and unlock inherent potential within organizations and individuals

Source: Barnard (2007), The Red Curve Program

During this research project, I was a director of the Goldratt Group, responsible for Africa as a region as well as CEO of Goldratt Research Labs where I had the opportunity to work with Dr. Eli Goldratt on spearheading development of new generic solutions for the more complex type of environments. These challenging environments often provided me with opportunities to make new contributions to the TOC body of knowledge through the necessity of inventing new processes or solutions, simplifying processes where they were still too complicated or finding new ways to apply and/or adapt existing processes to situations where no generic solution previously existed. During 2003 to 2005 I served as the Chairman of the Theory of Constraints International Certification Organization (TOCICO) board and from 2007 to 2009 as Chairman of the Certification Committee.

1.3 Research Questions and Hypotheses

Today, more than in any other period in history, there is enormous pressure on managers within both Public and Private Sector organizations to find new innovative

ways to achieve sustainable improvement and growth – achieving more with the same or less resources in less time.

The main question this research aims to answer is:

“How can we identify and unlock inherent potential within organizations and individuals?”

Related to this main research question, there are three sub-questions:

1. ***How do we know whether there is “inherent potential” to unlock?***
2. (If it does exist) ***What really limits or blocks organizations and individuals to “See” and “Unlock” this inherent potential?***
3. ***Is it possible to design a simpler, faster and better conceptual model and process that will be generic enough to apply to both organizations and individuals?***

Where:

“Simpler” means the process *can be applied to most, if not all types of organizations or persons.*

“Faster” means the process itself *takes days, rather than weeks or months to complete.*

“Better” means the process *has a high probability of achieving faster, better and more sustainable results compared to those used for previous change initiatives.*

1.4 Research Hypotheses

The main research hypothesis is that:

“It is possible to design a simpler, faster and better conceptual model and process that will be generic enough to enable both organizations and individuals to identify and unlock inherent potential (for achieving more goal units)”.

The research hypothesis is based on the following three initial premises that will, together with the research hypothesis, be validated (or invalidated) with the proposed research method:

1. *"Any system or situation can always be improved"* (Ford, 1926)
2. *"Every complex problem has a simple solution"* (Goldratt, 2000)
3. *"It is our limiting assumptions about reality and the resulting actions or non-actions, rather than limiting conditions within reality, that limit or block us from seeing and/or unlocking inherent potential"* i.e. "The bottleneck is always at the top of the bottle" (Gary Hamel, HBR) which is true for both organizations and individuals.

The initial "minimum requirements" for the process design was that it must be based on a "Holistic" or "Systems Approach" (rather than a Reductionist or Local optima approach), that the analysis must be based on falsifiable "effect-cause-effect" thinking processes (rather than analysis by consensus), that a trained (not necessarily experienced) facilitator could complete it within 5 days or less and that it must include "Safety Nets" – if we miss something in step 1 or made a wrong assumption, it should come out in step 2 or 3 or 4 or at least quickly during implementation.

1.5 Research Method

I decided to use an "Action Research" method for this research project (Figure 3). Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously using a set of plan, act, observe & reflect research cycles. Thus, there is a dual commitment in action research to study a system (using scientific methods) and concurrently to collaborate with members of the system in changing the system from what is (together regarded) as an undesirable to a desirable situation. Accomplishing this twin goal requires the active collaboration of researcher and client, and thus it stresses the importance of co-learning as a primary aspect of the research process. [Gilmore, Krantz, Ramirez, 1986).

Therefore, the three main reasons for using the "Action Research" method include:

- *Action research is **used in real situations**, rather than in contrived, experimental studies.*
- *It is based on a **win:win:win** for "client", researcher and field of study.*

- It is based on a **scientific and systems approach** for doing research – i.e. it explicitly aims to validate/invalidate/create & test new hypotheses.

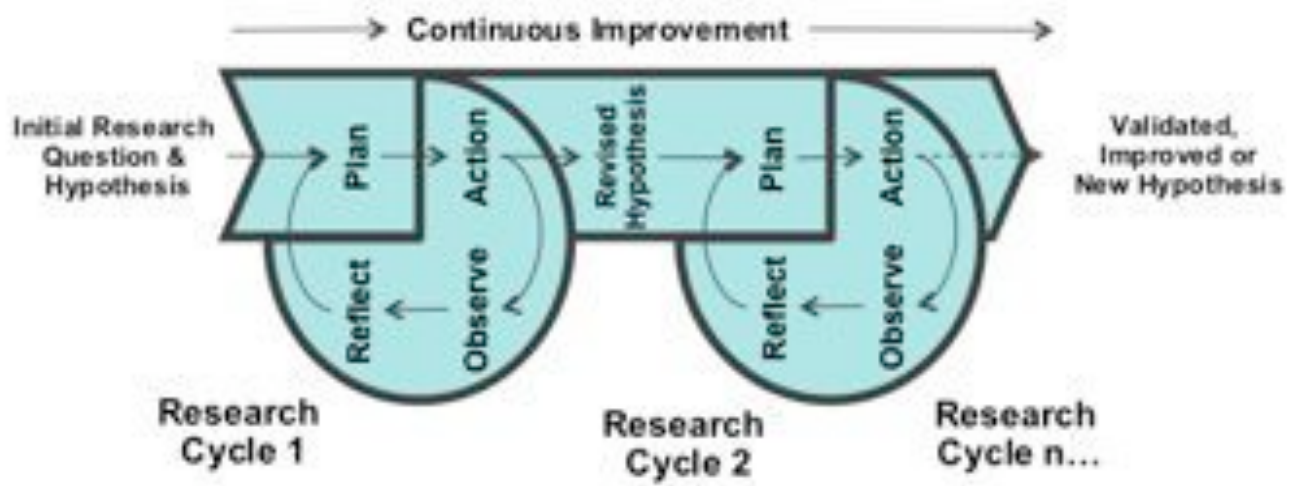


Figure 3 Action Research Method (Source: Adapted from Gilmore et al 1986)

The action research method followed for this research project included seven steps listed below:

- Step 1: Review relevant literature to confirm the extent, consequences and causes of the research problem and gaps in existing theories and/or methods that explain why the research problem remains a frustration for many managers and individuals.
- Step 2: Develop a Conceptual Design that has the potential to be simpler, faster and better.
- Step 3: Test the design with my peers (Certified TOC Practitioners and Implementers) to validate whether they will agree with the research problem and hypothesis and that the new conceptual design can potentially be simpler, faster and better than current TOC processes to the extent that (after validation with testing) it will be accepted into the published TOC Body of Knowledge.
- Step 4: Test the Design within the Private Sector.
- Step 5: Test the Design with the more complex case of an individual – young adults and spouses of TOC practitioners.
- Step 6: Test the Design with the most complex case – a Public Sector organization or system in a developing country.

Step 7: Analyse the results to validate/invalidate the main and/or sub-hypothesis and make recommendations for applicability and further research.

1.6 Scope of Research Laboratories

The Goldratt Group has a wide customer base within Africa and around the world that includes both Private and Public Sector organizations. Since the stated goal of all Goldratt Group projects are to achieve (much) more goal units with the same or less resources in less time (than what was previously thought possible), Goldratt Group projects provided an ideal research laboratory to identify potentially generic causes and consequences of success and/or failure.

Projects by Goldratt Consulting, the consulting arm of the Goldratt Group that partners with for-profit organizations, are called "Viable Vision" (VV) projects. They are called "Viable Vision" projects since this concept captures the essence of the focus of these projects. Creating a "Vision" means identifying a decisive competitive edge that will enable the company to satisfy its customers and meet a very ambitious growth objective. Ensuring this Vision is "Viable" means identifying the necessary and sufficient conditions to build, capitalize on and sustain this competitive edge, mainly through strategy-, supply chain- and business process- and policy innovation. Generally, Goldratt Consulting would be asked to also contribute in the implementation of these projects, with typically 90 % of their fees being based on actual results.

During this period, the Goldratt Group in Africa and Goldratt Research Labs also partnered with not-for-profit organizations such as InWEnt and the UN Development Program on their Capacity Building initiatives within developing countries to help identify the necessary and sufficient conditions for Public Sector organizations such as City Councils and hospitals to help make their own visions viable.

I acted as Project Leader or Project Auditor on a number of projects within both the Private and Public Sector. Experiences gained here, combined with the insights gained from the literature review, enabled me to develop a hypothesis around what previously blocked these organizations from seeing and/or unlocking inherent potential and what insights and processes are needed to remove this blockage. This hypothesis was then systematically validated/invalidated/improved on through creating simulation models, doing role plays and finally studying the results of actual implementations and participant feedback.

My research on Private Sector Organization projects included studying TOC implementations at the following companies:

- A South African medium sized Aircraft and Parts Manufacturer with a Viable Vision target to turn the company around to profitability from net losses of R200 million p.a, within 3 years.
- A South African large Bread and Flour Manufacturer and Distributor with a Viable Vision target to increase Net Profit from R20 million to R2 billion p.a. within 5 years.
- A large International Steel Manufacturer with a Viable Vision target to increase Net Profit from \$250 m to \$1.25 billion p.a. within 4 years.
- A large international Manufacturer and Distributor of Heavy Machines with a Viable Vision target to increase Net Profit from \$250 million to \$500 million p.a. in a generally flat market within 3 years.
- A large international Book Publishing Company with a Viable Vision target to increase Net Profit from \$150 million to \$300 million p.a. within 3 years in a declining market.

The second research laboratory involved the application of the hypothesis and new analysis and innovation process to individuals (specifically young adults between 16 and 30 years old). The program is run over 5 days and participants attend to learn the principles and thinking processes needed to overcome constraints or obstacles that block them from setting and achieving ambitious personal goals.

The Program's direct objective is to help individuals identify and unlock their inherent potential. This program is called "The Odyssey Program" and is run annually at an international destination with between 80 and 120 participants from around the world. This research included the analysis of the results and lessons learned from three such programs (2006, 2007, 2008).

The major focus of the research and the third research laboratory was the Public Sector, due to its higher level of complexity and larger number of stakeholders involved. This research involved a partnership between Goldratt Group and InWent (Capacity Building International) to help selected City Councils in Africa within their Solid Waste Management Meta-Systems with closing the very large and growing gap between waste created and waste collected and recycled or disposed.

1.7 Research Terminology and Key Concepts

In this research there are specific terminology and concepts which have alternative meanings or which have not been clearly defined before in publications. This list below provides definitions of the key terminology and concepts used in this dissertation.

1.7.1 Systems Approach

When organizations are encouraged to follow a “Systems Approach”, this generally means they should follow a Holistic, Logical and Inclusive approach to analyse and improve their organization. Goldratt (1990) states that one of the fundamental beliefs in the “hard sciences” is that *“the performance of any system is governed by a small number of fundamental causes”*. These “small number of fundamental causes” are called the “leverage points” of the system – the places where a relatively small change could result in a significant improvement to the system as a whole. When we analyse any system to find the leverage points (Barnard, 2003) , “we should look at the system from both a *physical flow view* (inputs, system, outputs, feedback and influencing stakeholders) as well as from a *logical flow view* to understand why the system’s throughput differs from expectations. (Effects, Starting Conditions, Rules and Goals)”.

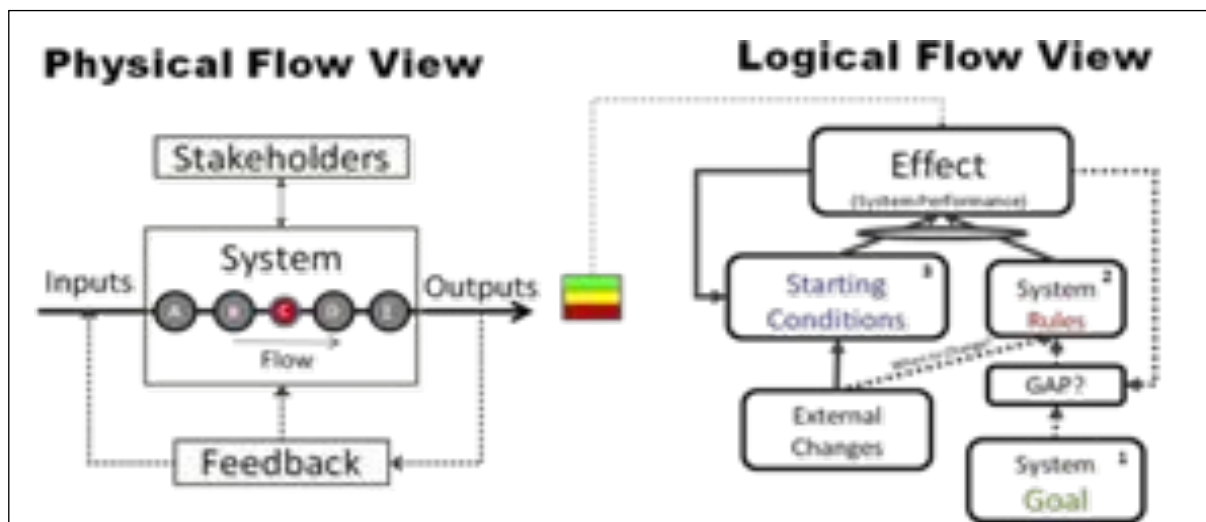


Figure 4 Physical Flow vs. Logical Flow Views of a System

Source: Barnard (2004) *A Simplified approach to Identify and Unlock Inherent Potential*

System Leverage Points can generally be classified into three types:

- I. The System STARTING CONDITIONS
 - a. e.g. Inputs, Stakeholders and Resources

II. The RULES used to manage the "System"

a. E.g. Planning, Execution and Feedback Rules

III. The GOAL/TARGET of the System

Methods based on the "Systems Approach" also recognize that "not all leverage points are created equally" – you get low- and high-leverage points based on the magnitude of the impact of changes in these points. When we look at utilizing the three types of leverage points above, the sequence should be first changing the goal, then the rules and only then the starting conditions (structure). I.e. start by setting very ambitious goals – ambitious to the extent that we consider them "unrealistic" because it is only when we consider a goal "unrealistic" that we will be open to challenge the "rules" (our assumptions and related policies, processes and measurements). Only then should we think of changing the starting conditions.

1.7.2 Innovation vs. Invention

Defining innovation requires a distinction between innovation and invention, since, in common language, these two words are frequently used interchangeably, but in fact they have very different meanings in the context of general research and specifically in the context of this research project.

Invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to apply the idea to create value. Roberts (1991) said that the result of invention is a new product or process, whereas the result of innovation is new value created through the use of the product or process. Kanter (1988) describes innovation as "*the process of bringing any new problem-solving idea into use*". It is the generation, acceptance and implementation of new ideas, processes, products or services. It can thus occur in any part of a corporation, and it can involve creative use as well as original invention.

For this research, invention will refer to the development of mental models and methods while "innovation" will refer to the new application of these new and past inventions to bring value to the organizations and individuals that apply them.

1.7.3 Theory of Constraints vs. Constraint Management or Constraint Theory

The Theory of Constraints (TOC) is a body of knowledge that was first developed by Dr. Eli Goldratt and has continued to evolve over the past 30 years through frequent inventions and innovations by Dr. Goldratt and other TOC practitioners around the world. This evolution has taken place through the ongoing application of the mindsets and methods of the "hard sciences" to develop new insights into the "science of managing organizations" – i.e. developing better, faster and simpler ways for analyzing, managing, continuously improving and predicting the performance of organizations. The most important of the mindsets of the hard sciences used by TOC, is the simple premise that "all complex systems are governed by inherent simplicity". The essence of this principle is captured within the statement that "the strength of any chain is governed by only the strength of the weakest link". The application of this basic premise as a focusing tool, enabling us to differentiate between the MANY parts, processes and relationships within a system that CAN be improved, from those FEW that MUST be improved to get more goal units.

TOC, as a body of knowledge, has seen tremendous development and expansion over the last 20 years (Figure 5). Over this time period, TOC has evolved into a new holistic management philosophy and approach, both to determine what is really limiting or blocking further improvement in your chosen subject matter or system and also how to identify and implement the necessary and sufficient solution to overcome these limitations in a way that will achieve the buy-in and active contribution of all the key stakeholders.

The TOC body of knowledge consists of five parts (Barnard, 2003): TOC's Five Focusing Steps, TOC's Thinking Processes, TOC's Throughput Accounting, TOC's Necessary but not Sufficient Questions for Technology and TOC's generic solutions for each of the eight parts of managing organizations (operations, finance, logistics, projects, sales, marketing, people and strategy).



Figure 5 Evolution and growth of Theory of Constraints over past 30 years

The terms Constraint Management (CM) or Constraint Theory (CT) are sometimes used (mainly by authors not really familiar with TOC) as a synonym for TOC, normally referring to one of the applications or aspects of TOC (rather than to TOC as a management philosophy). This can be confusing to novices, as CM or CT has its origins in other fields such as Mathematics, Software and Engineering Design and Economics. For this research, only "Theory of Constraints" or "TOC" will be used to refer to "Goldratt's Theory of Constraints".

1.7.4 System Constraint vs. Constraining Factors or Core Problems

A System Constraint, in the context of TOC, is "any internal resource or source of supply or demand that limits the system's ability to achieve more goal units" (Throughput). In organizations, a System Constraint can therefore be either internal (capacity, time or cash) or external (supply of some scarce material/skill or market demand). Goldratt (Goldratt, 1990) originally defined a System Constraint as "anything that limits a system from achieving higher performance versus its goal". This, more open definition, allowed many TOC authors (Dettmer, Schragenheim, Ptak and even Goldratt himself) as well as TOC practitioners to start to refer to different types of Constraints – Capacity Constraints, Policy Constraints, Behavioural Constraints, Measurement constraints etc. Although convenient from a classification view point, this had a major negative consequence. TOC practitioners started confusing the System's Throughput Constraint (that should be better exploited or elevated to increase goal units) with those policies; measurements etc. that currently block better exploitation or

elevation of the System's Throughput Constraint. When such confusion happens, it could result in a TOC practitioner looking for policy or measurement constraints without ever identifying the System's Throughput Constraint, which actually makes it impossible to judge whether a policy or measurement is really contributing to constraining system throughput or not. It is a similarly futile exercise as trying to identify a System Constraint when a clear goal has not been identified. This confusion started happening at such a scale that Dr. Goldratt made a public apology at the annual TOCICO (Theory of Constraints International Certification Organization) conference in 2006 for using terms such as "policy constraint" and asked the community, in future, to reserve the use of the term "System Constraint" only to refer to the System's Throughput Constraint that limits the flow of goal units through the system. And similar to the definition that "Every chain has only one weakest link", in organizations, each independent supply chain has only ONE Throughput Constraint. *Any internal policy, measurement, behaviour and the underlying beliefs and assumptions that blocks better exploitation or elevation of the System Constraint should rather, as used in this Research Report, be defined as 'core problems' or 'local optima rules'.*

1.7.5 Complex Systems vs. Simple Systems.

In the "soft sciences" and every day language, we tend to say a system or problem is "complex" when the system or problem has many parts and or there are many or apparently unknown interdependencies between parts. This "detailed" complexity makes the system appear complicated and more difficult to identify causes and/or predict the impact of changes on the system. In the hard sciences, a system or problem is "complex" only when it has many degrees of freedom, regardless of the number of parts or interdependencies. In the context of Systems Theory, the term "degrees of freedom" refers to the number of system variables (normally few), that, if changed, can make a significant impact on the system performance, in contrast to the many variables, where even significant changes will have an insignificant impact on the system. In the hard sciences it is believed that all systems, even those that appear very complex to us, are governed by inherent simplicity – there are very few rules that govern the behaviour of the system and these rules are normally simple compared to the perceived complex nature of the systems.

This research adopted the definition and beliefs of the hard sciences for "Complex Systems" – that any system, even those that have many parts and/or those whose

parts behave in “complex ways”, are governed by inherent simplicity. This means we can, if we just know where and how to look, find the few governing “rules” that provide us with the leverage points to make significant improvements in system performance and predictability by making relatively few changes to a few of its parts.

1.7.6 Types of Complex Systems

We can classify systems into three types, each with specific characteristics that contribute to its complexity and impact our ability to analyze, improve, manage and predict their performance.

Mechanical Systems: A mechanical system’s complexity stems from two characteristics – statistical fluctuations in the performance/behaviour of each part and interdependencies between these parts. A system with these characteristics, even one with only a few parts, can be difficult to manage and predict due to the unpredictable (but deterministic) way that variation and interdependency between parts impact the system performance. As an example, a system with three parts whose individual outputs fluctuate between 1 and 6 with a mean of 3.5 (like the throw of a dice) and which are connected in series (part A feeds part B and B feeds C) will not have a mean output of 3.5 but a mean output of 3 and if we need to improve the system, it is (to most) not immediately apparent what is causing this gap and how to correct it.

Biological Systems: A Biological system is more complex (more difficult to manage and predict) than a mechanical system, since its total performance is not only impacted by the statistical fluctuations and interdependencies between parts, but also by the feedback loops that biological systems have. A biological system with good feedback rules should outperform an equivalent mechanical system, but, one with bad feedback rules (e.g. over-reactions like the allergies that some humans suffer from) will perform worse than a mechanical system.

Social Systems: A social system is by far the most complex, since its total performance is not only impacted by statistical fluctuations and interdependencies and feedback rules within and between parts, but each part also has the “choice” to decide whether to follow the rules or not. Imagine the consequences of your heart “deciding” it does not feel motivated enough to work today! Again, when good choices are made by parts that realize the system conditions have changed to the extent that different rules are required, a social system should outperform their equivalent biological or mechanical systems. However, if bad choices are made by one or more of the parts

(e.g. due to local optima or silo thinking), it might even perform worse than a mechanical system (e.g. the investment in feedback and choice made it worse).

Since this research is dealing with organizations and individuals – both social systems – I realized early on that “***we should never give choice, without giving*** (knowledge about) ***the consequences*** (of the possible choices on the performance of the whole system)”.

1.7.7 Definition of a Problem as an unresolved Contradiction or Conflict

In the “soft sciences” a problem is defined as anything that bothers members of the system or any situation where there is a gap between expectations and reality. In the “hard sciences”, a problem is defined as a contradiction between the effects predicted by current models and reality. When these contradictions are found they trigger further research to determine whether it is the assumptions in the existing models that are not correct or whether there was a mistake in the measurement of the current reality. Since there is a belief in the “hard sciences” that contradictions or conflicts cannot exist in reality, a typical scientific analysis normally starts with clearly verbalizing the “problem” being addressed as the contradiction between current models and observed phenomena and then proceeds to find a way to resolve the contradiction or break the conflict.

The essence of the beliefs within the hard sciences regarding complexity and contradictions (or conflicts) is captured within Sir Isaac Newton famous quote on the foundations of science: “*Natura valde simplex est et sibi consona*”, which, when translated, means “Nature is exceedingly simple and harmonious with itself”.

In this research, the definition of the “hard sciences” was adopted for “problem identification” – the process and methods for finding the unresolved contradiction or conflict that is responsible for the undesirable effects within the system.

1.7.8 Leverage Points and Leverage

The great Greek mathematician and engineer Archimedes discovered the laws of levers and pulleys in 230 BC. “*Give me a place to stand,*” he famously declared, “*and a fulcrum on which to place it, and I shall move the world*”. While it was clearly impossible to test his claim directly, Archimedes was challenged to move a ship whose positioning had required the co-operation of a large group of labourers. Using a

complex system of pulleys, Archimedes pulled the great vessel out of the water and onto the beach.

As far as social systems are concerned, the term “leverage point” is used in the context of small changes that have a non-linear impact (high leverage) on the system performance. A small change on a leverage point can result in a large improvement (leverage) of the system performance. A System Constraint, as previously defined, is therefore a major leverage point for improving system performance. Leverage is gained when we focus limited resources on identifying and changing only those (few) policies, processes and or measurements that drive decisions or behaviours that block better exploitation or elevation of a System Constraint.

1.7.9 Paradigms, Mental Models and Assumptions

In this research, a paradigm or mental model is defined as a set of assumptions that someone believes is valid. Assumptions drive our decisions and behaviours. Therefore, if the objective is to change behaviours or decisions which resulted in an undesirable effect for the system as a whole, we should focus on identifying and changing those assumptions that caused the incorrect decisions and/or behaviour. We refer to a “paradigm shift” when one or more of a person’s or group’s assumptions needs to be changed to achieve desirable rather than undesirable effects for the system as a whole.

[For a more detailed definition see 2.4.1 What are “paradigms” or mental models?]

1.8 Research Report Structure

The structure of this research report follows the research process and methods used to reach the research aim.

Chapter 2 will provide an overview of an extensive literature review that was conducted to validate the extent, consequences and causes of the research problem, starting with a review of the general theories (e.g. General Systems Theory) and moving to the more specific theories (such as Theory of Constraints). This chapter will also provide an overview of the specific solutions that have been developed and tested to date to identify the remaining gaps within the general body of knowledge and, specifically, within the Theory of Constraints, that still make it difficult to successfully

apply the theory to identify and/or unlock inherent potential within many organizations and for many individuals.

Chapter 3 will provide an overview of the research design criteria and a justification of how the proposed new conceptual design and process can reduce or even close a sufficient number of the remaining gaps identified in Chapter 2 to achieve the research objective. It details which of the existing theory and processes were used, which were adapted (to meet design criteria) and where new inventions were required to close the remaining gaps in the definition and/or communication of the necessary transition from limiting to enabling Systems Approach-based paradigms and a collaborative constraint analysis process. The Chapter ends with a design – a 5 day step-by-step constraint analysis process and participant workbook (See Appendix 4) to help both individuals and stakeholders systematically overcome each of the major challenges that can block the identification and/or unlocking of inherent potential within their lives or organizations.

Chapter 4 details the design of the initial tests and the results achieved from presenting the analysis of existing theory and practices as well as the proposed new conceptual model and 5 day constraint analysis process for peer review at the 2003 TOCICO conference in Cambridge. The chapter further details the initial testing of the 5 day process that was done within the Private Sector in South Africa and later with Global Companies in the USA, Europe and India as well as with individuals and the lessons learned from these tests.

Chapter 5 details the results achieved from the final testing in the most complex environment - the Public Sector - that was done in partnership with InWEnt and the UN Development Program. This Chapter provides an overview of the objective of the partnership, how the pilots were selected and the results achieved and lessons learned in the first four pilots with African cities.

Chapter 6 details the latest developments to expand the solution to include Planning and Execution Management to ensure results are achieved within the shortest possible time without jeopardizing stakeholder collaboration and/or sustainability. The solution involved the development of software that is based on the Theory of Constraints Thinking Process called "Strategy and Tactic Trees".

Chapter 7 provides a summary of the research conclusions to confirm that the initial research hypothesis was validated and improved on and provides practical

recommendations to managers and individuals on how to apply this process or modify their existing conceptual models and analysis processes based on the insights gained in this research and also makes recommendation for further research to close the remaining gaps.

Chapter 2 Review of Relevant Literature

This chapter will provide an overview of the literature review that was conducted to validate the extent, consequences and causes of the gap between expectations and reality in both organizations and individuals. It starts with a review of the general systems theories and then moves on to the more specific theories such as Theory of Constraints. This chapter will also provide an overview of the specific solutions that have been developed and tested to date to identify the remaining gaps within the general body of knowledge and, specifically, within the Theory of Constraints. These gaps still make it difficult to successfully apply the theory to identify and/or unlock inherent potential within many organizations and for many individuals.

2.1 Introduction

Over the past 30 years there has been a major advance in the “science” of understanding what it takes to continuously improve organizations in a sustainable way. Increasingly, managers are aware that achieving continuous and sustainable improvement will require mindsets and methods that are based on a Systems Approach of managing and improving organizations (i.e. considering the whole system and not just one or more of the parts). Major contributions have been made to help managers manage their organizations according to a “Systems Approach” by specifically Systems Thinking (ST) and Theory of Constraints (TOC) and also by methods such as LEAN, 6 Sigma and the Balanced Score Card (BSC). Despite the impressive reference bank of successes from these mainstream “organizational improvement approaches”, especially from Theory of Constraints (Mabin & Balderstone, 1999), they all seem to struggle with achieving higher levels of adoption (Kendall, 2005) and also with finding ways to reduce the significant percentage of failures – some even catastrophic.

Robert Millikan (1868 –1953), who received the Nobel Prize for Physics in 1946, said that *"Science walks forward on two feet, namely theory and experiment. Sometimes it is one foot which is put forward first, sometimes the other, but continuous progress is only made by the use of both - by theorizing and then testing, or by finding new relations in the process of experimenting and then bringing the theoretical foot up and pushing it beyond, and so on in unending alternation."*

This chapter therefore provides an overview of my analysis of existing theories that have contributed to solving the problem of enabling managers to identify and unlock potential as well as an analysis of insights gained in the field through experiments - leading a number of Private and Public Sector Organizational turn-around programs to identify the remaining gaps in the current bodies of knowledge for the purpose of meeting my research objective.

2.2 The Improvement Challenge

Organizations and individuals (Goldratt, 2005) face a decision when their performance is no longer improving at the required or desired rate. If they do nothing, they will risk decay of performance (the blue curve shown in Figure 6). If they decide to target small incremental or evolutionary improvements (what Goldratt calls the green curve) they will likely not meet their growth objective, while if they decide to target the step-change improvement or revolutionary improvement (what Goldratt calls the red curve) they risk the stability and even survival of their organization as revolutionary changes has a higher chance of catastrophic failures.

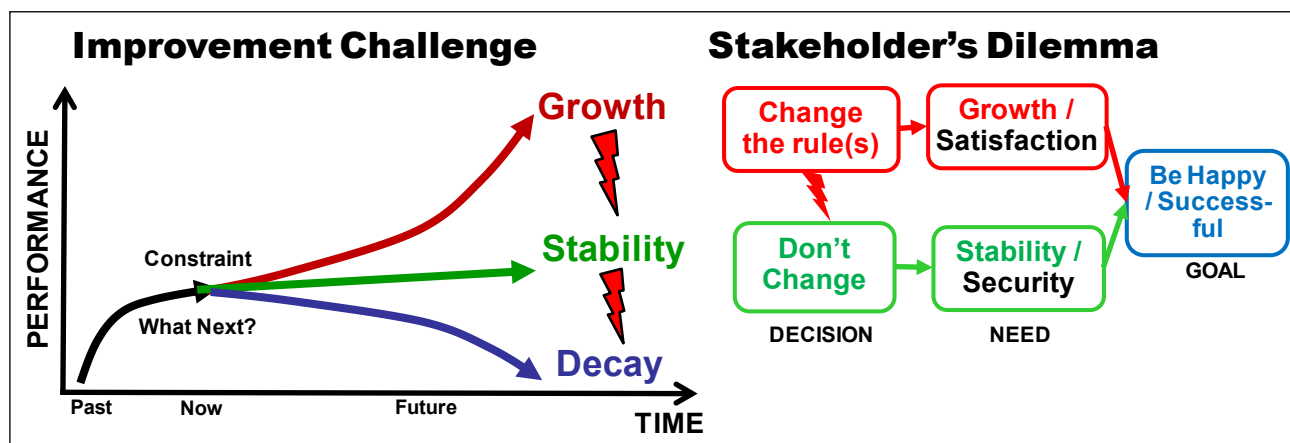


Figure 6 The Improvement Challenge and related Stakeholder Conflict

Source: Barnard (2007) developed from discussion with Dr. Eli Goldratt

Figure 6 shows that the fact that organizations (and individuals) need to achieve and maintain both stability and growth puts each stakeholder in the organization in a conflict (when faced with a decision about what type of improvement to target). On the one side, to maintain stability, they feel pressure not to make any significant changes, while, on the other side, to achieve the desired growth/step-change in performance,

they feel overwhelming pressure to make significant changes to processes, policies and even measurements (in future these will be referred to simply as “rules”).

The Management challenges (Kendall, 2005) related to this decision within any organization or individual can be summarized as follows:

- Knowing WHEN to change (rules) and more importantly WHEN NOT TO..?
- Knowing WHAT (rules) to change (What to STOP doing) and WHAT (rules) NOT TO change...?
- Knowing TO WHAT TO CHANGE (what to START doing)
- Knowing HOW to CAUSE the change in way that will ensure the active support and contribution from all stakeholders and probably more importantly “how not to attempt to cause the change?”

The above questions are revisited in section 2.6.7.

2.2.1 The Extent and Consequences of the Problem: High Failure rate of Change

Both Greiner (1972) and Goldratt (2005) showed that the outcome of any change can be classified as one of three types:

1. Rapid Improvement (Growth)
2. Relative Stability - Small Improvement or Small Decay (within the noise so very difficult to measure)
3. Rapid Decay

Most of the studies and surveys done to identify what percentage of change initiatives fail (e.g. IT Projects, Transformation Initiatives, TQM etc) show that between 50 % to 60 % of these initiatives fail to meet their original objectives. These statistics are quite a devastating validation of how difficult it is for managers to identify which changes in organizations will be “high-leverage” changes (Senge, 1992). Analysis of these studies shows that the vast majority of the changes are reported to fall into the second category where there is neither a direct measurable benefit nor decline.

The “penalty” in these cases are not real risk of “decay or even death” (Greiner, 1972) but simply the consumption of scarce resources and more importantly consumption of

scarce time of those responsible for making the changes (Goldratt, 2005). This consumption of scarce resources and time limits the availability of time and resources to invest in finding and executing more of the category 1 changes and or at least preventing more of the category 3 changes. John Kotter (1995, 3) confirmed this poor track record in his research that found that *"although major change efforts have helped some organizations adapt significantly to shifting conditions, have improved the competitive standing of others, and have positioned a few for a far better future, in too many situations the improvements have been disappointing and the carnage has been appalling, with wasted resources and burned-outs, scared and frustrated employees."*

Examples of surveys that confirm the high failure rates include:

- The Chaos Report (1995) by the Standish Group is considered as the landmark study of IT Project failures. The respondents of the survey were all IT executives and the survey included small to large companies. It showed that 31.1 % of projects will be cancelled before they ever got completed. 52.7 % of projects will cost over 189 % of their original estimates. Just in the US it means that companies and Government organizations will spend over \$81 billion on cancelled projects (representing 80,000 projects or about 220 projects/day). Only 16.2 % of IT projects were reported to be completed on-time and within budget. And the larger the company, the worse the result. In the large companies, despite access to the best resources, only 9 % of their projects were on-time and within budget. Projects completed in US companies have only 42 % of their originally-proposed features and functions.
- The OASIG Study (1995) found that 7 out of 10 change projects where IT is involved fail in some respect. OASIG also found that only about one-third of organizational change initiatives survive beyond initial implementation regardless of sector, whether public, private, for profit, non-profit, business, government, education, or health care. In all the cases about two thirds of the change initiatives failed.
- The Robbins-Gioia Survey (2001) found that 51 % of ERP implementations are viewed by management as unsuccessful. It improved quite a bit for those that had PMO in place –only 36 % of these with PMO's felt their ERP projects were unsuccessful. And this was just based on "perception".

- The Conference Board Survey (2001) interviewed company executives and found that 40 % of ERP projects failed to achieve their business case. 35 % were very satisfied, 58 % were somewhat satisfied and 8 % were unhappy. Those that did achieve benefits said it typically took 50 % longer than expected and had costs of more than 25 % higher than budgeted.
- Two independent studies in the early 1990's, one published by Arthur D. Little and one by McKinsey & Co., found that out of the hundreds of corporate Total Quality Management (TQM) programs studied, about two thirds "grind to a halt because of their failure to produce hoped-for results". Re-engineering has fared no better; a number of articles, including some by the founders, place the failure rate somewhere around 70 %.
- Harvard's John Kotter, in a study of 100 top management driven corporate transformation efforts, concluded that more than half did not survive the initial phases. He found a few that were "very successful", and a few that were "utter failures". The vast majority lay "...somewhere in between, with a distinct tilt toward the lower end of the scale".
- The situation in the Public Sector appears as gloomy. Virtually all new federally-funded educational programs failed to reach sustainability (Berman & McLaughlin in Yin, 1978: 44) and a study on the sustainability of public health programs showed that the majority are not sustained (Pluye, Potvin, & Denis, 2004: 121). Senge (1999) concluded, after expanding the research to include the success rate of change made in the Public Sector, that *"clearly business does not have a very good track record in achieving and sustaining changes that result in significant and sustained improvements and there is little to suggest that schools, healthcare institutions, governmental and non-profit organizations fare any better."*

There is remarkable consistency in the failure rates and presumed causes amongst all change initiatives. Whether it is the failure of new products, new markets, mergers, acquisitions, IT projects, Business Process Re-engineering, etc, the studies all share a similar conclusion, as discussed in the next section. There is also consistency in the reported consequences of such a high failure rate. Considering the high failure rate of most changes, it is no surprise that most of the studies identified two major consequence of the high failure rate – firstly most people resist change (especially the

"revolutionary type of change that can result in either rapid growth or rapid decay) and secondly, those that do not resist the change (over time) have a significantly lower expectation about both the likely success rate and impact of changes.

In Summary, the literature review found that change initiatives in both the Private and Public Sector are more likely to fail than to succeed and despite the significant insights gained as to the consequences and causes of these failures since the early 1990's, the failure rate has not changed measurably and such a high failure rate results in more resistance to change and lower expectations for the next change initiative, which negatively affects the level of top management commitment.

But why do so many of the change initiatives fail?

2.2.2 The Causes of the Problem: Why most changes fail?

Many of the studies did not only qualify or quantify the extent and consequences of the high failure rate of change (e.g. The Chaos Study, McKinsey and Kotter studies) but also analysed the most likely causes. Again, there is a remarkable consistency in their findings. Most of the studies list two main causes: "Resistance to change" (especially by middle managers) and "Lack of active support and/or under-resourcing by top managers", frequently because of relatively low expectations of the likely benefit of the proposed change. But these two factors are the same as what was identified as the consequences of the high failure rate.

When a specific behaviour is both a consequence and a cause, it means we are stuck in a vicious cycle (Senge, 1990). The higher the failure rate, the higher the resistance and the lower the expectations become. And the higher the resistance and the lower the expectations, the more likely those necessary changes will be blocked and/or that necessary changes will not receive the full support and resources needed to make them a success, which again increases the probability for failure. Over time, a vicious cycle such as this stabilizes (research studies conducted in 1990, 1995, 2000 and 2005 all show similar failure rates) and soon those trapped within the cycle concludes that, considering the complexity and uncertainties within their system, this (high failure rate) is probably the best they can do.

Kotter identified a number of general errors which cause changes to fail, such as allowing too much complacency, failing to create a sufficiently powerful guiding coalition, under-estimating the power of vision, under-communicating the vision by a

factor of 10 (or 100), permitting obstacles to block the new vision, failure to create short-term wins, declaring victory too soon and lastly neglecting to anchor changes firmly in the corporate culture.

Kotter also identified a "Eight stage Process of Creating Major Change" that included establishing a sense of urgency, creating the guiding coalition, developing a vision and strategy, communicating the change vision, empowering broad based action, generating short term wins, consolidating gains and producing more change and anchoring new approaches in the culture.

What is interesting from the literature review is that once the major causes are known, and a solution for each has been identified and even tested, surely one would expect the statistics to improve? But as can be seen from the studies mentioned before, surveys done 5 years and 10 years after Kotter published his "Leading Change" showed similar and even worse results than before.

Paul Ormerod's classical *"Why Most Things Fail: Evolution, Extinction and Economics,"* begins with the observation that, although failure is everywhere and statistically much more likely than success, it is not the subject of standard analysis by the economics profession. Since the advent of the modern corporation, 22 % of the top 100 companies at any given time drop from the elite rankings in the next decade, 10 % of all companies fail each year and 50 % of globally successful companies go extinct within the lifetime of a modern human. Why? In this book, Ormerod dismisses most of the conventional wisdom and explains why failure is so common and apparently unavoidable, and what we can do about that unfortunate fact. He says the reason that companies are almost as likely to be blindsided as dodo birds is that the world is simply too complex and non-linear for anyone to predict more than a short while ahead. What you can't predict, you can't avoid. And the reason that mass extinctions aren't so rare is that species, and companies, exist in networks analogous to the World Wide Web. The complex webs of relationships in networks - some competing, some co-operating - can breed chaotic outcomes. Both successes and failures tend to cascade. Winners take all, or most, and losers disappear in great bunches.

What does this mean for the average overstressed organizational executive? For government, Ormerod counsels restraint because most interventions in the workings of the market will just make matters worse. For business, he offers two bits of advice. First, keep trying to predict the future because, "Even a tiny bit of genuine knowledge

goes a very long way." Second, keep experimenting, because eventually something is bound to work. Here is how he ends the book: "Karl Marx famously wrote that the motto of capitalists was 'Accumulate, accumulate, that is the law of Moses and the Prophets!' As in many other respects, Marx was completely wrong. 'Innovate, innovate!' - that is the guiding principle..." And by 'innovate' he means continuous experimentation, frequent validation and ongoing adjustments to correct for erroneous assumptions. There are a few companies that Ormerod believes are getting it right. One example is Coca-Cola Co. that had the courage to try New Coke and then the humility to reintroduce the classic formulation of Coke less than three months after New Coke fell flat. He mocks Long-Term Capital Management, not just because the hedge fund failed in 1998 but because of why it failed. According to Ormerod, its partners, including Nobel laureates Robert C. Merton and Myron Scholes, stuck to a misguided academic theory in order, linearity, and equilibrium. The real world had other plans.

So, it appears as if continuous innovation is the answer.

2.2.3 Review of Theories on how to drive growth through innovation

Robert Tucker, in his book "Driving Growth Through Innovation: How Leading Firms Are Transforming Their Futures" (Tucker, 2008) warns leaders that they are either "*inventing the future or managing the past*". In his research of 23 companies, considered to be leaders in not only product, but also process and strategy innovation, he found that "*these companies were doing something most other companies aren't: they were creating a systematic process (a la TQM, TOC etc.) and literally innovating the thinking behind innovation*". As a result, their organizations are pace setters, bringing smart new products and services to market and generating impressive success for customers and shareholders alike. In his research, he identified six common strategies with which innovation-adept companies were creating their futures:

- 1. Be Open to Opportunity:** Innovation-adept firms continuously think: "opportunity". Think about where your new ideas will come from to grow your business in the future. What opportunities exist to innovate products, processes or strategies in your company?
- 2. Assault Your Assumptions:** Too often, firms are stymied by rigid assumptions about how fast they can grow, what markets they might serve, and what existing

customers will expect tomorrow. Innovation-adept companies have assumption-assaulting cultures and leadership.

- 3. *Mine the Future:*** Mining the future is an organized, systematic, and continual process to spot opportunities in change.
- 4. *Fortify Your Idea Factory:*** Innovation vanguard firms make a concerted effort to “ideate” – that is, to follow a systematic process for generating, harvesting, culling through, and implementing the best ideas. Most importantly, they’re involving everyone from employees to customers to suppliers in the ideation process.
- 5. *Cultivate the Culture:*** Culture encompasses the values, beliefs, and behaviors of an organization. To cultivate a culture of innovation, he suggested breaking barriers to innovation by addressing the “lack of time” barrier, adopting practices that cause openness, balancing the mix of people to ensure a conducive culture, supporting mavericks in the company and identifying and developing idea champions.
- 6. *Build the Buy-in:*** Behind every innovation lies a person and a team with the passion to persuade others that it will work. Successful innovators learn what it’ll take to gain trust and persuade others, from the boss to the board to colleagues, customers, and other stakeholders or key players. Buy-in is what moves the innovation process forward and leads to market success and profit.

2.2.4 Remaining gaps in why the failure rate of change is so high

In the literature review, it was interesting to observe that although not reported as “a major cause” or “solution” to the high failure rate, many of the studies hinted at the fact that the statistics is only likely to improve if managers at all levels adopted a Systems Approach to identify and implementing change. Therefore, System Theory as a potential solution is covered in the next part of the literature review.

2.3 *Review of General Systems Theory as a Potential Solution*

This section provides an overview of the body of knowledge known as General Systems Theory and Systems Thinking. It starts with a historical perspective of its origins, the definition of what constitutes a “system” and why it is important to view organizations as “systems”. It also includes the major contributions of General Systems Theory (GST) and Systems Thinking (ST).

2.3.1 Historical Perspective

Most information sources trace the origins of a Systems Approach to analysing, improving, managing and predicting the performance of systems to the early 1930's with the work of the biologist Ludwig von Bertalanffy (1901–1972). In this work, he formulated a Theory of Development and Growth for organisms and later expanded this idea to a General Systems Theory (GST), a description of which was published in 1950 in the British Journal for the Philosophy of Science titled "An outline of General Systems Theory" (von Bertalanffy, 1950). He proposed the idea of a general systems theory to embrace all levels of science, from the system of a single cell to the study of society and the planet and universe as a whole. Bertalanffy believed a general systems theory (GST) *"should be an important regulative device in science, to guard against superficial analogies that are useless in science and harmful in their practical consequences"*.

In actual fact, the origins of Systems Theory can be traced back to South Africa in the early 1920's with the publication by Jan Christian Smuts of his Theory of Holism in "Holism and Evolution" (Smuts, 1926). Smuts described Holism (from the Greek 'holos', wholes) as a new theory and schema, which makes the existence of "wholes" a fundamental feature of the world. It regards natural objects (systems), both animate and inanimate, as "wholes" and not merely as assemblages of elements or parts. And these bodies or things are not entirely resolvable into parts; in one degree or another they are wholes which are more than the sum of their parts, and the mechanical putting together of their parts will not produce them or account for their characters and behaviour. With his new theory of holism, Smuts criticized the nineteenth century scientists for their narrow concept of causation which was based on a dogma that "there can be no more in the effect than there was in the cause". His theory supported Einstein's Theory of Relativity, which was based on an absolute presupposition that "No events have causes" and that it was laws, rather than causes, that account for changes. These insights and discoveries by Smuts were considered so important by Einstein himself, who stated that he regarded Smuts's Theory of Holism as one of the three most important contributions to modern science - the other two being Darwin's Theory of Evolution in his "Origins of Species" (Darwin, 1959) and his own Theory of Relativity (Einstein, 1915).

In 'Holism and Evolution' Smuts (1926) states that *"in its analytical pursuit of the parts, science has missed the whole, and thus tended to reduce the world to dead aggregations of the parts rather than to*

the real living wholes which make up nature. It is my belief that Holism and the holistic point of view will prove important in their bearings on some of the main problems of science and philosophy, ethics, art and allied subjects".

Smuts's 'Holism' (Beukes: 1989) is "simply the belief that "the whole is greater than the sum of its parts", while Reductionism is simply the belief that "a whole can be understood completely if you understand its parts, and the nature of their sum."

Later in his life Smuts wrote about the challenge of getting a new paradigm such as Holism accepted and adopted (Beukes, 1989):

"I am content to be patient and wait for actual results. New ideas take a long time to filter into the public mind, and Holism may not produce early results, but in the long run and in the end I have little doubt that it will secure its place in the development of human thought, and will help lead public opinion away from the destructive atmosphere of the past to that saner and larger viewpoint, which will once more bridge the gaps and fill the fissures which the mechanistic science and philosophy have created for the human spirit."

An analogy frequently used to illustrate the challenge of studying systems is one by the famous physicist, Richard Feynman. He used the analogy of a scientist trying to understand the universe as similar to an observer that looks at a chess game and is trying to figure out the rules that govern the relationships between the parts of the chess game. Like with a chess game, he said that it is quite useless to study each part (chess piece) in isolation – you have to study their behaviour within the system. Also similar to chess, despite the seemingly complex and variable behaviour of the systems studied by scientists (e.g. the movement of planets within the universe), the underlying rules that govern the possible behaviours and states of a part and the interaction between the parts are always found to be very simple.

Managers trying to understand the behaviour of their organizations face a similar challenge to the scientist who studies complex adaptive systems such as the universe. As a result, many of the mindsets and methods used by scientists that have resulted in continuous scientific breakthroughs are likely to be relevant to identifying potential breakthroughs within the study of understanding and improving organizations.

To investigate this further my Literature Review continued by asking the simple questions of *"What is a system?"* and *"Why should organizations be viewed and managed as systems?"*

2.3.2 What is a "System" and specifically what is a "Complex System"?

Very simply, a system is a collection of parts (or sub-systems) integrated to accomplish an overall goal (e.g. a system of people is an organization). Systems have inputs, processes (within boundaries), outputs and outcomes, with ongoing feedback among these various parts. If one part of the system is removed, the nature of the system is changed.

Systems range from very simple to very complex. There are numerous types of systems. For example, there are mechanical systems (i.e. a thermostat), biological systems (i.e. the heart), and social systems (i.e. groups, supply and demand, friendship etc.). More complex systems are normally comprised of numerous sub-systems with complex interdependencies between parts within a sub-system and between the various sub-systems. These sub-systems are arranged in hierarchies and integrated to accomplish the goal of the overall system. Each sub-system has its own boundaries of sorts and includes various inputs, processes, outputs and outcomes geared to accomplish an overall goal for the sub-system. A pile of sand is not a system. If one removes a sand particle, one still has a pile of sand. However, a functioning car is a system. - remove the carburettor and one no longer has a working car.

Complex systems have unique properties that are important to consider when we aim to analyze, improve, manage or predict the performance of such systems:

System Goal vs. Necessary Conditions: All systems are created or have evolved to achieve a goal. (E.g. the goal of a Private Sector organization could be profitable growth). It is important, from a systems analysis and improvement perspective, to clearly differentiate between the goal of a system and the necessary conditions to achieve that goal (satisfied customers, satisfied employees etc.) or else it could result in local optimization (achieving higher levels of satisfaction/performance of a necessary condition than what is really needed) to achieve the goal.

Nature of System Complexity: There are two very different ways in which a system can be "complex" (i.e. difficult to analyze, improve or manage/control a system and predict its performance). The first is based on the number of parts a system has (e.g. a

jigsaw puzzle). This is called complexity of detail. The greater the number of parts, the greater its detail complexity. The second type of complexity is dynamic complexity. This refers to the different ways parts can relate or interact with each other (e.g. a chess game). The greater the number of possible interactions, the greater its dynamic complexity. A system with even a few interdependent parts, whose states fluctuate over time and where feedback is involved (a non-linear system) can be very difficult to analyse and/or predict in terms of its performance at specific point in time. At the same time, a system with many thousands of parts could be simple to analyse and to predict its performance if the states of the parts do not fluctuate over time (linear system) and/or have simple dependencies. Knowing whether we are dealing with detail- or dynamic complexity (a jigsaw or a chess game) should guide the way we attempt to analyse a system.

System Openness: Any system can fall into one of two categories (Haines, 1998), namely open or closed. An *open system* accepts inputs from its environment, acts on the inputs to create outputs and releases the outputs to its environment. In contrast, a *closed system* is isolated and hermetic. Traditional "Non-Systems" approaches made simplifying assumptions to treat open systems as closed systems. Every living system is an open system and, although some are more open than others, we pay a penalty for dealing with open systems as if they are closed unless we can create "buffering" mechanisms that protect an open system from significant external changes in a way that maintains a desired level of stability.

System Stability: A system is considered stable when the performance of the system fluctuates within a relatively narrow band. A system whose performance fluctuates dramatically over time is an unstable system. Dynamically complex systems frequently display this type of behaviour when the flow rate of the system exceeds stability levels and we observe chaotic behaviour (performance varies between stable and unstable). When dealing with unstable systems, the focus should be on first achieving stability (getting it out of the "chaos-conditions" before attempting any interventions). This is similar to the way doctors would first "stop the bleeding" to stabilize a patient entering their emergency room, before working on the parts of the person that need repair or replacement.

Emergent Properties: Systems have emergent properties that are not found in their parts (O'Connor & McDermott, 1997). One cannot predict or understand the properties of a complete system by taking it to pieces and analysing the parts. At the same time,

if one takes a system apart (to analyse it), it loses these properties. Resolving this paradox requires a realization that we can observe patterns of behaviour (by observing the system as a whole) that can provide the necessary clues to know which parts (structure) or interdependencies between the parts (the rules) currently have the largest impact on the performance of the system.

Cause & Effect and Causal Loops: The interactions between the parts of any system are governed by cause-effect. There is much discussion in literature whether cause-effect exists (in its simple linear form) and the general consensus (Senge, O'Connor, Goldratt, Ackoff) is that cause-effect does exist, but that it exists in causal loops that either result in balancing or changing behaviour (positive or negative causal loops). Systems analysis of cause-effect, especially with traditional methods, is very difficult due to the fact that, frequently, the cause is far removed from the effect in space in time (Senge, 1990) and that causes and effects are never proportional. Although it is often difficult to identify the extent, consequences and causes of specific effects on a system, the key is to stop looking for specific problems and to rather look for patterns of problems within the system. And there are always triggering events when patterns change (either changes from within the system or external to the system). If we can identify these triggering events and the resulting patterns, we improve our ability to improve systems and predict their performance. Hypotheses within General Systems Theory, like with any other science, can and should be tested through the application of the scientific method: effect-cause-effect (Goldratt, 1990).

Principle of Leverage and Leverage Points: Any system has fewer causes than effects. Leverage is achieved when these few causes are acted upon. The principle of leverage is also sometimes called the Pareto or 80/20 principle – in honour of Vilfredo Pareto (1848-1923) who discovered a consistent mathematical relationship between the proportion of people (as a percentage of the total population) and the amount of wealth this group enjoyed. He found, for example, that 20 % of the population enjoyed 80 % of the wealth and realized that this relationship was not only predictably unbalanced, but appeared to be consistent over different time periods and even over different countries. This principal reminds us that there are always very few parts in a system that contribute most to the performance of that system and that if we can find these "leverage points", we can get significant changes with relatively little effort. However, to capitalise on this, we need a reliable mechanism to differentiate the low-leverage from the high-leverage variables and changes.

Principle of Unintended Consequences (Side-Effects): By definition, the components or parts of any system are connected to each other through relationships such as dependence or inter-dependence. When one component of a system (or a relationship between parts) changes, it affects many other system components and may even alter the entire system - *"when we make a change in one part of a system, we should expect that it can, and frequently does, impact the other parts of the system."* (Haines, 1998). When we make a change and the impact is unintended, we call it unintended consequences or (unexpected) side-effects. Therefore, when making changes to any system, we should be aware that there is always the potential for unintended consequences – sometimes these are positive and at other times they are negative (in relation to the goal of the system) – but we should try to predict what these can be (through methods such as scenario planning or system dynamics modelling) and put mechanisms in place to detect these as soon as possible and, where possible, correct them.

Dealing with System Complexity

The importance of knowing how to deal with this system complexity is emphasized by Michael L. George in *Conquering Complexity* (George: 2004): *"The winners and losers in the next decade... may well be separated by a single factor: those that conquer complexity and those that do not"*.

Organizations become complex because of two driving forces (George & Wilson, 2004) – firstly, "deliberate complexity" to expand product and service offerings as a way to be more competitive or meet more clients needs and, secondly, "unmanaged proliferation" – adding complexity unintentionally. It is the latter that "silently kills profitability and growth" and therefore traps inherent improvement potential from being identified and unlocked. For any business to survive and prosper, they have to find practical ways to "conquer complexity". George and Wilson suggests three rules for conquering complexity: a) Eliminate complexity that "customers" will not pay for b) Exploit the complexity customers will pay for and c) Minimize the cost of the complexity you offer.

2.3.3 Why is it Important to Look at Organizations as Systems?

Peter Senge, the Organizational development theorist, developed the notion of organizations as systems in his book *"The Fifth Discipline"* (Senge, 1990). Systems Theory encourages managers to look at organizations from a broader perspective – a

systems perspective that incorporates the recognition of systems characteristics as presented in section 2.3.2.

Following such a Systems Approach to analyze, manage, improve and predict the performance of an organization is in contrast with the reductionist approach still used in many organizations that encourages managers to analyze and improve every part that can be improved (e.g. the departments and processes within organizations where there are gaps between their current and potential performance). It is assumed that, in this way, the system as a whole will be continuously improved and that, by developing mechanisms to predict the performance of each part (e.g. departmental budgets, efficiency measurements), they can predict the performance of the system as a whole.

However, according to Senge (1990) this reductionist approach suffers from three potential negative side effects. Firstly, it is quite likely that one part might take an action that will improve its own performance, while not improving the system performance or even worse, deteriorating the system performance (local optimization). Secondly, breaking a system or problem up into its parts makes it really difficult to judge the impact that changes to a part of the system might have on the system as a whole, which could result in parts not considering the impact on the wider system (silo thinking). Lastly, improving each of the parts in isolation, rather than in combination towards the same end goal, frequently results in parts no longer being synchronized - each part is pulling in its own direction, rather than towards a common goal.

Senge reasons that, by following a Systems Approach, managers will recognize the various parts of the organization (structure) and, in particular, the interrelations of the parts (the rules and cause-effect relationships that govern interactions between the parts) to prevent making changes that are very likely to fail. Such managers will also be aware that the way to analyse the system is through synthesis - diagnosing system problems and the patterns that cause them rather than just examining problems within each part and fixing these as if they exist in isolation. Through recognizing larger patterns of interactions, managers can maintain a systems perspective by always focusing on analyzing the impact of changes on the outcomes they want from their organizations. Managers should focus on changes in structures and rules that provoke behaviours that determine events - rather than reacting to events as they have always done in the past.

2.3.4 Systems Theory and Systems Thinking

One of the major breakthroughs in understanding the complex world of systems is Systems Theory. The application of this theory is called Systems Analysis. One of the tools of Systems Analysis is Systems Thinking (ST). Systems Thinking (Senge, 1990) is a *"conceptual framework, a body of knowledge and tools that has been developed over the past 70 years to make the full patterns clearer and to help us see how to change them effectively"*. Though the tools are new, the underlying world view is extremely intuitive - experiments with young children show that they learn Systems Thinking very quickly.

Systems Thinking (Senge, 1990: 128) finds its greatest benefits in helping us distinguish high-leverage- from low-leverage changes in highly complex situations or systems. In effect, the art of Systems Thinking lies in seeing through complexity to the underlying structures generating the change. Systems Thinking does not mean ignoring complexity. Rather, it means organizing complexity into a coherent story that illuminates the causes of problems and how they can be remedied in sustainable ways. The increasing complexity of today's world leads many managers to assume that they lack the information they need to act effectively. Senge suggested that the fundamental "information problem" faced by managers is not too little information but too much information. What we most need are ways to know what is important and what is not important, what variables to focus our limited resources and time on, and which to pay less attention to – and we need ways to do this which can help groups or teams develop shared understanding.

Senge said in his book, "The Fifth Discipline", that from an early age we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable, but he explained that we pay an enormous hidden price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole. When we then try to see the "bigger picture", we try to reassemble the fragments in our minds, to list and organize the pieces, but, as physicist David Bohm says, the task is futile – similar to trying to reassemble the fragments of a broken mirror to see a true reflection. Thus, after a while we give up trying to see the whole altogether.

Over time, Systems Thinking experts have converted the individual's insights into a roadmap to formulate, test, and plan the implementation of a "systems strategy".

Figure 7 shows how the roadmap starts with the identification of issues (specific events) and then goes on to the identification of the variables and behaviours that caused these issues, diagramming the causal loops, doing simulation modelling to identify sensitive variables and finally to testing the new policies and strategies and planning the implementation.

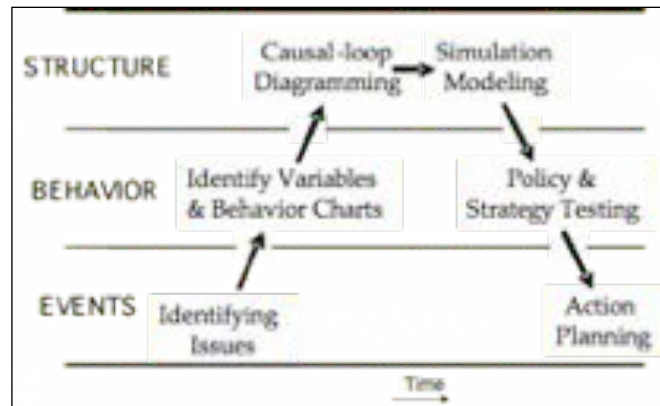


Figure 7 Systems Thinking Roadmap to Strategy Development: From Issues to Actions

Source: Adapted from Systems Thinking Roadmap by Pronamix Business Consulting, 2005

As shown above, Phase 3 in this roadmap involves the diagramming of Causal Loops to gain a deeper understanding of the viscous and vicious cycles that occur through balancing and feedback loops. An example of such a causal loop is shown in Figure 8.

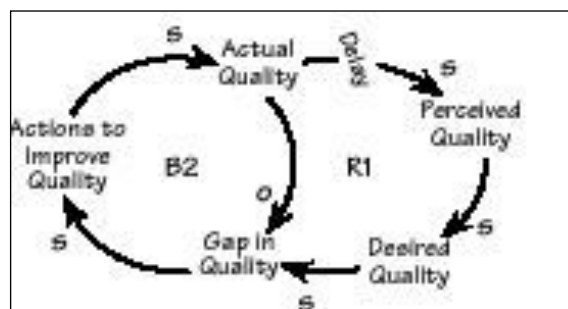


Figure 8 Example of Causal Loop Diagram

Source: Kim, Daniel, The Systems Thinker™, Volume 3, Number 1

During this research, there were a number of weaknesses identified in the causal loop diagramming method that made me favour the use of the Theory of Constraints conflict clouds and current reality tree (see "Thinking for a Change" by Lisa Scheinkopf for a detailed overview). The weaknesses identified include that the causal loops contain no qualification of a magnitudinal contribution or test of sufficiency (i.e. can the cause

explain the full effect?) and, even more importantly, there is no attempt to verbalize the underlying assumptions on which the inter-relationships are defined. As I will show later, the identification of these assumptions are frequently critical to achieving the necessary breakthroughs.

2.3.5 Why have so few organizations adopted Systems Thinking?

The logic and results that have been achieved by individuals and organizations that have used Systems Thinking is compelling. But we should ask: *"If this way of thinking and this way of improving organizations is as good as they say it is, why don't more organizations use it?"* Well, the typical response from Systems Thinking experts to this question normally includes in the answer something like *"...because most organizations naturally resist change"*. And if asked *"how do you know that this is the main reason?"* they are likely to answer *"simple ... we know most organizations resist change, because most organizations have not yet adopted Systems Thinking"*. This answer is, of course, a tautology in the same way as saying that the reason why customers use our products is because they like it and then explaining that the way we know that customers really like it is... because they use it!

Russell L. Ackoff, an American organizational theorist and Professor Emeritus of Management Science at the University of Pennsylvania, Wharton School of Business, and one of the pioneers in the field of systems thinking was one of the first authors in the field to try to answer the question: "Why do so few organizations adopt Systems Thinking?" in his article by the same name, published in 2006.

In the article, Ackoff stated that he believes there are two reasons – one general (why organizations in general do not adopt any transforming or radical ideas) and one specific (why specifically organizations find it difficult to adopt Systems Thinking). He claims that the general reason relates to the fact that we must recognize that there are two mistakes a manager can make - errors of commission (doing something that should not have been done) and errors of omission (not doing something that should have been done). He believed the culture in most organizations (and in the minds of most people) that failure or making mistakes is a bad thing, causes people to rather make errors of omission than errors of commission. This tendency, he claims, is perceived as "resistance to change", but it really relates more to the fear of the possible failure (or even lack of success) of a proposed change. And considering how few of the changes made in organizations are judged by the organizations themselves as "successful", it

makes sense to bet on the fact that most changes will likely be considered failures and that, in the famous words of Donald Trump in the TV program *The Apprentice*, "Someone will be fired!"

The specific reason, Ackoff claimed, that blocked organizations from adopting Systems Thinking was simply that very few managers (especially those within the Public Sector) have any knowledge or understanding of Systems Thinking and, even if they have been exposed to it, most ST education programs cover only the "What" but not the "How to" and "Why". Giving students theories without showing which of their specific assumptions about reality will have to change and not providing practical ways (methods, tools, systems etc.) to apply these theories make them impractical. This does not mean that most of the required logic, methods and tools don't already exist – it simply means that education and general awareness, yet again, lags the innovation and field experience that is being obtained by the growing number of practitioners of Systems Thinking (O'Connor & McDermott, 1997).

Both the general reason and the specific reason postulated by Ackoff provide a reminder that any change initiative should ensure not only that the principles behind the change are well communicated and understood, but that these principles are also backed up by practical methods (the how to) and concrete examples of how to apply the principles on a daily basis. Without such "actionable information" and a culture that encourages experiments and the analysis of both successes and failures to continuously improve our understanding of cause-effects (what Senge called "*creating a Learning Organization*" in the Fifth Discipline), we should expect that the adoption of changes, especially radical changes or counter-intuitive changes like Systems Thinking, will be resisted.

Is it possible to overcome this resistance?

Among the methods based on a Systems Approach, there is one that stands out - if we consider just the consistency and magnitude of the results that have been achieved from its application in many types and sizes of organizations around the world over the past 20 to 30 years. This is the Theory of Constraints (TOC) and the cases prove that TOC is able to either prevent or overcome the resistance to change normally experienced on other projects by providing both the principles as well as the method of application or "how to". The principles and methods of TOC will be reviewed in detail later on in this chapter in section 2.6.

The next part of the general theory search, relevant to the research aim was to search for the criteria that a new idea, solution, technology or process had to satisfy to not only be adopted by its target market but also to last. The next section covers the literature review on identifying the criteria for adoption and sustained use of any new idea or approach.

2.3.6 Criteria for the Adoption and Sustainability of a Solution

The concept of “stickiness” was defined by Chip and Dan Heath in the 2007 best seller, “Made to Stick”. In their research, the brothers revealed the characteristics that make some ideas thrive, while others, lacking these characteristics, simply die. The six criteria (together with my own summary of its justification and “how to” ensure the criteria can be met are detailed in Table 1.

Table 1 Stickiness Criteria adapted from "Made to Stick" by Heath & Heath

Stickiness Criteria	Why?	How to?
Simple	Complex ideas or too many simple ideas cannot only paralyze people but can even result in irrational actions.	Find / Create the inherent simplicity (essence) of ideas and communicate only this (proverbs are ideal).
Unexpected	Surprises make people pay attention and think. Ideas that are unsurprising are boring and make them lose interest, regardless of how good the ideas.	Develop questions or games that trap people to commit to wrong answers and then give them the opportunity to find the right answer.
Concrete	Lack of concreteness of ideas can paralyze people by the uncertainty of what to do or how to do it.	Speaking concretely (not abstractly) is the best way to ensure that the idea means the same thing to everyone in the audience.
Credible	People don't believe ideas that do not sound credible or do not originate from credible sources.	Present ideas in a professional manner, present results from relevant case studies and use supporting quotes by credible experts.
Emotional	People do not care about ideas that will not invoke strong feelings.	Identify which emotions related to the idea will inspire the audience to action and create situations to invoke these feelings.
Story...	A story helps people mentally prepare for action and enables people to act more quickly and effectively.	Use stories about real situations that describe how your ideas have been applied and why and, where possible, let the audience shares their own stories.

Source: Created by Barnard from criteria proposed by Heath & Heath: 2007

Most of the literature reviewed on Systems Theory and on ensuring that new ideas are adopted and will "stick" identified the critical role of our mental models, paradigms or assumptions. The next section provides an overview of the literature review on the role of paradigms in adopting an approach such as a "Systems Approach" that could help managers and individuals alike reduce the high failure rate of changes.

2.4 Role of Paradigms in adopting a Systems Approach

Leonardo Da Vinci (1452 –1519) said that *"All our knowledge has its origins in our perceptions"*.

How do the perceptions of all key stakeholders in organizations impact the decisions they make in relation to deciding *"when to change"*, *"what to change"*, *"to what to change"* and *"how to cause the change"*?

In *"The Art of Possibility"* (Zander & Zander, 2000), the authors present compelling evidence of how our happiness and success is impacted by our expectations and beliefs. Their research shows that *"owners are more likely to extend their business and have a fulfilled life if they have an attitude that there are always enough new customers out there waiting to be enrolled rather than that money, customers and ideas is in short supply"*.

Benjamin Zander, co-author of *"The Art of Possibility"* and the conductor of the Boston Philharmonic Orchestra and Professor at the New England Conservatory of Music, also presented a similar outcome from research he conducted on his own students whose chronic anxiety about the final exam and fear of failure, he believed, had a major negative impact on their grades. So he did an experiment by telling his students at the beginning of the term that he decided to *"give everyone an A"*. It was *"unconditional on their performance"*, except that they were required to write a letter that began with *"Dear Mr. Zander, I got my A because..."* and they had to describe, in as much detail as possible, how they came to achieve this *"extraordinary grade"* and how it made them feel. The letters had to be written in the past tense as if they had just got their A's. The result was a significant rise in the performance of all students. The research validated one of the most famous quotes by Henry Ford from *'Today and Tomorrow'* (Ford, 1926): *"Whether you believe you can do a thing or not, you are right"*.

In *"The Fifth Discipline"*, Peter Senge warned that *"all managers know that many of the best ideas never get put into practice. A pilot approach leads to better results, but widespread adoption of the approach is never achieved"*. Why? Senge explained that mental models are so powerful in affecting what we do (and don't do) because they affect what we *"see"*. If CEO's do not believe in the potential of their business it is unlikely that they will *"see"* it, even if this potential might be very obvious to an external observer. Senge also shared research with some (very) good news: *"if mental*

models can impede learning – freezing companies and industries in outmoded practices – why can't they also help accelerate learning?"

This next section explores the existing definitions, theories and field experience to help answer the questions of how our mental models or paradigms impact our abilities to see and unlock potential, which paradigms or mental models can block us and which can enable us to "see" and, as importantly, whether it is possible to go through a paradigm shift or induce others to go through a necessary paradigm shift.

2.4.1 What are "paradigms" or mental models?

The Historian of Science, Thomas Khun, in *"The Structure of Scientific Revolutions"* (Khun, 1970) gave the word *paradigm* its contemporary meaning when he adopted it to refer to the set of practices that define a scientific discipline during a particular period of time and which form the basis of all their decisions. Joel Barker, in *"Discovering the Future: The Business of Paradigms"* (Barker, 1986), defined paradigms as "frames of references we use to see the world and make decisions". Barker said paradigms let through data that match our "expectations" but unfortunately also block data that don't. This definition helps us understand why, with one paradigm something looks impossible (because we only see what we believe) but with another, it might not just be considered possible, but even easy to do.

For my research and to simplify the way in which I explain paradigms and mental models to groups not familiar with the concept, I have defined "paradigms" simply as "*a set of assumptions we believe are valid*". With this definition, I can then define a 'paradigm shift' as simply an event in time, when we realize (by ourselves or with the help of someone else) that one or more of our assumptions are no longer valid. I have found that this way of explaining it, backed up with a few concrete examples of how we all go through paradigm shifts everyday (e.g. "*I really thought she was not very clever because she is blonde – turns out she has a PhD...*"), removes a lot of the fear and anxiety from changing our assumptions (paradigms) and makes the groups realize that the significant steps in our understanding and knowledge all came from paradigm shifts – a specific event or series of events that made us realize that one or more of our assumptions were not valid or were no longer valid. This new realization frequently helps to solve not just the original problems we started with, but also many other related and even unrelated problems.

Based on the research of Khun and Barker and other authors in this field, I observed that there were two simple ways we can think of a paradigm – both are useful to help understand the consequences of paradigms on how we perceive reality (do we see problems or opportunities), how we “form” paradigms in the first place and what type of events can help us to change the ones that don’t help but rather hinder good decisions.

Firstly, paradigms are like “*FRAMES OF REFERENCE*” that allow us to look at reality through a “filter/fence”. They should block out bad light (unimportant details) that could “blind us”, while at the same time they should let through good light (the important details) that allows us to SEE and MAKE good decisions. The ability to block out “noise” is critical in a world where we are flooded daily with oceans of data.

Someone who decides to have a very “open” filter (“open minded”) may think that this increases his/her probability of not missing important details, but frequently almost guarantees it as he/she gets overwhelmed with all the unimportant details. The relevance here of managers in organizations is to develop the ability to differentiate between all the parts and processes that can be improved (because they see GAPS) from those few - the high-leverage gaps - that must be improved to generate more goal units for the system as a whole.

Secondly, paradigms are also like “IF... THEN... ELSE” rules that provide shortcuts so we can respond very quickly without having to think. John Holland, author of “Hidden Order: How Adaptation Builds Complexity” (Holland, 1996), gives an example of how living organisms use “If...then...else” rules, programmed into their DNA to make fast decisions and discover new rules. An example is the “flight or fight” rule most organisms have: “*IF it is larger than you THEN flee, ELSE (if it is smaller than you) try to fight/eat it*”. Such rules are very useful to make fast decisions, but without feedback, can result in the organism either missing great opportunities (e.g. eating an animal that, although it is larger, is not capable of defending itself) or in it being exposed to a threat hidden from the rule (e.g. don’t eat animals that are smaller than you are if they have little red dots on them).

Holland proved that starting with a few simple “IF...THEN...ELSE...” rules, with the ability to continuously validate and invalidate them to create new (hopefully better) rules, is both necessary and sufficient to explain how a single cell organism can evolve into something as complex as human beings.

This mechanism is as applicable to humans as it is to organizations. The “rules” or paradigms within organizations are like simple “IF...THEN...ELSE...” rules that, if continuously tested for validity, can create amazing growth, while those that refuse to change their “this is the way we’ve always done it” rule, will become extinct.

There is also a certain phenomenon called “irrational” or inconsistent behaviour, which seems to arise from conflicting paradigms that result in inconsistent rules and unpredictable behaviour. An example frequently quoted in the literature (Talieb, 2006) is one where a person called John is asked to choose between apples and oranges. He selects apples and as a result we derive a rule that helps to predict John’s behaviour (he prefers apples over oranges). John is then given a choice between oranges and pears to which he chooses oranges. Now we know that John, when given the choice will pick apples, then oranges and then pears. We call behaviour irrational or unpredictable when suddenly, when faced with a choice between apples and pears, John selects pears. What makes “irrational behaviour” so disturbing is that we simply don’t know (once the inconsistency has happened) whether this will be a “once-off” (exception) or a permanent change in the rules. Economists define such “irrational behaviour” as inconsistent and therefore unpredictable behaviour or, in the extreme case, as “behaviour that goes against your objective – either unintentionally or intentionally”. Such “irrational” behaviour is not uncommon in most organizations. We frequently see “irrational” behaviour that is, at best, “inconsistent” with the agreed rules and, at worst, actually damaging the organization. Frequently behaviour is driven more by the formal or information measurements than by written policies. Goldratt (1990) frequently refers to this type of behaviour and inconsistency due to Local Efficiency measurements as “Local Optima” or “Silo Thinking”.

The fact that employees in organizations have the choice to follow or not to follow rules (sometimes confused with good empowerment practices) is exactly the reason why organizations as social systems are the most complex type of system – the irrational behaviour (inconsistent choices with reference to other rules or the goals of the system) make it very difficult and frequently impossible to understand and predict the performance of such a system. To solve this problem, we need a way to align everyone’s frame of reference of what is really needed to improve the organization as a whole. To achieve this objective, we need to identify the “enabling paradigms” to replace those that limit or block current improvement.

2.4.2 What triggers people to change paradigms?

The famous quotation, "Necessity is the mother of invention", can be traced to Plato's Republic, book II, 369C, which was written 360 B.C. When Socrates and Adeimantus discussed the origin of the State (and the nature of justice and injustice as they appear in the ideal State), Socrates makes the following statements: *"A State, I said, arises, as I conceive, out of the needs of mankind... let us begin and create in idea a State; and yet the true creator is necessity, who is the mother of our invention."*

We all know that a crisis allows us to challenge and overcome prevailing assumptions but what if you do not have a real crisis now? In such situations, the literature is quite consistent – create a "crisis" by creating a large gap between the current level of performance and the goal. An example of this is a new CEO coming into an organization that is already doing well at 10 % profit to sales and giving his team the goal doubling their profit to sales within 3 years.

The article on resistance to change, on which most practitioners confer "classical status", is one by Kotter and Schlesinger titled "Choosing strategies for change" which appeared in Harvard Business Review in early 1979. It represents perhaps the culmination of the "how to overcome resistance" theme, describing both the range of strategies available to managers for overcoming resistance and how to use each technique in particular circumstances. In this pioneering article the authors identified six approaches to overcome resistance to change:

Education and Communication, Participations and Involvement, Facilitation and Support, Negotiation and Agreement, Manipulation and Co-option and Explicit and Implicit Coercion.

I will show later in this chapter, that Goldratt, with his Theory of Constraints Thinking Process and Change questions, proposed a much simpler approach. His premise is that people resist change only when they do not understand it – i.e. they can't predict the outcome or if they feel the change will in some way hurt them or another stakeholder. So he proposed a simple solution. Make sure change is a win:win. But how do we get someone to move from one type of assumption to another?

2.4.3 Replacing Limiting Paradigms with Enabling Paradigms

Gobin (2007) stated: *"You got this far operating under one set of assumptions. Abandoning those assumptions and embracing a new (more holistic) set may be exactly*

what you need to do to get to the next level". The heroes who have reinvented institutions and industries (from Martin Luther King Jr. to Richard Branson) all did it in exactly the same way – they challenged and changed the prevailing assumptions and had the courage to make it through the "conceptual dip"; the time it takes for it to become accepted.

The observation that humans only behave irrationally when they are given the choice to follow or not to follow good rules (or when it is tolerated when they take actions to make their part look good at the expense of the rest of the system) – provided a valuable insight on how to design a process that can transform (shift) people and groups away from their "limiting paradigms" towards "enabling paradigms".

As a working definition, I decided to use the terms "*Limiting or Disabling Paradigms*" as assumptions that limit or even block (disable) us from seeing and/or unlocking inherent potential. "*Enabling paradigms*", on the other hand, are ones that enable us to see and capitalize on opportunities that were simply hidden or even impossible to "see" or capitalize on with the limiting paradigms.

We have a choice as to which paradigms we use to make our decisions. The literature review on paradigms shows how easy it is to make the wrong choice. But it also shows we have a choice as to whether to allow or tolerate ourselves and our peers and subordinates to make decisions on paradigms that we know are no longer valid and therefore could have predicted will result in "bad" decisions (in relation to the system goal) or which we could have tested (after the fact) to prevent similar mistakes in the future, but frequently fail to do so (i.e. we assumed that outsourcing would save us money, but a relatively simple check could have shown that it actually cost us money). Having these feedback loops to continuously validate our paradigms (using proper effect-cause-effect rather than using the exception to justify our rules) is critical in creating learning organizations that will continue to achieve higher levels of stability and growth.

How do these insights impact the responsibility of managers within organizations?

Real innovators are sometimes called "mavericks" in organizations. These are individuals who are not only frequently "dissatisfied" with the status quo, but they have

the ability and courage to challenge and actively contribute to changing the status quo by finding inconsistencies and inventing and testing (innovating) practical solutions to resolve these. The characteristics that make good innovators are also the characteristics that make good Systems Thinkers (Senge, 1990). They can be found at any level within the organization and typically have the ability to see events for what they are, identify patterns of behaviour, maintain a systems view (regardless of their position) and lastly can identify and overcome mental models that have become a limiting factor to further improvement.

The type and strength of mental models held by a team contribute to its success in general and to innovation in particular (Davidson et al, 2005). To exploit the power of shared and different mental models, the innovation process should actively encourage and even require the use of cross-functional teams that include external stakeholders such as supply partners and customers (as a "reality check").

2.5 How are new Paradigms created and tested?

Scientists use a process commonly known as "The Scientific Method" for creating and testing existing and new hypothesis such as finding solutions to problems or theorizing about how or why things work or will be in the future. It tries to reduce the influence of "faith" or bias or prejudice of the experimenter so that the process is valid anywhere in our world. The history of Scientific Method is almost inseparable from the history of Science itself. Many scientists (e.g. Feynman and Goldratt) have argued that the reason why the hard sciences such as Physics have made so much progress in comparison to the soft sciences such as the Social Sciences is simply because of the total absence or only partial use of the Scientific Method in these soft sciences.

A simple test of this hypothesis is to ask to what extent technology (triggered by inventions in the hard sciences) have been advanced over just the past 100 years and then compare it with whether we can really claim we are much happier today compared to people 100 years ago (a reasonable expectation considering all the "advances" in understanding about what really makes people happy).

Since the initial formulation of the Scientific Method by Aristotle (384 BC – 322 BC) and even after the major advances by the Islamic Scientist in the period around 1000 AD (e.g. contributions by the brilliant Ibn al-Haytham's in his "Book of Optics") and more

recent contributions by Newton (1642-1727) and Karl Popper (1902-1994), the Scientific Method has consisted of four major steps:

1. Observation and description of a phenomenon or group of phenomena (the observed EFFECT).
2. Formulation of a hypothesis to explain the phenomena (the hypothesized CAUSE).
3. Use of the hypothesis to predict the existence of other phenomena, or to predict quantitatively the results of new observations (the predicted EFFECT).
4. Performance of experimental tests of these predictions (the EXPERIMENT).

What makes the Scientific Method unique and probably so difficult to accept to the social sciences is that, although the more of your predicted effects are validated, the stronger the evidence of validity, the opposite is not true. If even one of your predicted effects cannot be validated, it can falsify the whole hypothesis. In fact, Popper introduced a very strict rule on the formulation and acceptance of theories - unless a theory can be falsified, it cannot be called a scientific theory. These strict criteria also made it clear that, at least as far as scientific theories go, a scientific theory (hypothesis) can never be proved, only disproved. Nassim Taleb, in "Fooled by Randomness" (Taleb, 2005), provided a simple example of this. If you are a scientist that studies swans, you will never be able to prove a hypothesis that "All swans are white" - even after doing 1000's of observations that all confirm the hypothesis - as it takes only a single observation of one black swan (as happened after the discovery of Australia) to falsify the hypothesis.

Since scientist can only disprove hypothesis but, at the same time, have a need for using the best one(s) available, the other important part in the evolution of the Scientific Method is the evolution of what "good enough" criteria can be used to decide when to adopt a new hypothesis/paradigm vs. when to keep on testing.

During this specific part of the research, it became more and more evident:

- How frequently we make assumptions (hypothesis) in every-day life and in managing organizations which we never attempt to validate or invalidate and yet continue to act as if they are true (or false).

- How frequently we do not make the effort to identify criteria for validation (or invalidation).
- How seldom we test our own assumptions since our brains seems to be almost wired to validate rather than invalidate assumptions.

I therefore wanted to ensure that the basis of the Scientific Method - applying EFFECT-CAUSE-EFFECT as recommended by Dr. Eli Goldratt in his Theory of Constraints (Goldratt, 1990) - should be the basis for formulating and testing and continuously improving our hypothesis around what really limits us from seeing and unlocking inherent potential within our own lives and organizations and how these limitations can be overcome.

As stated earlier, there is one application of the System's approach that stands out from the rest if measured simply by the level of results achieved and its sustained usage and evolution over a period of more than 30 years. The next section provides an overview of the Theory of Constraints and provides the justification of why I specifically selected the Theory of Constraints as both a guiding philosophy for the new Conceptual Design as well as the basis for the practical "how to" processes and methods to achieve the research aim of finding a simple and generic process to help organizations and individuals identify and unlock inherent performance without triggering "resistance to change" and without the risk of the high failure rate of previous changes.

2.6 Review of Theory of Constraints

The Theory of Constraints, developed by Dr. Eliyahu M. Goldratt, is a management philosophy that is based on a Systems Approach that has the aim of providing practitioners not only with the "what" (the underlying principles for continuously and sustainably improving organizations) but also the "how to" – the analysis processes, policies, practices and measurements needed to practically implement a Systems Approach for achieving continuous improvement within their organizations.

The continuous evolution and growth in its adoption can be qualified through an investigation of books that have been launched since the first TOC book - THE GOAL by Dr. Goldratt - appeared on book shelves in 1984. A search on Amazon showed over 100 books that are currently in-print which either contain "Theory of Constraints" in its title or are fully dedicated to one or more of the applications of Theory of Constraints.

As an illustration of how widely TOC is being applied, in 2008 IBM Press released "Reaching the Goal: How Managers Improve a Services Business using Goldratt's Theory of Constraints", authored by John Ricketts, an executive with IBM's Global Services division, that shows how IBM have applied TOC within their business and how other service organizations can do the same. In 2005, Julie Wright and Russ King, both practitioners within the National Health Services (NHS) in Britain, authored "We all fall down: Goldratt's Theory of Constraints for Healthcare Systems" on the story of how TOC has revolutionizing Health Care. Khaw Choon Ean, a TOC for Education teacher, authored "Thinking Smart: Applying the Theory of Constraints in Developing Thinking Skills" about the story of how schools within Malaysia have applied TOC within the school systems and the results achieved (more than 500,000 kids are educated there every year to learn how to think using TOC). Appendix 1 includes a full listing categorized by TOC application and publishing date).

Another way to qualify the popularity of TOC is to investigate the results achieved by those managers that have implemented TOC within their organizations. The magnitude and consistency of the results that have been achieved through the application of TOC within thousands of organizations, of all types and sizes around the world, have been widely reported¹. One such example is a research study by Victoria Mabin and Steven Balderston titled "The World of Theory of Constraints: A review of International Literature", which reported the following mean improvements achieved by organizations that implemented TOC:

- Lead times: Mean Reduction of 70 %
- Cycle-times: Mean Reduction of 65 %
- Due Date Performance: Mean improvement of 44 %
- Inventory levels: Mean reduction of 49 %
- Revenue / Throughput: Mean increase of 63 % (outlier exclusive)

¹ See websites like www.toc-goldratt.com and www.realization.com that contain extensive reference banks with results presented by managers from the organizations that implemented TOC.

How is it possible for TOC to have helped managers within these organizations (many of which would be considered large and complex) to identify and unlock so much inherent potential?

The next sections provide the answer to this question in the form of identifying the specific TOC mindsets (principles) and methods (processes) that enable managers from a diverse group of organizations to consistently achieve such significant and sustained system improvements as well as my observations and reasoning on the remaining difficulties to apply TOC and the gaps within the current body of knowledge that can block organizations from fully adopting and/or benefiting from TOC.

2.6.1 Goldratt's "Cost World vs. Throughput World Thinking" analogy

Goldratt, in "The Haystack Syndrome" (Goldratt, 1990), refers to the traditional reductionist approach still being used by many organizations as "Cost World" (CW) thinking – a thinking that assumes the additive rule applies and therefore assumes that *global optima for the organization can be achieved by achieving local optima in each of its parts*. In the CW, systems are viewed as made up of sets of independent variables where everything becomes important. For example, each cost driver provides an opportunity to reduce the total cost. In the CW, analysis consists of identifying and solving the biggest problems (those parts or processes with the largest gap between actual and potential performance). In this CW, there is an endless supply of problems to solve, creating a high (and false) expectation for systematic, predictable and continuous improvement in goal units as these "local" problems are solved one-by-one. However, CW type managers are also fully aware (based on their past experience) that most of the past "improvement projects" did not deliver any overall system improvements and some even caused damage (despite the strict "return-on-investment" justifications that must normally be submitted for each new change or investment).

Surely solving any problem should bring benefits to the system as a whole, and the larger the problem, the larger the benefit should be? Unfortunately, this simplifying assumption of the CW is simply not true for systems (organizations) where a change in one part can have a potentially negative side-effect on other parts or where there are scarce resources such as management time or cash from shareholders.

- *Unintended Negative Consequences example:* The purchasing department is under pressure to "save every cent possible" and decide to buy from China to

reduce the cost per part by 5 %. However, the lower quality parts require additional rework or repair and cause a 10 % loss in total factory throughput.

- *Scarce Resource Consequences example:* When management invest their time on changes or initiatives that, although it improves the local part's potential performance and to a small extent contributes positively to the whole system's actual performance, these efforts occupies scarce management time and resources that could have been used to invest in changes that could have made a big impact on the system. I.e. by investing time in the many things that make a small system impact, management do not have the time to invest in the few things that can make a big system wide impact.

The approach of the CW is in stark contrast to the Systems Approach proposed by Goldratt, which he calls the Throughput World (TW) thinking. TW thinking acknowledges that, for all real-life systems, the additive rule simply does not apply to explain the relationship between changes to the parts of system and progress towards the goal of the system. TW acknowledges that *global optima can never be achieved through local optima*. TW thinking claims that the only way to reach global optima for the system as a whole is to focus on improving the few parts that, at any point in time, constrain the performance of the system as a whole. Goldratt called such parts a "System Constraint" or the "Weakest Link" within the system (*the strength of any chain is limited by its weakest link*).

2.6.2 Goldratt's new classification of "complex systems" and its implications

Probably one of the most significant contributions by Goldratt was to provide an alternative definition for system complexity. General Systems Theory (GST) and Systems Thinking (ST) firstly made managers aware (e.g. in Senge's "Fifth Discipline" of 1990) that they should not make local changes that can damage the system as a whole and, secondly, that they should rather focus on high-leverage changes (small changes that result in a large system impact) and not waste time and money on low-leverage changes (small changes that result in a small system impact). But, has the awareness created by GST and ST really been sufficient to help managers make better decisions (to prevent these two types of mistakes)?

The answer is "no" and the reason is quite simple. Even the smallest of organizations can rightfully claim that they are complex systems, both in terms of detail complexity

(many parts) and dynamic complexity (many interactions between the parts over time). Systems with both types of complexity are defined within ST as “inherently complex” because their behaviour is non-linear, which makes it extremely difficult (with our linear orientated intuition) to predict the impact of a change or to differentiate between high-leverage- and low-leverage points.

In the 1960’s, Jay Forester and his team at MIT developed a potential solution to this problem. Forester called the new field “System Dynamics”, which focused on constructing fairly representative computer simulation models that can be used to better understand the behaviour of “inherently complex” (non-linear) systems over time. These models could directly assist with answers to the two unresolved problems: predicting the impact of changes at a specific point in time and space on the performance of the system over time and (through experimentation and sensitivity analysis) use the models to differentiate between low-leverage- and high-leverage points. The way these simulations models are constructed involves, in simple terms, modelling the major parts of the system that are believed to contribute to its behaviour (defining the characteristics and range of the states of each part) and then adding to the model the rules that define how the parts interact under specific conditions. Any “what will happen if” type questions are answered by simply pressing the “play” button, observing the dynamic changes over time, and then analysing the results compared to a baseline where no changes were introduced.

These types of tools are used extensively today with excellent results in fields such as Economics, Accounting and Operations Research. But Systems Dynamics has provided limited assistance to managers that have to make decisions and judgements every day on when to make changes, where to make these changes and what changes to make to give the highest leverage on their investment of time and/or money.

Goldratt showed in his business novel “The Goal” in 1984 that the System Constraint limits the throughput of the whole system in the same way as the weakest link limits the strength of the whole chain. But what about systems (such as organizations) with multiple flows and multiple flow constraints, some of which might be connected, that make such systems appear closer to a network than a chain with only one weakest link?

In his 1988 article titled “How complex are your systems?”, Goldratt reminded managers and ST practitioners that it is not the number of parts, interdependencies or even the number of constraints that determine the complexity of the system.

Complexity is a result of the number of interactive constraints – constraints that impact each other.

The performance of a system with a large number of *independent* sub-systems, each with their own constraint (that limits the throughput of that sub-system), is simply the summation of the performances of the subsystems. For example, the total sales and profitability of a Holding company made up of 4 *independent* business divisions is simply the summation of the sales and profitability of each of these business divisions. This, Goldratt claims, is a simple system since there are no inter-active constraints. But what about systems with multiple and interactive constraints?

Goldratt already proved in his 1981 article titled "The unbalanced plant" that, due to the existence of two phenomena we find in all real-life systems – statistical fluctuations and dependent events – the existence of interactive resources constraints are highly improbable since such systems behave chaotically (unpredictable and unreliable performance) and these types of systems do not survive long in competitive environments.

The implication of this realization is that most organizations, although containing significant detail and dynamic complexity, are still inherently simple, since it is likely these organizations still have only ONE System Constraint at any point in time (where average availability is less than the demand placed on it). If an organization really has interactive constraints, the TOC message is simple – find ways to elevate the availability of these or to reduce the demand until there is only one System Constraint (since chaotic performance cannot be tolerated).

Goldratt's Theory of Constraints is, therefore, a major breakthrough, since it provides a practical alternative to the current management practice, which is driven mainly by the assumption that global optima are achieved through local optima. Goldratt showed that, in fact, we can analyze, improve, manage and predict the performance of the whole system by simply analyzing, improving, managing and predicting the performance of only the System's Throughput Constraint(s) (not all the system's parts).

Goldratt translated this insight into a practical focusing mechanism called the Five Focusing Steps and later created the Thinking Processes (based on necessity and sufficiency logic) to help practitioners when resistance to change or other obstacles block them from implementing any of the Five Focusing Steps.

The following sections provide a summary of the research on TOC's Five Focusing Steps, the insights of TOC to create a systematic way to identify and overcome resistance to change, the Thinking Processes that have been developed to help managers develop their own answers to the three important change questions they face (what to change, to what to change and how to cause the change) and finally, how the insights on TOC can be applied to develop sustainable and "profitable" growth strategies.

2.6.3 Goldratt's new definition of a "Problem" and its implications

A "problem" is defined in the Oxford Dictionary as any question or matter involving doubt, uncertainty, or difficulty that needs to be answered or resolved. We tend to use the word "problem" to describe anything (e.g. a gap between our expectations and reality) that bothers us. Something "bothers" us when we know the consequences of not dealing with it could be negative for others and ourselves within our system and/or because it puts us in a dilemma of what action or decision to take to deal with the problem.

Considering the importance and difficulty of knowing which problems are important to solve from a system's perspective (and, as importantly, which problems are not important) and the potentially major negative consequences on the system as a whole if major system problems are not solved, Goldratt proposed a new way in *"What is this thing called Theory of Constraints"* (Goldratt, 1990) to improve our ability to *"define and solve the right problems"*. This is an approach that is based on the definition used within the hard sciences for "problem".

In science there is general consensus that *"Define a problem precisely, and you are half-way to a solution"*. Einstein is quoted as having said, "if I had one hour to save the world I would spend fifty-five minutes defining the problem and only five minutes finding the solution"; while Bertrand Russell (1872-1970), the famous British philosopher, said that "The greatest challenge to any thinker is stating the problem in a way that will allow a solution".

Goldratt proposed a method called the "Evaporating Cloud" (sometimes referred to as a Conflict Cloud or Conflict Diagram). In the same way as scientist looks at problems as inconsistencies or contradictions, the Evaporating Cloud method aims to define any unresolved problem as an unresolved conflict in trying to satisfy two different necessary conditions of the same system. Goldratt identified two types of conflicts of which a "bad" compromise will result in significant problems for the system as a whole.

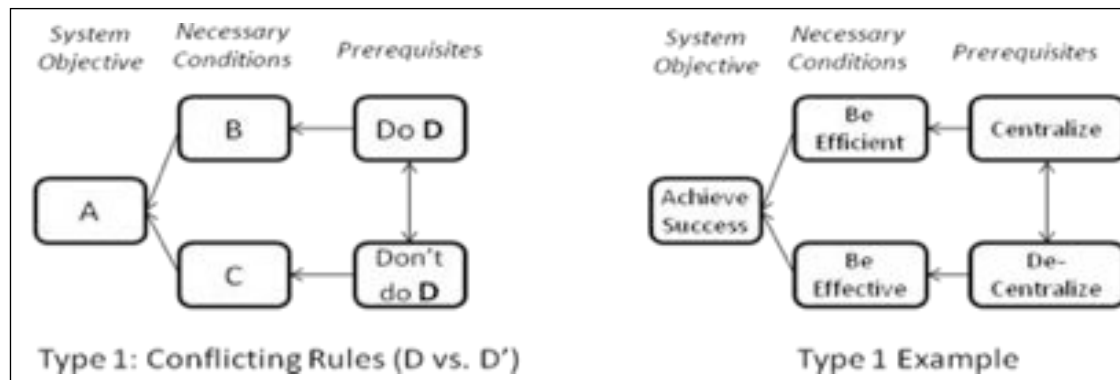


Figure 9 Goldratt's Evaporating Cloud: Type 1 conflict due to Conflicting Rules

Source: Adapted from Representation (Goldratt, 1990)

The first type of conflict (as shown in Figure 9) is a conflict which stems from a choice between opposite or different "rules or actions". The structure shows that if the system chooses "D" to satisfy the necessary condition "B", it will, by definition, jeopardize the satisfaction of necessary condition "C", which requires the system not to choose "D".

An example of this type of conflict is a choice between using a centralized structure to maintain common standards and efficiency within an organization vs. using a decentralized structure to reduce bureaucracy and the response time to changes. Both of these are necessary conditions to have a successful organization (system objective). Choosing "centralization" is assumed to enable achievement of better compliance to common standards and higher efficiency but at the same time, divisions claim that centralization will affect their effectiveness through causing more bureaucracy and increasing response time. The same is true for choosing "de-centralization" – divisions claim it should enable achievement of greater effectiveness (faster response and less bureaucracy), but corporate complain that decentralization will jeopardize efficiency and ensuring compliance to common standards.

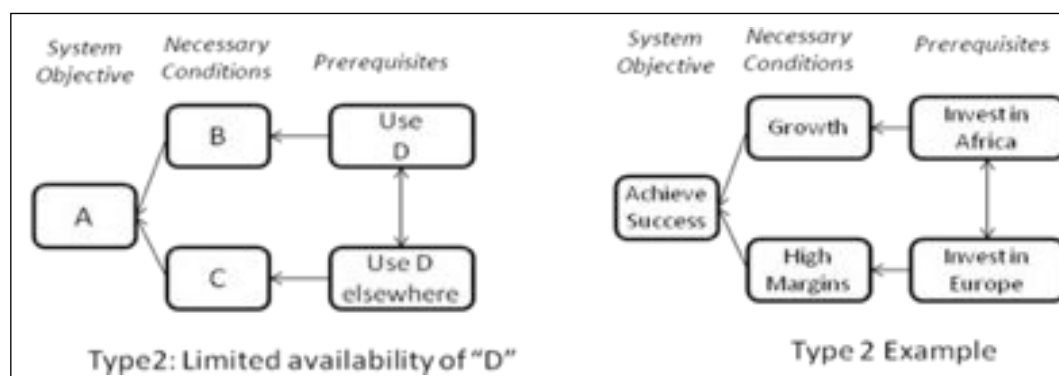


Figure 10 Goldratt's Evaporating Cloud: A Type 1 conflict due to a Scarce Resource

Source: Adapted from Representation (Goldratt, 1990)

The second type of conflict (Figure 10) is a conflict which stems from a choice between using the same scarce resource for two different applications. The structure shows that if the system chooses to use "D" to satisfy the necessary condition "B", it will, by definition, jeopardize the satisfaction of necessary condition "C", which requires the same resource "D".

The Process to define a problem as an unresolved Conflict Cloud is detailed in Figure 11.

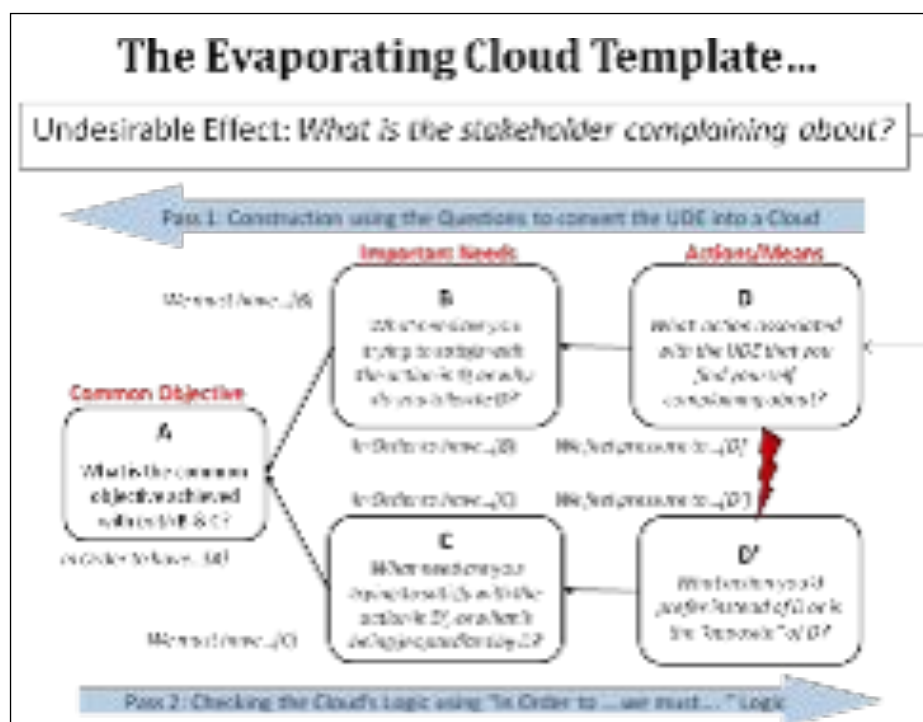


Figure 11 Evaporating Cloud Template for converting a UDE into a Unresolved Conflict

Source: Avraham Y. Goldratt Institute, "Jonah Program Workbook" (1998)

An example of this type of conflict (Figure 12) is a choice between investing management time and money in expanding into Africa to meet growth objectives, while at the same time feeling pressure to rather invest the time and money to further expand operations in Europe to maintain high margins. Again the structure of the conflict cloud shows that by investing scarce resources in Africa the business probably will jeopardise margins, while investing the same scarce resources in Europe will jeopardise growth.



Figure 12 Evaporating Cloud Example for defining a UDE as an unresolved Conflict

Source: Barnard (2006)

Figure 12 shows how, with this “Evaporating Cloud” method, Goldratt offers a simple way for managers to predict why one set of problems are frequently solved at the expense of another - either through focusing on only one side of the conflict or finding a compromise (a situation which attempts to satisfy both necessary conditions in an equal, but still only partial, way).

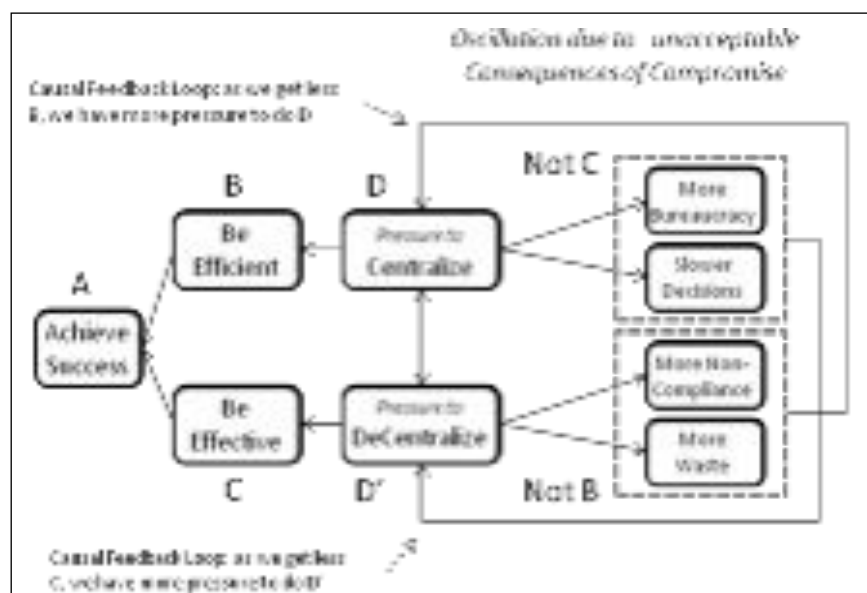


Figure 13 Oscillation from one side to another in conflict due to compromise

Source: Barnard, 2006, Goldratt "Jonah" Thinking Program

Relating back to the previous example of a Type 1 conflict (Figure 9), the conflict cloud diagram in Figure 13 shows that solving the problems stemming from centralization (*bureaucracy and slow decisions which impact effectiveness*) by switching to de-centralizing (as problems related to centralization become intolerable), will simply result in new problems – the problems relating to de-centralization such as non-compliance and waste from duplication of resources which negatively impacts efficiency. As these become more and more intolerable, pressure rises to once again go back to centralization.

The message from this way of explaining the consequences of an unresolved conflict is simple – if we want to escape the vicious cycle and oscillations, we need a way to break the conflict!

The realization that all problems observed within a system are the consequences of an unresolved conflict or bad compromise also highlighted the risks of using traditional problem solving techniques in dealing with systemic problems. In the traditional way, a manager will start with the highest level problem (e.g. profits are too low) and, through deductive logic, trace the "cause" to, say, centralization. What would be the solution from a traditional "root cause" analysis? Simply de-centralize (jumping to the opposite side of the conflict), which initially will appear to solve the problems related to the centralization (reduced bureaucracy and slow decisions), but these will soon be replaced with the undesirable effects related to de-centralization. In the traditional way, it is therefore not uncommon to keep going through the same cycles without ever realizing the unresolved conflict and without ever attempting to find a way to break the conflict.

For Goldratt, the "defining a problem precisely" phase therefore does not end with finding the "core problem(s)" within a system, but ends only after verbalizing the related unresolved conflicts and understanding the vicious cycle of simply oscillating from the one side to the other (similar to the vicious cycles shown in the Causal Loop Diagrams used in Systems Thinking). And "finding a solution" means finding a simple and practical solution to break the conflict (to evaporate the cloud) rather than simply solving the most prevalent problem currently and inadvertently simply oscillating from one side to the other side of the conflict or settling for some acceptable compromise where both necessary conditions are equally, but only partially, satisfied.

2.6.4 Goldratt's invention for finding simple solutions in complex systems

The structure of the Evaporating/Conflict Cloud highlights that we should redefine the criteria for a solution. The objective of finding a solution is no longer to find a way to diminish or remove a problem, but to find a way to remove the conflict conditions that will allow us to satisfy BOTH necessary conditions for achieving more goal units for the system.

Goldratt showed that inventing such a solution requires two conditions. The first is simply a basic belief that it is (almost always) possible *"to have your cake and eat it"* – i.e. it is (almost always) possible to satisfy both necessary conditions with a win:win solution. When we believe that it is *"not possible to have your cake and eat it"* we will immediately look for acceptable compromises rather than ways to remove the conflict altogether. In the same way that scientists do not accept contradictions in reality as inherent but treat contradictions as warnings that there must be one or more erroneous assumption within their current models, Goldratt states that we (in social systems) should not accept conflicts as inherent. We should view them simply as warnings that there is at least one erroneous assumption within the current way of managing our organizations.

To break conflicts, Goldratt proposed a simple mechanism for verbalizing and validating/invalidating the assumptions behind each of the logical arrows in the conflict cloud (*In Order to achieve more of A, I must have more of B because...[assumption]*) and then checking whether this assumption is always true and, if not, whether replacing it will break the conflict.

In summary, Goldratt's Theory of Constraints was the first to offer a practical solution to three of the most important problems that, for practical purposes, remained unsolved for managers who wanted to manage their organizations with a "Systems or Holistic Approach". These three problems are:

1. ***Where to focus improvements?*** TOC reminds us that if we want to improve the system as a whole, we should FOCUS improvement on the System Constraint(s) that currently limits the system performance.
2. ***How to differentiate between important and unimportant problems?*** TOC reminds us that "important problems" are problems that negatively impact the

System Constraint(s) now or in the foreseeable future as they limit or will soon limit the achievement of more goal units for the system as a whole. "Unimportant problems" are those that (although they highlight future improvement opportunities) do not impact the constraint negatively now or in the foreseeable future. Investing time or money to deal with these is not only a major waste, but will jeopardize the efforts needed to solve the important problems.

3. ***How to break the vicious cycle managers frequently experience when solving one problem simply comes at the expense of another?*** We can define any problem as an unresolved conflict and the resulting vicious cycle (when we oscillate from one side to the other) and sub-optimal performance (if we seek compromises) if we do not find a way to break the conflict. Once the conflict and vicious cycle is validated, we should use the same methods employed in the "hard sciences" to identify and validate potential erroneous assumptions and then find solutions to replace these that will "evaporate the conflicts" and therefore stop the vicious cycles and related problems.

The next sections summarize the practical mechanisms (processes) and methods (thinking tools) developed by Goldratt to enable managers to capitalise fully on these three new insights.

2.6.5 TOC's holistic focusing mechanism – The Five Focusing Steps

Goldratt (1990: 10) defined a simple five step focusing process for achieving continuous and step-change improvement. The process is based on the principle that any organization's performance is limited by the "weakest link" or current System Constraint.

TOC's five step focusing process exploits the inherent potential that can be "unlocked" or "created" through focusing scarce resources on identifying and continuously strengthening the "weakest link" in the system.

Theory of Constraint's Five Focusing Steps

Step 0: Agree on the System GOAL (to define "Constraint" and "problem")

Step 1: IDENTIFY the Systems Constraint(s) (the Weakest Link)

Step 2: Decide how to EXPLOIT (protect - not Waste) the Systems Constraint(s)

Step 3: SUBORDINATE everything else to the above decision

Step 4: ELEVATE the Constraint

Step 5: If, in the previous steps, a constraint has been broken, GO BACK TO STEP 1.

Warning: Do not allow inertia to cause a Systems Constraint.

Recently, Goldratt announced (TOCICO Conference of 2006 in Miami) that he has, from the latest experience with Viable Vision Projects, realized that there should be a few clarifications and additional warnings within the Five Focusing Steps. A new realization from applying the Five Focusing Steps to develop Business strategy is that, to achieve both stability and growth, we need to start Step 1 by defining the constraint to be in the market. Taking this decision means that Step 2 and Step 3 should focus on only identifying and replacing those few “rules” (policies, measurements and behaviours) that are in conflict with the better exploitation and/or elevation of the current Systems Constraint (full subordination). After this is done, the system becomes quite stable and predictable until the constraint moves. This is when the organization is at risk of falling back into chaos (with unpredictable behaviour and very high sensitivity to changes in starting conditions). Goldratt’s advice on how to prevent this is to build a strategy that will ensure the constraint does not move. If it does not move, we do not need to change the rules (we might have to add rules as we grow into new markets and products/services, but not change existing rules).

Although not yet published, Goldratt’s recommendation is that, in future, Step 4 should carry a warning that all resources should be elevated to ensure the constraint remains in the same position or, simply put, to try never to reach Step 5. Goldratt calls this new way of thinking “progressive equilibrium”, which means we actually subordinate everything to the desired growth rate of the company – ensuring the company does not grow too slow but also not too fast.

How do we apply TOC’s five focusing steps to developing Business Strategy and specifically Business Model innovation?

As stated earlier, when the five focusing steps are applied to Business Strategy, the System constraint is normally assumed to be within the market (Step 1). Therefore, the next step is to decide how to better exploit (and not waste) the market constraint – i.e. identifying those conditions that, if satisfied, will get more customers to buy or get customers to pay more. Examples of such conditions include shorter lead times, penalties on late deliveries etc. The third step of subordination provides the details of

what changes will be required to ensure we satisfy the conditions for exploiting the market constraint. Step 4 specifies that if the improvements in the previous 2 steps were insufficient to achieve the goal, then we need to elevate the constraint. When the constraint is in the market, elevation means elevating market potential with new products or new markets.

2.6.6 TOC's holistic decision making mechanism – Throughput Accounting

One of the key requirements of adopting a Systems Approach is the ability to judge the impact of decisions on the system as a whole – especially the impact of financial decisions. For most managers in organizations, the idea of trying to evaluate the impact of their local decisions or proposed investments on the “system as a whole” is a daunting, lengthy and frequently frustrating experience (especially if they need to make a decision ASAP). Throughput Accounting (TA) was invented by Dr. Eli Goldratt (Goldratt, 1990) to meet this challenge as an alternative to cost accounting. Throughput Accounting (according to the IMA Statement 4HH on Theory of Constraints) differs from traditional Cost Accounting firstly in its recognition of the impact of constraints on the financial status of an organization (i.e. if a decision impacts the constraint, the system's Throughput will be impacted and vice versa) and secondly in that it separates Totally Variable Cost from Operating Expenses (all costs that are not totally variable with increased /decreased production) to assist with faster and better decisions. This definition removes the need to allocate all costs to products and services, which frequently results in sub-optimum decisions when managers erroneously assume that once Operating Expenses were allocated they become variable (Smith, 2000).

Throughput Accounting improves profit performance (even for not-for-profit organizations) with better and faster management decisions (Corbett, 1995), by using measurements that more closely reflect the effect of decisions on three critical monetary variables – Throughput, Investment/Inventory), and Operating Expenses (defined below).

When cost accounting was developed in the 1890's, labour was the largest fraction of product cost. Workers often did not know how many hours they would work in a week when they reported on Monday morning because time-keeping systems were rudimentary. Cost accountants, therefore, concentrated on how efficiently managers

used labour since it was their most important variable resource. Now, however, workers who come to work on Monday morning almost always work 40 hours or more; their cost is fixed rather than variable. However, today, many managers are still evaluated on their labour efficiencies, and many "downsizing", "rightsizing" and other labour reduction campaigns are based on them.

Goldratt argues that, under current conditions, labour efficiencies lead to decisions that harm rather than help organizations. Throughput Accounting, therefore, removes standard cost accounting's reliance on efficiencies in general, and labour efficiency in particular, from management practice. Many cost- and financial accountants agree with Goldratt's critique, but they have not agreed on a replacement of their own and there is enormous inertia in the installed base of people trained to work with existing practices.

Goldratt's alternative begins with the idea that each organization has a goal and that better decisions increase its value. The goal for a profit maximizing firm is easily stated - to increase profit now and in the future. Throughput Accounting applies to not-for-profit organizations too, but they have to develop a goal that makes sense in their individual cases.

Throughput Accounting also pays particular attention to the concept of a 'bottleneck' (referred to as constraint in the Theory of Constraints) in the manufacturing or servicing processes.

Organizations that wish to increase their attainment of their goal should therefore require managers to test proposed decisions against three questions:

Will the proposed change:

1. Increase Throughput? How will it impact the Systems Constraint or Bottleneck?
2. Reduce Investment (Inventory)? How?
3. Reduce Operating Expenses? How?

The answers to these questions determine the effect of proposed changes on system-wide measurements:

1. Net profit (NP) = Throughput - Operating Expense = T - OE
2. Return on Investment (ROI) = Net Profit / Investment = NP/I
3. TA Productivity = Throughput / Operating Expense = T/OE

4. Investment Turns (IT) = Throughput / Investment = T/I

These relationships between financial ratios, as illustrated by Goldratt, are very similar to a set of relationships defined by DuPont and General Motors financial executive Donaldson Brown in approximately 1920. Brown did not advocate changes in management accounting methods, but instead used the ratios to evaluate traditional financial accounting data.

In summary, Throughput Accounting is an important development in modern accounting that allows managers within both Private and Public Sector organizations to understand the contribution of constrained resources to the overall profitability (goal unit generation) of the organization and the frequently non-linear impact of local actions or decisions on the overall profitability and viability of an organization.

2.6.7 TOC's logical Thinking Processes to develop simple solutions

Goldratt (1990) emphasizes the importance of using a "Socratic Approach" for leading change and especially in facilitating innovation. He explains that if what you want is action to be taken, then you simply must refrain from giving answers. He also claims that management simply does not have all the answers. The people that deal with the problems on a daily basis are the ones with the strongest intuition about this. For both these reasons Goldratt recommends that a "Socratic Approach" in facilitating change and innovation should be followed – an approach where change or innovation facilitators ask questions but do not give answers. But a "Socratic Approach" requires that we know which questions to ask and what thinking processes can be used to answer these questions.

Every manager is overwhelmed with problems or, as some would call them, opportunities or gaps between the actual performance of a part or process within a system and its potential performance. We all frequently tend to concentrate on taking corrective actions that we know how to take, rather than focusing on the problems we should correct and the actions needed to correct these. To prevent this mistake (which can happen at every level within an organization), Goldratt proposed that the first question managers should have the means (process, information.) and ability (skills, confidence, experience) to answer should always be WHAT TO CHANGE? This is the ability to differentiate and identify the core (high-level) problems - those problems that, once corrected, will have a major impact on the goal units of the system - from the many small (low-leverage) problems that, even if corrected, have two major negative

side effects. Firstly, correcting a low leverage problem, by definition, implies that its impact is likely within the “noise” or natural fluctuation of the system, so we won’t be able to measure its success. Secondly, and by the far the most damaging, is that solving low-leverage problems consumes scarce management time and resources that prevent managers from solving those core problems that could have made a significant contribution to the goal units.

Once core problems have been identified, the next means and ability required by managers is to construct simple, practical solutions. Goldratt warned that, considering the fascination of most managers with sophisticated solutions, this ability and even awareness is quite rare. We should remind ourselves that complicated solutions are difficult to understand (and therefore to get buy-in for) and seldom work because of all the potential negatives and implementation obstacles. In contrast, simple solutions are easy to understand and normally quick to implement and to get feedback on whether it has worked or not.

This means that an ability to invent and validate simple practical solutions will allow the manager to answer the second question of any change initiative - TO WHAT TO CHANGE? Once a simple solution has been identified and tested (through rigorous effect-cause-effect logic and/or field testing), Goldratt proposed that the third question which managers need the means and ability to answer is HOW TO CAUSE THE CHANGE? – i.e. identifying the detailed steps and the sequence of these steps to gain buy-in for the solution and develop practical ways to overcome implementation obstacles.

To ensure that the application of the three questions achieves the system’s improvement target, it is critical to always use the three questions within the framework of the Five Focusing Steps, rather than as a separate entity.

In summary, Goldratt proposed a simple framework for achieving system-wide improvement:

1. WHAT TO CHANGE? – identifying core problems that block better exploitation or elevation of System Constraints.
2. TO WHAT TO CHANGE? – inventing and validating simple practical solutions to enable better exploitation or elevation of System Constraints.
3. HOW TO CAUSE THE CHANGE – achieving consensus and ownership by inducing the appropriate people (through a Socratic process) to invent such solutions and

to enable them to find ways to prevent any negatives and/or overcome implementation obstacles they are concerned could block or compromise an implementation.

Appendix 2 shows the roadmap of TOC Thinking Processes invented by Goldratt (Source: Jonah Program Workbook by Goldratt and Houle from the Avraham Y. Goldratt Institute, 1998) that shows which of the TOC Thinking Process is used to provide answers to each of the above three change questions.

2.6.8 The 3 Cloud Process and the 4x4

In 1996 a new process for answering "What to Change" was discovered at a Program where the TP were being used by individuals (mostly children and spouses of TOC practitioners known as "Jonahs"). In the traditional process, all the UDE's identified in a specific subject would be connected via cause-effect and then check for sufficiency to create a "Current Reality Tree". It was assumed that those UDE's that appeared at the bottom of the tree would be the Core Problem(s). This Core Problem was then defined (Scheinkopf, 1999) as a Core Conflict with the "Cloud Process" to firstly understand the conflict that is blocking the organization or individual from addressing the core problem, then to expose possible erroneous assumptions and finally to find a simple way to break the conflict with a win:win (rather than a compromise).

The new process was called "The 3 Cloud Process" and relied on the "fractal nature" (Goldratt, 2008) of organizations to start with 3 UDE's, do their respective "UDE Clouds" to identify the specific conflicts that block the organization or individual to deal with the UDE's and then to synthesise these 3 UDEs into a single Core Conflict (Lapore & Cohen, 1999). After comprehensive testing by TOC practitioners around the world, the then Managing Partner of the Avraham Y. Goldratt Institute announced at the 1998 "Jonah Upgrade Workshop" that this new 3 cloud process *"is not only faster but more comprehensive, highlighting exactly what needs to be changed in reality"*.

In 2001, the 3 Cloud Process started to be used as a reliable and fast way to help organizations develop "constraint breaking business strategies" (Kendall, 2003) in what was then known as the "4x4" process – 4 days to re-align the paradigms of managers by exposing the cause-effects for each of the main functions in their organization and another 4 days to use the TOC Thinking Process roadmap (Appendix 2) to answer each of the three Change questions: "What to Change?", "To What to Change?" and "How to cause the change?".

2.6.9 TOC's insights on Resistance to Change and how to overcome it

The TOC approach to change follows a standard set of steps that proceed incrementally and logically toward buy-in. By embracing objections (typically verbalized as "yes, but..."), rather than discouraging them, buy-in grows progressively stronger. Hence, changes don't just disappear as soon as the change agents leave. Moreover, the enterprise itself is better positioned to achieve continuous improvement via a series of changes orchestrated around its constraints.

The TOC approach to managing change can and has been successfully applied to both Private and Public Sector organizations (Kendall, 2003). However, the unique characteristics of the Public Sector means that, internal or external change agents will frequently be required to facilitate not just first-order, but also second-order and even third-order change that introduce higher probabilities of failure.

- First-order change requires contribution and/or buy-in from only one group or enterprise such as a client or the change agent's own enterprise. Note that the group or enterprise goal is common to all members, even though those members have different personal goals.
- Second-order change requires contribution and/or buy-in from groups or enterprises with a direct relationship but separate goals, such as service providers and clients, manufacturer and distributor, retailer and consumer or utility and regulatory authority.
- Third-order change requires buy-in from groups or enterprises with an indirect relationship and different goals, such as a client's client, customer's customer, supplier's supplier, professional association or legislative body.

The more parties involved and the more disparate their goals and perspectives, the harder it is to get comprehensive buy-in. Moreover, selling a decision to people not involved in the decision making can be extremely difficult. So, bringing multiple parties into the TOC approach to change can increase the odds of buy-in and reduce rework, but at the same time increase the risk of failure, especially in environments where there are significant levels of distrust between stakeholders and, as with most bureaucracies, anyone can say "no" but almost no-one can say "yes".

Table 2, adapted from "Reaching the Goal: How managers improve a Service Business using Goldratt's TOC" (Rickett, 2008), provides a summary of the generic levels of

resistance defined within TOC that can block implementation and the associated steps of achieving contribution and buy-in to overcome each of the levels of resistance.

Table 2 TOC's Layers of Resistance and a Step-by-Step Contribution & Buy-in Process

Levels of Resistance	Change Question	TOC's Steps of Contribution and Buy-in
0. Disagreement on the Goal and GAP		0. Agreeing on the Goal and GAP
1. Disagreement on the Core Problem	What to change	1. Agreeing on the Core problem
2. Disagreement on the direction of the solution	To what to change	2. Agreeing on the direction of the solution
3. Lack of faith that the solution will be sufficient to achieve the goal	To what to change	3. Agreeing that the solution is sufficient to solve the problem
4. Too many negative side effects	To what to change	4. Agreeing that the solution will not lead to significant negative effects
5. Solution is too hard to implement	How to cause the change	5. Agreeing on how to overcome obstacles that block implementation
6. Un-verbalized Fear		6. Agreeing to implement with the needed means, ability and accountability

Adapted from table by John Rickets in "Reaching the Goal: How managers improve a Service Business using Goldratt's TOC" (2008)

The layers of resistance and steps to overcome these are similar to the Eight-Stage Process for creating major change published by John Kotter in "Leading Change" (1996) as seen in Table 3.

Table 3 The Eight Stage Process of Creating Major Change

The Eight-Stage Process of Creating Major Change While Avoiding the Eight Errors Common to Organizational Change Efforts	
Advice for avoiding common errors to organizational change	Implications
Error #1: Allowing too much complacency 1. Establish a sense of urgency Examine the market and competitive realities Identify and discuss crises, potential crises, or major opportunities	All employees must feel a sense of urgency at the beginning of a transformation in order to motivate them to give extra effort, make needed sacrifices.
Error #2: Failing to create a sufficiently powerful coalition Create the guiding coalition Put together a group with enough power to lead the change Get the group to work together like a team	Create the coalition of department members with the "right" titles, information and expertise, reputations, relationships and capacity for leadership.
Error #3: Underestimating the power of vision Develop a vision and a strategy Create a vision to help direct the change effort Develop strategies for achieving that vision	Communicate a <u>clear, compelling, sound, and sensible</u> vision to direct, align, and inspire action.
Error #4: Under-communicating the vision by a factor of 10 or 100 or even 1000 Communicate the change vision Use every vehicle possible to constantly communicate the new vision and strategies Have the guiding coalition role model the behaviour expected of employees	Communicate that the change vision is <u>attractive</u> and <u>possible</u> . Say it often Have many people say it Hold visible, important (see 2 above) people accountable <u>to act it</u> Coalition must act consistently with the verbally communicated vision
Error #5: Permitting obstacles to block the new vision Empower broad-based action Get rid of obstacles Change systems or structures that undermine the change vision Encourage risk taking and non-traditional ideas, activities, and actions	Assure that supervisors help employees to identify and overcome true obstacles. Especially assure that supervisors themselves are adapting to new circumstances, and not undermining change and disempowering their employees.
Error #6: Failing to create short-term wins Generate short-term wins Plan for visible improvements in performance, or "wins" Create those wins Visibly recognize and reward people who made the wins possible	Real transformation takes time. Therefore, <u>create</u> , don't hope for, short-term wins based on short-term goals, and <u>celebrate</u> . Managers must actively look for ways to: obtain clear performance improvements establish goals within the yearly planning system achieve these objectives Reward the people involved with recognition, promotions, or money. Being forced to produce short-term wins can be a useful element in the change process.
Error #7: Declaring victory too soon Consolidate gains and produce more change Use increased credibility to change all systems, structures, and policies that don't fit together and don't fit the transformation vision Hire, promote, and develop people who can implement the change vision Reinvigorate the process with new projects, themes, and change agents	Cultural change can take 3 to 10 years, and until it is complete, new approaches are fragile and subject to regression. Therefore, don't declare victory too quickly. Don't go overboard with enthusiasm when you see progress. Resisters can be quick to spot an opportunity to undermine the effort. Change can come to a halt and previous, irrelevant, traditions can creep back in.
Error #8: Neglecting to anchor changes firmly in the corporate culture Anchor new approaches in the culture Create better performance through customer- and productivity-oriented behaviour, more and better leadership, and more effective management Articulate the connections between new behaviours and organizational success Develop means to ensure leadership development and succession	Consciously demonstrate how specific behaviours and attitudes have helped improve performance. Assure that promotion criteria are reshaped to reward behaviour that is consistent with the new culture.

Source: From *Leading Change*, by John P. Kotter. Boston: Harvard Business School Press, 1996.

The next section reviews the implications of TOC on the principles and methods used to formulate strategy and planned changes.

2.6.10 The TOC way to formulate Strategy

In 'Reaching for the Goal' (2008), John Rickett states that "the TOC approach to strategy recognizes that strategy should be built around constraints, because they limit what the enterprise can accomplish even though they aren't incorporated in its strategy". The TOC approach is based on careful analysis of cause-effect relationships between constraints, core conflicts, core problems (erroneous assumptions and related "local optima" rules) and undesirable effects. It therefore increases the odds that a change in strategy will move the enterprise towards its goal. Table 4 summarizes the difference between the conventional and the TOC way of developing Strategy and dealing with Change.

Table 4 The Conventional and TOC way of defining Strategy and managing Change

Strategy and Change	Conventional	Theory of Constraints
Guiding principle is...	Push	Pull
Strategic innovation address...	Any aspect of enterprise	Constraints
Impetus for strategy is...	Pain Points	Core Problems
Strategy is determined by...	Various methods	Cause and effect
Competing mainly on price is...	Acceptable	Not Acceptable
Heart of strategy is...	Core competency	Compelling market offers
Strategy constraints are...	Not crucial to strategy	Deliberately chosen
Investments often target...	Operating Expenses	Throughput (Sales – Variable Cost)
Impetus for change is...	Pain Points	Core Problems
Resistance to change is...	Discouraged	Embraced
Problems are...	Framed by change agent	Reached by consensus
Direction of Solution is set by...	Compromise	Conflict resolution injections
Solution is presented...	As soon as possible	Only after groundwork is laid
Reaction to side-effects is	Persuasion (to ignore)	(to use them) to Polish the solution
Reaction to obstacles...	Persuasion (to ignore)	Polish the implementation
Reaction to un-verbalized fear is...	(Even more) Persuasion	Redo earlier steps
Change and sales...	Separate Steps	Same Steps
Main Focus is...	Many problems in each part	Few System Constraints

Source: John Ricketts, 2008, "Reaching the Goal: How managers improve a services business using Goldratt's Theory of Constraints", IBM Press

Central to TOC's approach to strategy is the assertion that the following conditions are necessary for a successful enterprise:

- Owners set the organization's goal
- Employees get secure and satisfying work
- Customers / clients receive satisfactory products / services
- Supply Chain partners are treated fairly
- Authorities regulations are satisfied
- The enterprise achieves ongoing improvement

If any of these conditions are not met, the organization is probably at risk of stagnation or even decay in their performance. Conversely, if any conditions could be improved on that are currently not at the level of "good enough" (it negatively impacts the organization's overall performance), the enterprise has an opportunity to achieve more goal units e.g. higher levels of stability and growth).

An effective strategy therefore addresses one or more core problems related to better exploitation or elevating a Systems Constraint or simply to ensure satisfaction to the level of "good enough" of any of the above "necessary conditions". In TOC terms, an innovation that matters is a change that helps an organization to better exploit and/or elevate a constraint and/or ensure satisfaction of a necessary condition. Rickett claims this is a subtle but profound distinction because an innovation that improves a non-constraint just doesn't matter in so far the goal goes – regardless of how "innovative" and "world-class" it is.

This realization should also be a warning against the conventional way of benchmarking: finding gaps within local performance based on benchmarking against an organization considered to be the best within that area and then implementing their benchmark solution.

In TOC terms, a solution is only "innovative" if it allows the organization to address a core problem that currently limits or blocks the organization from better exploiting or elevating a Systems Constraint or satisfies a necessary condition that is not at the level of good enough. Benchmarking, according to the TOC way, should therefore be focused

on only adopting “benchmarked” solutions of organizations with similar core problems or constraints.

Innovations that really matter are those that address physical (capacity or capability) constraints such as equipment capacity, material quality and people capability. Other innovations that matter address process- or policy related core problems such as transfer pricing, local optima planning rules etc.

Table 5 summarizes the difference between the TOC and Conventional approach to strategy within Public Sector (service orientated) organizations.

Table 5 Conventional vs. Theory of Constraints way to manage Public Sector Organizations

Strategy for Public Service Org.	Conventional	Theory of Constraints
Basic Elements are ...	Expertise, Clients, services, charges	Goals, constraints, innovations (exploit), investments (elevate)
Schools of thought are ...	Varied	Cause-effect
Approaches are...	Varied	Solve core problems related to necessary conditions
Interface constraints affect...	Cost	Throughput and buffer sizing
Breakthroughs come from...	Expertise, service levels, pricing	Breaking multiple policy constraints
Strategic constraints are...	Unseen / Arbitrary	Deliberately positioned
Investment decisions use...	Cost Accounting	Throughput Accounting
Guiding principle is...	Global optimization comes from local optimization	Global optimizations comes from constraint optimization (better exploitation / elevation)

Adapted from table by John Ricketts in "Reaching the Goal: How managers improve a Service Business using Goldratt's TOC" (2008)

2.6.11 Remaining Gaps in TOC Body of Knowledge

The success of the application of TOC and its Thinking Processes has been widely published and its application of expanded to cover all areas of an organization and is now used by more than 10 million children around the world as a learning aid at their schools.

However, despite the success, there has always been criticism that (Ricketts, 2008) the level of awareness of TOC is still relatively low and that despite the apparent simplicity, the analysis and thinking process tools are still too complex to be used by novices and that many of the paradigms on which it is based have not been made explicit enough.

2.7 Literature Review Conclusions

"We have met the enemy and he is us!"

This famous Pogo quotation (from the comic strip authored by Walt Kelly by the same name), perfectly sums up the literature review findings.

The literature review confirmed that although the starting conditions we face and the level of complexity and uncertainty of our systems (our living conditions in which we grow up, the competitive environment in which our companies have to compete, the natural resources a country has at its disposal, the level of inherent complexity of the organizations we manage) do contribute to making it either easier or more difficult to be successful in our lives and in managing our organizations, the research from multiple fields overwhelmingly shows that it is our *own* assumptions about our reality and the way we act on these assumptions (rather than the reality itself) that have the most significant impact on our success and happiness and those of the organizations we manage.

A summary of the findings from the literature review and anecdotal evidence are:

- We do have the choice to decide what we believe and assume. The choices regarding what we believe (and don't believe) have a far more significant impact on the success we will experience in life and business than the impact of limiting starting conditions.
- We do have the ability to "change our minds" (almost) over night if the "right" trigger exists (the triggering event frequently involves someone from outside the system, since they have nothing invested in the old paradigm / nothing to lose in changing the paradigm, so it is easier for them to "see" the inconsistencies and/or opportunities)
- We do have the ability and should take the responsibility within our own lives and within our organizations to continuously and objectively validate and or invalidate our assumptions. We should expect that we can (almost) always find exceptions to justify not changing our "old rules/paradigms", but should rather adopt an attitude in which we are continuously looking for ways to prove that our assumptions are not valid (while being perfectly OK to use the ones we have until such time).

- Using the Scientific Method of EFFECT-CAUSE-EFFECT, combined with rigorous testing through logical or practical experiments, provides a simple mechanism to develop and validate new knowledge (such as knowing whether inherent potential exists or not).
- Many of the needed insights on what assumptions and/or associated processes, rules and measurements can limit or even block and which can enable organizations to “See” and “Unlock” inherent potential already exist.
- However, despite all the work done before, especially within Systems Thinking and specifically Theory of Constraints, there is still a GAP in a simple Conceptual Model (the “What?”) and application of this Conceptual model as a simple step-by-step process that is generic enough to be applied to any environment or situation (the “How to?”) and a need for a simple explanation of the justification for moving to a Systems Approach and why such a shift in paradigm from the traditional “reductionist or local optima” view will be more likely to enable managers of organizations and even individuals to “see” and “unlock” inherent potential (the “Why?”).
- This GAP indicates the need for a simple conceptual model of the paradigm shift required and a process to facilitate the shift in paradigm required to “See” and “Unlock” inherent potential.

Chapter 3 provides an overview of how I combined all the key insights from the literature review and from anecdotal evidence obtained through field experience into a step-by-step process, where I identified major GAPS and what processes and/or tools I created or adapted to fill these GAPS.

Chapter 3 Conceptual Model and Process Design

3.1 Introduction

It was Sir Isaac Newton who said, *"I can see so far because I am standing on the shoulders of giants"*. This is also true for my research project. Much work has been done in the past to create processes that will allow groups to identify common goals, to identify constraints or obstacles that block them from reaching these goals and to find a way to overcome these in a collaborative way. Typically this work has built on existing knowledge through adaptation and/or simplification and focused on creating new knowledge and/or methods only where gaps still existed (between our expectations and past results achieved from existing models and/or methods).

This chapter will provide an overview of the research design criteria and a justification of how the proposed new conceptual design and process can reduce or even close a sufficient number of the remaining gaps identified in Chapter 2 to achieve the research objective. It details which of the existing theory and processes were used, which were adapted (to meet design criteria) and where new inventions were required to close the remaining gaps in the definition and/or communication of the necessary transition from limiting to enabling Systems Approach-based paradigms and a collaborative constraint analysis process. It also deals with the complicating factors within the Public Sector that needed to be catered for in the design. Finally, it contains an overview of how all the existing concepts, adaptations and new concepts fit together into a simple step-by-step, 5-day constraint analysis and strategy design process that guides, in a collaborative manner, all stakeholders within the wider system to "see" and contribute to "unlocking" inherent potential.

Figure 14 shows my "Current Reality Tree" analysis of why managers, despite the constant pressure to improve and the increasing awareness of the potential benefits of adopting methods based on a Systems Approach to improvement, are quite reluctant to adopt such methods now. This diagram is called a "Current Reality Tree" in Theory of Constraints and is read as follows: "If [100] AND If [110] THEN [120]".



Figure 14 The Improvement Dilemma for managers in many organizations

Source: Barnard (2005), Goldratt "Jonah" Thinking Program, Introduction

To meet the aim of this research (*to develop and test a holistic and inclusive process to identify and unlock inherent potential within organizations - without major investments or risks*), the first step was to explore why most managers really resisted the adoption of a Systems Approach (its mindsets and/or methods), especially since most, if not all these managers, normally fully agree with the objectives and principles of a Systems Approach and also accept the significant potential that has been unlocked by those organizations that have really implemented the methods properly.

3.2 Design Criteria for the Conceptual model and Proces

The criteria for the conceptual model and process were divided into three categories.

1. The applicability criteria – i.e. *what types of “systems” should the process be designed for?*
2. The adoption and sustainability (or “stickiness”) criteria for the conceptual model and process itself – i.e. *what criteria must be satisfied to ensure the process will be adopted by the intended target market and remain in use to drive ongoing improvement once the external change agents have left?).*

3. The criteria for the outcomes of the process - i.e. *what criteria can be used to validate whether the process really enabled most, if not all of the participants to "see" the inherent potential for improvement and to walk away with a clear idea of how they can contribute to unlocking this potential in a win:win manner?*

3.2.1 Applicability Criteria and Scope

From the outset of the research it was my intent that the conceptual model and "5 day constraint analysis and strategy design process" should be applicable to both Public and Private Sector organizations (since many of the stakeholders within the meta systems of Public organizations are private companies).

The aim of the research was to identify the general principles that govern the identification and unlocking of inherent potential by individuals and groups across all types of organizations (the conceptual model) and to create a generic step-by-step process that could be adapted relatively quickly (if adaptation was needed) to cater for any unique differences in types of organizations. Since early indications from organizations such as the UN was that (if successful) there could be a major demand for such as process and, part of the "applicability" criteria was the need to keep the process simple enough so that most existing internal or external change agents could be trained and coached relatively quickly (in weeks rather than years) to successfully facilitate the process without significant variation.

During the research, the scope was expanded to validate what, if any, changes would be needed if the process was applied to individuals who want to use it to set ambitious goals for themselves, identify what conflicts and constraints are limiting them from achieving these goal(s) and how to systematically overcome these in an effective and efficient manner.

3.2.2 Adoption and "Stickiness" Criteria for New Conceptual Model and Process

The two major concerns of the inventor of a new idea or model is that a) it will not be adopted and b) that it will not stick (i.e. that it will fall into disuse as soon as the inventor is no longer driving it).

To address these two concerns I adopted the criteria for "ensuring the adoption and stickiness of ideas" as defined by Chip and Dan Heath and detailed in section 2.3.6 which is based on an acronym of SUCCES. i.e. For an idea or new process to be

adopted and for it to “stick” it must be Simple, Unexpected, Concrete, Credible, Emotional and told through Stories)

Experience gained through implementing the Theory of Constraints in organizations around the world also made me realize the importance that after going through a process such as the one designed in this research, participants must leave with “actionable information” – else the behaviour is unlikely to change. The authors of “Made to Stick” confirmed this with their warning: *“If a message can’t be used to make predictions or decisions, it is without value, no matter how accurate or comprehensive it is. Ideas need to be actionable!”*

Probably the most important criteria for the design of the conceptual model and process were added only later in the research (after gaining some early feedback from stakeholders). It came from a direct quote by the famous French Aviator and writer, Antoine de Saint Exupéry (1900-1944) who said: *“A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away”*.

I think for an inventor of new ideas or processes, this must be one of the toughest criteria to meet since we tend to keep adding additional elements to meet the requirements of different environments and seldom check whether these additions are absolutely necessary. Applying this criterion helped to reduce the process and workbook to the “bare minimum”.

3.2.3 Criteria for validating the success of a specific workshop.

The objective of the planned workshops and program is not just to “build capacity” or “change the culture” but to ensure the principles and processes that the participants learned and applied would deliver results – i.e. allow them to achieve rapid improvement in the goal units of their system. To ensure that both the facilitators and all the stakeholders have the same expectations for the outcomes of the implementation of the changes to better exploit their system constraint and/or to elevate it, I adopted the 6 criteria (Table 6) for success as defined by Dr. Eli Goldratt in his 2008 Webcast on what his expectations are when developing a solution based on a Systems Approach to a subject such as Project Management. These criteria are shared with participants at the beginning of the workshop and used for ongoing audits on the resulting improvement programs that follow the initial workshop.

Table 6 Success Criteria used by the Goldratt Group

Success Criteria	Why?	How to?
Must deliver EXCELLENT RESULTS	There is significant variation (noise) within the "goal units" of any system. If the variation is 10 % and we target 5 % improvement, we cannot measure it. Also, there are many ways to achieve 5 % improvement, but very few that can give 50 % or 100 % (these are the ones we target).	At the beginning of the workshop, a very ambitious target is set for improvement in goal units. We validate that achieving the target will be measureable (outside current noise) and what the consequences will be if the target is achieved or not achieved on all stakeholders to ensure it provides a "common vision" of the future.
Be based on WIN:WIN:WIN for all stakeholders	In any system with multiple stakeholders, a "lose" for one quickly degenerates to a "lose" for everyone. Especially where current systems are in a perceived "win:lose", getting agreement that we will only accept solutions based on win:win goes a long way to rebuild trust and respect.	The criteria of win:win:win are shared with all participants upfront and we get them to share stories of what happens when new solutions are perceived as a "lose" for one or more stakeholders. We end with a commitment from all stakeholders that "from today, only win:win:win solutions will be acceptable".
LOW RISK compared to the likely benefits	Most managers, especially those in the Public Sector are very good at determining the risk of doing something, but not at determining the risk of not doing something and also not good at differentiating between "taking calculated risks with fast feedback" vs. "taking uncalculated risks with slow or no feedback".	In the workshop, the facilitator covers a few examples to enable participants to differentiate between an action that has high probability but low impact of failure and high impact of success (playing lotto) from those actions that have low probability but high impact of failure and relatively low impact of success (e.g. playing Russian Roulette)
Be SIMPLER than before	Changes that are more complex are likely to be resisted (as they are likely to require more effort), be misunderstood, be difficult to implement and unlikely to deliver quick results.	Use the quote by Albert Einstein to set expectations of simplicity <i>"Any fool can make things... more complex... It takes a touch of genius - and a lot of courage to move in the opposite direction..."</i> and let participants explain why SIMPLER is the key (easier to understand, implement etc.)
Be defined as ACTIONABLE with FAST FEEDBACK	Unless changes have been defined as "actionable", we should not expect that they be implemented. Also, the shorter the feedback loops, the quicker we will know whether our solution is necessary and sufficient to achieve the expected results.	Participants are encouraged to ensure that all changes proposed from the workshop will be actionable and measurable. On the final day, each participant in turn shares <i>"My insights gained, how I will apply/implement these and how I will know if it is working or not"</i> .
Must not SELF- DESTRUCT (if it works too well) and be SUSTAINABLE	Any solution, especially ones that are real breakthroughs, have the probability of working too well and moving the constraint in a system, for which the system is not prepared – frequently with terrible consequences	In the workshop, the facilitator gives examples and lets the audience contribute examples of what happens if one or more parts of a system are unprepared for a new change really working. Ensure that such scenarios are identified and that contingency plans are put in place when early warning signs appear.

Source: Created by Barnard from criteria proposed by Goldratt (2008)

3.3 New Conceptual Model Design and Innovations

This section provides an overview of the key questions and challenges that must be answered or addressed as part of the new process to close the gaps identified in the literature review in Chapter 2.

3.3.1 The five management challenges

The analysis of existing theory as well as insights gained from field experience indicated that there were five paradigms that needed to be shifted from “limiting” to “enabling” paradigms. This was included in the conceptual design of the model on which the 5 day Constraint Analysis and Strategy Design Workshop would be based for participants to meet the objective of being able to “see and unlock inherent potential within their organizations or systems”. These five paradigms relate directly to the five most significant management challenges I have identified from the research. They include:

- 1.** How to deal with internal or external CONSTRAINTS within your reality, especially when setting targets and expectations for improvement?
- 2.** How to deal with the inherent COMPLEXITY of your organization and system, especially when deciding where to focus your improvement efforts and scarce resources?
- 3.** How to deal with strategic and tactical CONFLICTS within your organization and between stakeholders from different parts of the system, especially in environments where there is significant distrust?
- 4.** How to deal with the UNCERTAINTY and potential RISK when having to decide on changes needed to achieve more goal units, especially with those changes for which a good cause-effect understanding (how will a change in the “cause” impact the system – the “effect”) is not yet in place?
- 5.** How to deal with “BAD BEHAVIOUR” of people that has resulted or could result in a significant undesirable effects for the system, especially in cases where the way we deal with such people could have other repercussions (e.g. union strikes etc).

Table 7 provides a summary of the Limiting vs. Enabling Paradigms that are included in the conceptual model.

Table 7 Summary of Limiting vs. Enabling Paradigms to deal with 5 Management Challenges

Challenges	Limiting Paradigms	Enabling TOC Paradigm
1. Constraints	Assume Inherent Constraints – Blame the GAPS on "Out-of-my Control" changes and focus on only "in-my-control" changes.	Assume Inherent Potential - Most "constraints" are "In-my-Control or Influence" – find ways to EXPLOIT or ELEVATE.
2. Complexity	Inherent Complexity - Simplify it by breaking the system up into simpler parts and optimize each part / solving each problem.	Assume Inherent Simplicity. Identifying the few system constraints and focus all efforts on finding ways to better exploit or elevate these.
3. Conflicts	Inherent Conflicts – Find "acceptable" compromises or even "win-lose" solutions if a compromise is not an option.	Inherent Harmony – Finding a Win-win is ALWAYS possible with a system that shares one goal, just look for it.
4. Uncertainty	Inherent Certainty - Look for "Formulas" to calculate Optimal answers.	Inherent Uncertainty - Find "Good Enough" and use Feedback to Improve and Sustain.
5. Choice (Bad Behaviour)	Bad Behaviour = Bad Person - Some people are just inherently BAD – find and get rid of bad people.	Bad Behaviour = Bad Assumptions. People are inherently GOOD – find and get rid of Bad Assumptions.

Source: Barnard, TOCICO 2007 Conference Presentation.

3.3.2 How do we know whether a system has "inherent potential" to unlock?

To validate whether a hypothesis is likely to be true or not, we can use the Scientific Method of EFFECT-CAUSE-EFFECT. It starts with an observed effect, identifying a likely cause for the effect or majority of the effect and then predicts one or more effects that must exist if a.) The cause really exists and b.) the cause exists to the extent that it can explain all or at least a major part of the observed effect.

3.3.3 How do we know that an organization must improve?

Our observed EFFECT is that a specific organization is not meeting their target for goal units. They are both getting out fewer units per time period than required to meet demand and it generally takes significantly longer than what the customers are willing to wait. (This could refer to a hospital where the hospital cannot cope with the arrival of patients at an emergency ward and where it generally takes much longer to process

a patient than what the government has committed to. We observe the gap in goal units here as a backlog of patients waiting inside and sometimes even outside the hospital).

3.3.4 How can we validate (in general) that an organization has inherent potential to unlock?

The “fact” that we observe a GAP between the actual performance of an organization and its goal is a warning sign that we should find a solution. What could cause such a GAP? There are at least two hypotheses for a CAUSE.

Hypothesis #1: The system’s starting conditions (its capacity, capability etc.) is simply insufficient to meet the demand and that the only solution will be to “elevate” it’s starting conditions by investing in more resources or better resources. This hypothesis of the underlying cause for a GAP is quite a common claim. *“If you want my department to do more...I need more resources, better systems etc.”*

Hypothesis #2: The system’s starting conditions (its capacity, capability etc.) is sufficient to achieve significantly higher levels of Throughput within significantly shorter Lead Times than currently. The “CAUSE” of the GAP is therefore not insufficient capacity or capability, but wasted capacity or capability. *“You are not getting more resources or better systems until you show me you are not wasting what you have...”*

How can we go about validating or invalidating these hypotheses?

During the review of the literature and from numerous interviews with Systems Thinking and TOC practitioners, I identified four common methods used in organizations:

1. Use a literature review (to find case studies) or hire consultants to show that a significant number of credible experts agree that it is possible (or not) to achieve higher levels of Throughput within less time with the current starting conditions. We might find a case study that could serve as a reference or benchmark of what is possible within our type of organization and what not. The weakness in this method is the challenge of dealing with the assumption that “we are different”. It is seldom that we are fortunate enough to find a case, which matches our starting conditions sufficiently, that all stakeholders will accept it. Even showing a department within the same organization that has achieved “more in less time

with the same or even less resources” is frequently dismissed by the assumption that “we are different”.

2. Do surveys to see how many people within our organization agree and how many disagree. If the majority agree (e.g. via a show of hands to a question of whether it is possible to still “*do more in less time*” we can assume this is validation). Although, generally, people’s intuition is good enough to identify whether it is possible to do better and, if so, by how much, the weakness in this method (root cause identification through majority vote) is that frequently causes are counter-intuitive and frequently there is no incentive to admit that we can do better. As a result, identifying and validating root causes by majority vote is, despite its common use within organizations, not a reliable method.
3. Use a thought experiment by using deductive (going from the general to the specific) or inductive logic (going from the specific facts to the general) to identify and validate causes. The weakness in this method is that when causes are really counter-intuitive, neither deductive nor inductive logic are likely to identify the cause and solution, unless combined with the rigor that should go with logically testing hypotheses. An example of a “counter-intuitive cause” was the identification and validation by Goldratt that in order to do more project faster we should start projects later. The normal assumption is that if you want a project to finish earlier or with a higher probability of meeting the due date it should be started earlier.
4. Use actual experiments (of the type “let’s try and see”) where one or more alternative causes are identified and addressed in controlled environments and monitor the impact of the solution to determine which CAUSE was responsible for the observed undesirable EFFECT or which CAUSE contributed to it the most. This method of “trial-and-error” testing within the same environment where the EFFECT was observed is really the only one that can be used as “high probability validation” but it does suffer from the same weakness as the thought experiment method. If the CAUSE and/or SOLUTION are really counter-intuitive, the most valid CAUSE or SOLUTION might never be identified to be tested.

My research and field experience show that method 3 is frequently the fastest and least expensive so this should be our starting position. Where the cause-effects within the system are unknown, then method 1 can provide valuable inputs as to what the

alternative hypothesis should be. In such cases, method 3 could be used to eliminate non-viable alternatives (if there is sufficient understanding) and method 4 can be used as the final validation of the most likely alternative CAUSES and SOLUTIONS. Method 2 can provide the same valuable inputs to identify likely hypotheses and/or eliminate unlikely hypotheses, but should NEVER be used as a proof.

Having covered the general principle, we can now return to our example of validating or invalidating whether inherent potential exists within organizations.

3.3.5 How do we validate that a specific organization has inherent potential?

How can we validate whether Hypothesis #1 (no significant inherent potential) or Hypothesis #2 (significant inherent potential) is most valid for a specific organization?

To use method 3, we should start with the general facts (governing principles) we know about the specific system and what we can deduce or induce from these.

Fact 1: The System Constraint (bottleneck) governs the Throughput (flow rate) of goal units for the whole system.

Implication: The system can (on average) never produce more goal units than what the constraint is capable of. However, if constraint capacity is wasted through starvation, blockage, breakdowns or rework, then the system will achieve a lower Throughput than what the system (based on its constraint) is capable of. The level of constraint capacity wasted on starvation, blockage, downtime, rework etc. can be used as a reliable way to estimate whether inherent potential exists or not (i.e. the opportunity to do more without investing in more resources).

Fact 2: The Critical Chain (the longest path of dependent events considering both process and resource dependency) governs the Lead Time (Flow Time) of all goal units through the system.

Implication: The parts going through the system can never go faster (on average) than the time to cover the Critical Chain. However, this *flow time* will be longer than the sum of processing and movement times on the Critical Chain when goal units travelling through the system have to wait for a resource or a decision. The level of time wasted on the Critical Chain due to resource or information unavailability (delays) can be used as a reliable way to estimate whether inherent potential exists or not (i.e.

the opportunity to do the same or more within less time without investing in more resources).

Fact 3: Every system's performance varies over time. Sometimes there is a significant variation between the best, the average and the worse.

Implication: The "best ever" performance shows what is possible with the current starting conditions. Normally the "best ever" is achieved under exceptional circumstances (e.g. a crisis). It is in such situations that we become very open to "do whatever it takes" including changing the current rules (normal mode of operation) and ignoring efficiency measurements. For example if there is a scarcity in the market, we naturally move to a "wait for the PULL" rather than "PUSH as much as you have". Why not use PULL all the time? "Necessity is the mother of invention" but frequently these "inventions" that got us out of the crisis don't "stick" since we go back to the "way we've always done it before".

Therefore, if when we observe a significant GAP and VARIATION between the actual performance of a system and its goal, we simply need to identify how much constraint capacity (that governs the overall system throughput) or Critical Chain time (longest path of dependent events that govern total lead time) is being wasted (poor constraint or Critical Chain exploitation) to validate (or invalidate) the level of inherent potential that can be unlocked without any significant investment in more or better resources. I represent this opportunity within the new conceptual model with Figure 15.

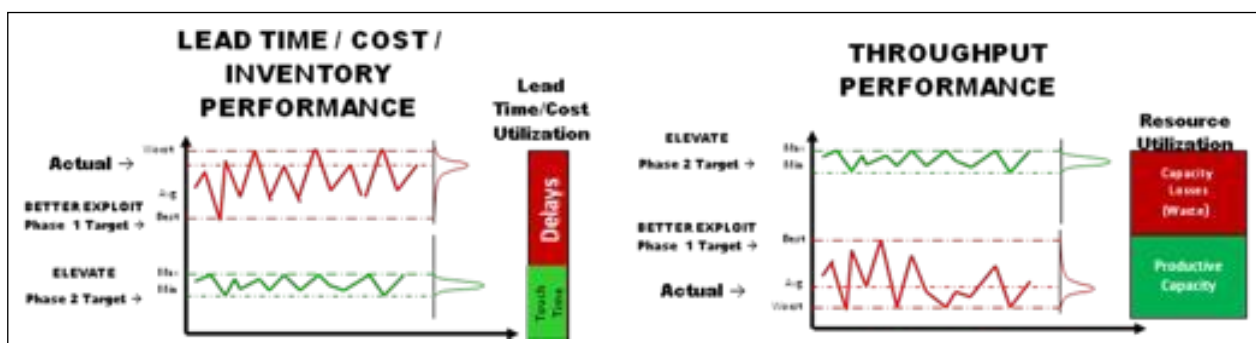


Figure 15 Quantifying Inherent Potential by looking for GAPS between Best, Average and Worst Case performance

We can apply the same logic to validate or invalidate whether it is possible to achieve the same (Throughput) with less resources (Cost or Investment). We can determine this through observations, studying "best-of-breed organizations" or simply identifying all possibilities where costs and/or investments are incurred unnecessarily (events such

as overtime cost or emergency shipments or investing in more capacity than needed because of starvation and/or blockage caused elsewhere in the system). Once these categories of "avoidable or unnecessary costs and/or investments" have been identified, we can then validate whether they exist within the organization we are analyzing and, if so, to what extent they exist as a reliable way to quantify the "inherent" improvement potential and then tests can validate how much of this potential we can unlock without significant investments.

My research and field experience on how much inherent potential exists and its extent is illustrated in Figure 16 that shows a summary of the hypothesis and validation that, in most organizations, it is possible to DO MORE (achieve more throughput by not wasting any constraint capacity), WITH LESS (achieve lower costs and/or investments by eliminating the causes of avoidable costs and investments) and IN LESS TIME (achieve shorter lead times by eliminating the causes of delays on the Critical Chain).

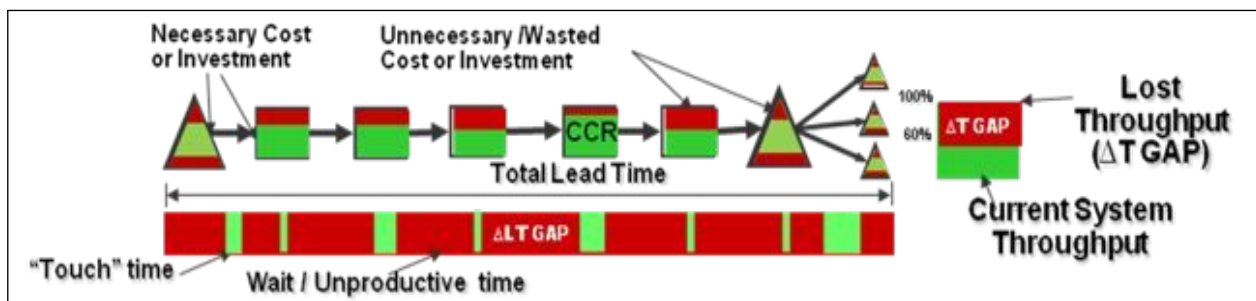


Figure 16 Identifying the Inherent Potential to "do more with less in less time"

Source: Barnard, 2004, TOCICO Conference Presentation

Potential to Increase Throughput (with the same resources)

- **Current Reality:** The ratio of the system Throughput in most organizations vs. their constraint capacity is generally less than 60 % (i.e. 40 % of the constraint capacity is wasted).
- **Inherent Potential:** It is therefore possible, in most cases, to increase system Throughput by 25 % – 50 % while keeping enough protective capacity to increase Due Date Performance (DDP) to above 95 % by getting the system

Throughput to be equal to the capacity constraint potential by reducing constraint starvation, blockage, rework, downtime etc.

Potential to Reduce Lead Time (LT) and improve Due Date Performance (DDP) and Availability

- *Current Reality:* The typical "Touch Time" (the actual processing and move time) to "Total Lead Time" ratio is less than 20 % and typical Due Date Performance is less than 80 %. This means up to 80 % of the time it takes materials or information to travel through the system is wasted due to delays (waiting for resources, approvals etc).
- *Inherent Potential:* It is therefore possible, in most cases, to achieve 25 - 50% reduction in LT, while keeping sufficient "buffer time" to achieve Due Date Performance of above 95 % by reducing Total Lead Time (and Inventory) to be equal to *Touch Time + Sufficient Time Buffer*.

3.3.6 The existence and impact of Variability on System Performance

It has already been established that "variability" or "variation" in the performance of the parts of a system is inherent in all systems. The performance of a specific part fluctuates over time. When this variation in the performance of one or more parts is combined with interdependency between parts, it becomes difficult to predict the output of the system and to identify the cause of the current system performance.

Goldratt showed in his article "How complex are our systems?" (1988) that even for a system with only three parts that are interdependent and suffer from variation, it can be difficult to predict its output and identify the root cause of lower than expected performance. In his example he used a simple system where materials flow through three serial processes, each process with the capacity to process on average 3.5 parts/day. Process B can only process parts completed by Process A and Process C can only process parts completed by Process B. The question he posed was simple: If each process can, on average, do 3.5 parts/day, how many parts will the system produce after say 20 days?

This example showed how our generally "linear" thinking and assumptions would cause most people to which this question is posed to answer 70 parts. I have personally validated this with more than 100 workshops around the world with people from all

levels in the organization. Generally more than 90 % of the audience will answer (without hesitation) with “70 parts”.

To help people find the correct answer themselves (or at least the correct order of magnitude of the answer), Goldratt suggested we use the throw of a dice to simulate processes with a capability to produce 3.5 parts/day. The simulation (Figure 17) starts with Process A throwing their dice, which determines the output for that day. If they throw a 3, then Process B will receive 3. If Process B throws a 4, it can only process the 3 it received from A. This simulation is then carried out over 20 cycles (to represent the 20 days) and the output from Process C per day is tallied to obtain the total output for 20 days. The answer is normally a shock to most people. Normally the output ranges between 40 and 50, rather than the 70 that they expected (35 % below their expectation).

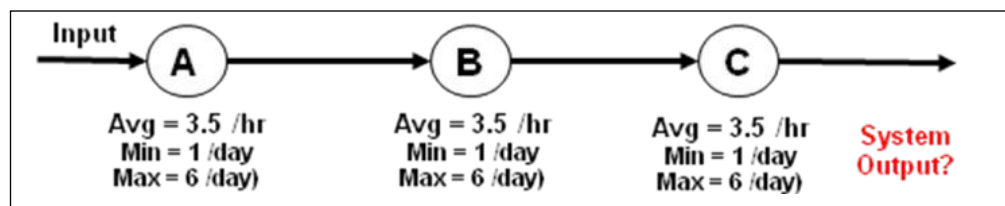


Figure 17 Simulation Model to show impact of Variation + Interdependency

Source: Barnard, 2004, TOCICO Conference Presentation

This simple experiment has proven to be very effective to help participants understand why their system's output (Throughput) is almost consistently below their expectations and frequently significantly below their expectations (that are based on the average capability of the individual parts).

From this simple experiment, we can reach three important conclusions (in terms of how to identify and unlock inherent potential):

- The average performance of the system is less than the average capability of the bottleneck - due to dependency on and variation of non-bottlenecks.
- The average performance of the system is significantly less than the average of the bottleneck and gets less and less as variation of non-bottlenecks increase or as their capacities decrease.
- The average performance of the system can be made to be equal to the average of the bottleneck by adding sufficient 'protective capacity' at the non-bottlenecks.

This is a far more efficient way to increase system output than trying to reduce the variation in performance of all the parts.

The rest of this section provides an overview of the new ways of explaining to process participants the "Limiting vs. Enabling" paradigms as a new Conceptual Model or "Frame of Reference for identifying and unlocking inherent potential", that I developed as part of this research.

3.4 The Five Limiting vs. Enabling Paradigms

3.4.1 Dealing with Constraints

One of Leonardo Da Vinci's famous quotations was that *"there are three classes of people: those who see, those who see when they are shown and those who do not see."*

This highlights the fundamental difference between treating constraints as inherent and using them as reasons (excuses) for not achieving our goals vs. viewing constraints as great opportunities to focus our efforts to find innovative ways to better exploit or elevate the system constraint in order to achieve more goal units. I developed a simple way of explaining the difference between these two approaches (Figure 18). The method of viewing a constraint either as an insurmountable obstacle (limiting paradigm) or as a great opportunity to focus (enabling paradigm) is illustrated in the figure below from the presentation and workbook now used in the Constraint Analysis Strategy Workshops.

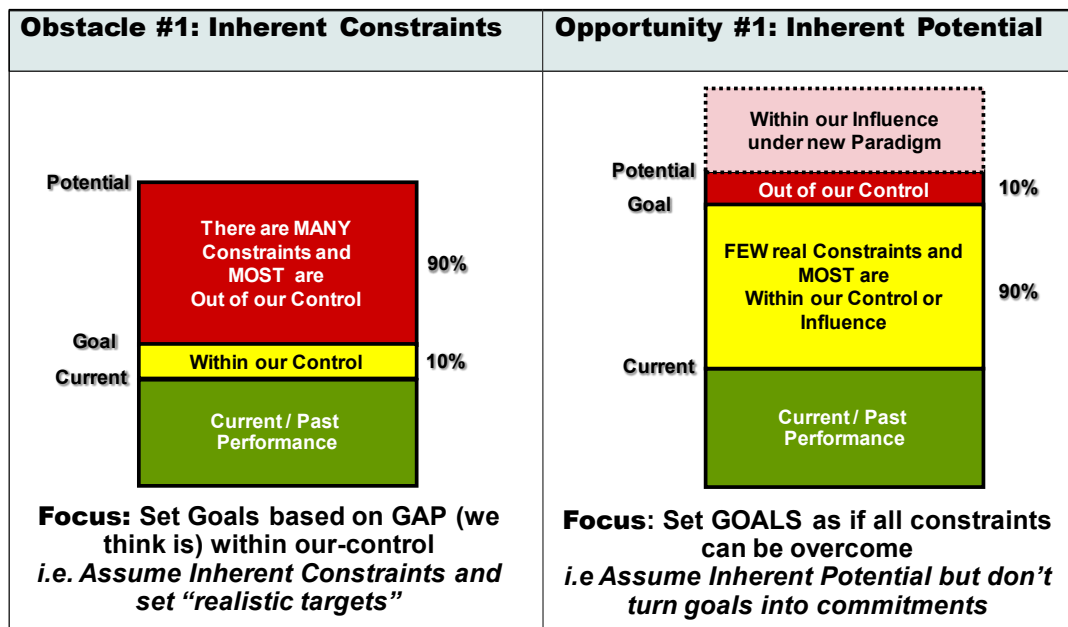


Figure 18 Inherent Constraints vs. Inherent Potential Paradigm

Source: Barnard, TOCICO 2007 Conference Presentation

This fundamental difference in the two ways of looking at reality as filled with either obstacles or opportunities is captured eloquently in Henry Ford’s famous quote (Today and Tomorrow, 1926) in which he stated “*Whether you believe you can or can’t - you are right*”.

3.4.2 Dealing with Complexity

Once individuals or groups see the opportunity (the inherent potential that exists if we start believing any constraint can be better exploited or elevated), the next challenge is identifying where to focus their limited time and resources.

To many people, a “complex system” or “complex problem” means “complicated”. The most common way of dealing with “complicated” things like systems, problems or organizations is to break these systems/problems up into smaller and simpler parts for analysis and improvement. The inherent assumption is that optimizing each of the parts (from a Physical Flow perspective) or solving each of the problems (from a Logical Flow perspective), will also optimize the system as a whole or solve the overall problem.

Pierre Laplace (1749-1827) said that “the simplicity of nature is not to be measured by that of our conceptions. Infinitely varied in its effects, nature is simple only in its

causes and its economy consists in producing a great number of phenomena, often very complicated, by means of a small number of general laws.”

The insight from the Theory of Constraints is that “all complex systems are governed by inherent simplicity” – every complex system has one or very few constraints (weakest links) that govern the throughput of goal units for the whole system (Physical Flow) in the same way as only a few fundamental causes explain the majority of the problems that exist today (Logical Flow).

Figure 19 illustrates the way I explain the fundamental difference between viewing complexity as an obstacle that can only be overcome by breaking the system/problem up into parts (Limiting Paradigm) or seeing complex systems as a major opportunity, since the more complex the system, the more profound its inherent simplicity and, therefore, the leverage we can unlock (Enabling Paradigm). A chain with two links has one weakest link, while a chain with 100 links still has only one weakest link. In the second scenario, rather than focusing on 100, we can only focus on one, which gives tremendous leverage for our efforts.

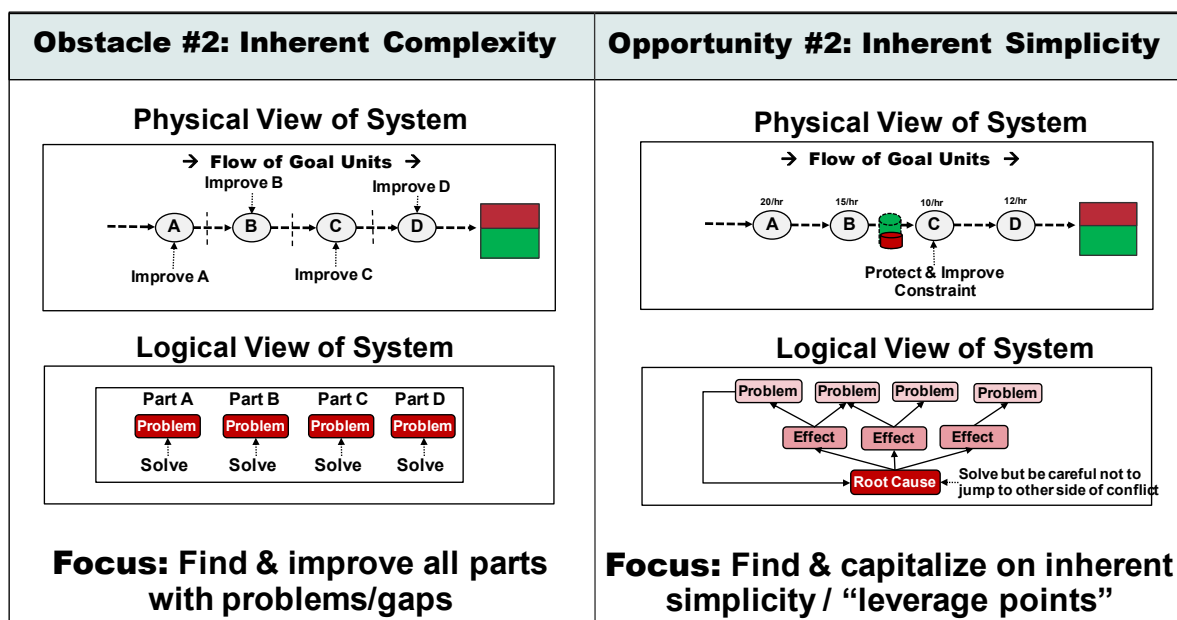


Figure 19 Inherent Complexity vs. Inherent Simplicity Paradigm

Source: Barnard, TOCICO 2007 Conference Presentation

The most significant “inherent simplicity” therefore comes from the realization that every complex system has one or very few constraints and that only one set of rules is needed to best manage that constraint. Multiple constraints mean multiple rules and

interactive constraints mean chaos. In a social system, the constraint is management time, which means managers need to ensure their "rules" (e.g. exception management) must enable them to best exploit their time since it is not easy to elevate a time constraint.

3.4.3 Dealing with Conflicts

The way we deal with conflicts has a significant influence on our ability to both see and unlock inherent potential. If a person assumes conflicts as inherent and therefore a significant obstacle to progress (Limiting Paradigm), he will seek tend to seek (at best) a better compromise or (at worst) fight for a win for himself (which inevitably results in a "lose' for the other side). Both of these tendencies not only damage the trust between people and organizations (and even countries) but "lock-in" a significant amount of potential that could be released by finding a way to break the conflict. The other negative effect of this way of dealing with conflicts is that every compromise, paralysis or oscillation leads to creating more complexity in the system.

In contrast, another way of looking at conflicts is to view them as great opportunities for unlocking inherent potential (Enabling Paradigm). Like "constraints in a system", we know unresolved conflicts also limit the achievement of more goal units, since the two necessary conditions cannot be fully satisfied until the conflict is broken. In this second approach, conflicts are not viewed as "inherent", due to a belief that conflicts can always be broken with a win:win as long as there is a common goal. This assumption is similar to the assumption in the sciences that the universe does not have inherent contradictions – when we see these it simply provides an opportunity to go back to challenging our models until there is no longer a contradiction.

This method, used in the sciences to advance knowledge, is the one proposed by Dr. Eli Goldratt in his book THE GOAL (1984) with the quote: *"Finally, and most importantly, I wanted to show that we can all be outstanding scientists. The secret of being a good scientist, I believe, lies not in our brain power. We have enough. We simply need to look at reality and think logically and precisely about what we see. The key ingredient is to have the courage to face inconsistencies between what we see and deduce and the way things are done. This identification of inconsistencies and challenging of basic assumptions is essential to breakthroughs."*

Figure 20 shows the conceptual model I have developed to explain the difference between these two paradigms.

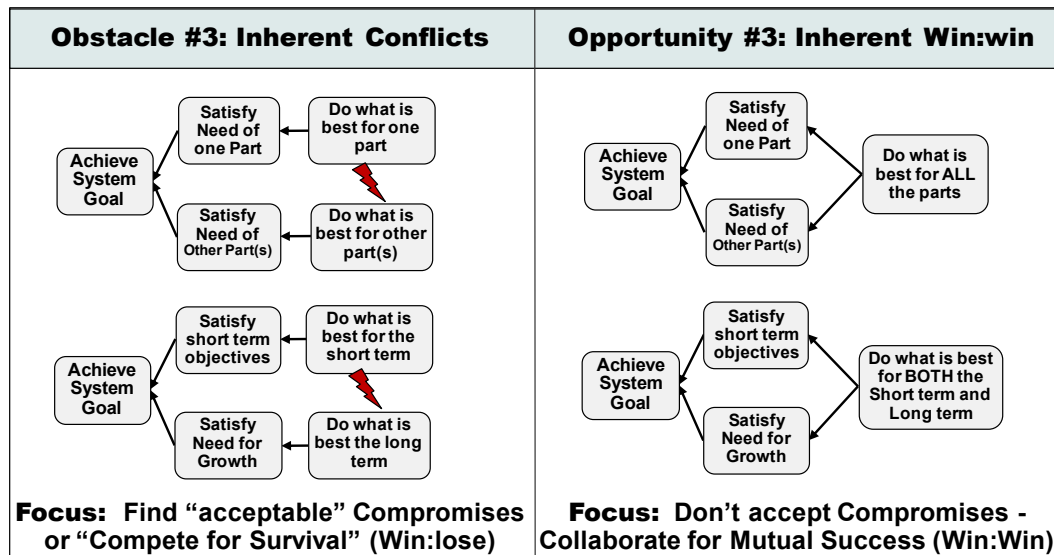


Figure 20 Inherent Conflict vs. Inherent Win:win Paradigm

Source: Barnard, TOCICO 2007 Conference Presentation

Joel Barker, one of the pioneers in the study of paradigms, developed a very effective question to help individuals and organizations challenge prevailing paradigms of what is possible and what is not with what he calls “The Paradigm Shift Question” – ***“What action is impossible to take in your organization today, but, if it could be done, will fundamentally change (improve) your organization and its ability to generate more goal units?”*** As part of this new conceptual model, I developed a similar question in relation to breaking conflicts, which participants can ask themselves when faced with a conflict, especially when faced with a chronic conflict: *“What action/decision is impossible today, but if it could be done, will allow you to break the conflict?”*.

3.4.4 Dealing with Uncertainty and Risks

Richard Feynman famously stated that *“I can live with doubt and uncertainty. I think it's much more interesting to live not knowing than to have answers which might be wrong.”*

The way we deal with uncertainty (unknown probability) and risk (known probability) has a significant influence on our ability to both see and unlock inherent potential. If a person realizes that a specific action or decision has significant uncertainty or risk associated with it, the natural tendency is to seek an answer that will give certainty. To find such answers, we frequently turn to mathematical formulas since their outputs can be determined in great accuracy. We have formulas for calculating the “right” or

"optimum" answer for the prices we should charge, the amount of stock we should keep, the forecast for next year, the number of years to return our investment in capital etc. Unfortunately, they all have the following "error" in common: All the starting assumptions used for the calculations have significant uncertainty and variation associated with them. Simply selecting one number for each variable (out of a large universe of possibilities) does not give us greater certainty – just a false sense of certainty that frequently causes us to be surprised when reality turns out differently.

In contrast is when a person realizes that most, if not all of the inputs do have variation, which makes the answer to any question related to such a system deterministic but unpredictable (even if we do understand the cause-effects, we can do a calculation and get an answer but for only one possibility). With this assumption of "inherent uncertainty" a person therefore does not seek "accurate answers" or "optimal points", but tends to seek an understanding about the possible ranges or zones a change can have its result in – will it definitely be too little or too much or "about right"?

Since managers (and individuals) have to make many decisions each day and most of these decisions contain uncertainty, moving from the limiting paradigm of "finding the optima" (which frequently leads to "analysis paralysis") to an enabling paradigm of "finding the "good enough" and then putting in a fast feedback loop to reduce the time to detect and correct for changes in goal units, is a critical management skill and therefore included in my new conceptual model.

It is also interesting to note that our field experience on projects has shown that we frequently confuse "Resistance to Change" with the perceived risk blocking someone from making a decision between alternatives. This is management's responsibility and should be done within a conceptual model for finding a "good enough answer" and putting in a fast feedback loop to guide corrections.

Figure 21 shows the conceptual model I have developed to explain the difference in these two paradigms.

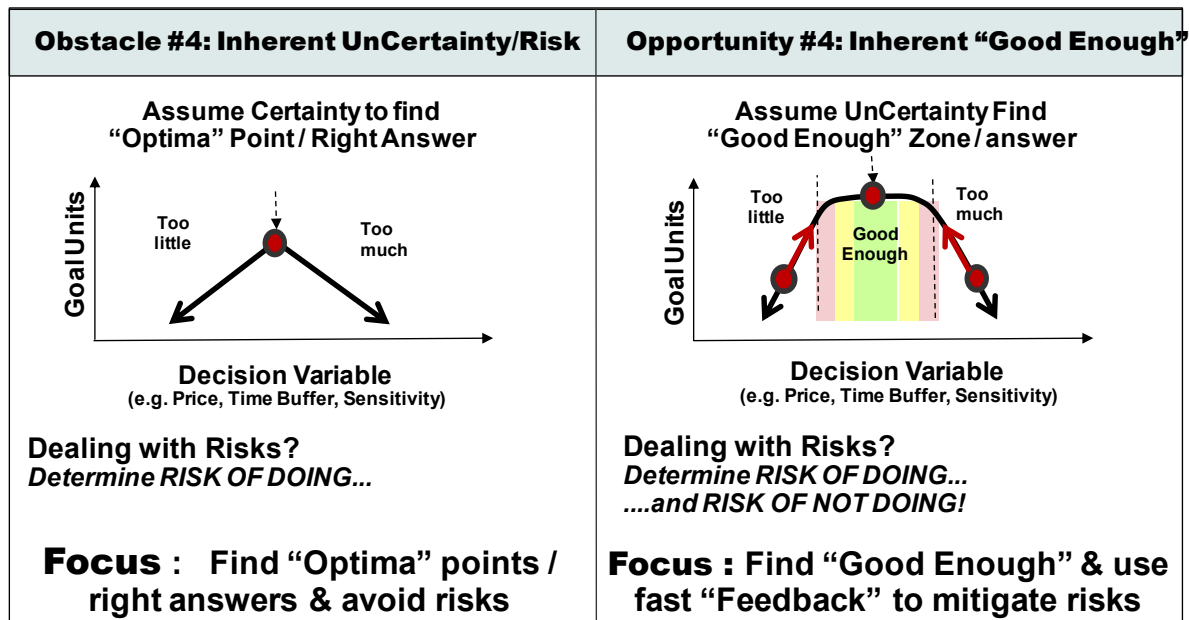


Figure 21 Inherent Certainty/Risk Avoidance vs. Inherent Uncertainty/Good Enough Paradigms

Knowing which zone you are in (too little, good enough or too much) is critical in deciding if a corrective action is needed or not, and, if so, what type of action is required. Zone 1 requires adding more. Zone 3 requires making it less, while Zone 2 requires no action – in fact any action increases the chances of moving to Zone 1 or Zone 3.

Another interesting observation is that this way of identifying the current status of the system also leads to a simple but effective alternative for problem classification, as all problems can be described in terms of its impact on the overall FLOW of the system. Therefore, like with a heart in the human body, we get four types of problems:

1. Too high/fast flow
2. Too low/slow flow
3. Too erratic flow (over- and under reactions)
4. Too inefficient (using too much energy)

3.4.5 Dealing with Bad Behaviour

The tendency to find someone to blame whenever we see problems or undesirable effects not only breaks down trust and mutual respect, but locks-in potential that could have been released if a way could be found to prevent the “bad behaviour” in the future.

If a person assumes that all “bad behaviours” come from “bad people”, then his focus is likely to be to find these “bad” people and get rid of them. But we know that, to a large extent, behaviour, especially behaviour in the work place, is driven by the way people are measured.

A person that assumes that people are inherently good will be open to realize that most instances of bad behaviour (bad in the sense that it negatively impacts the system as whole) come from bad assumptions. And, therefore, the best way to prevent bad behaviour is to find and get rid of the bad assumptions.

Figure 22 shows the conceptual model I have developed to explain the difference in these two paradigms.

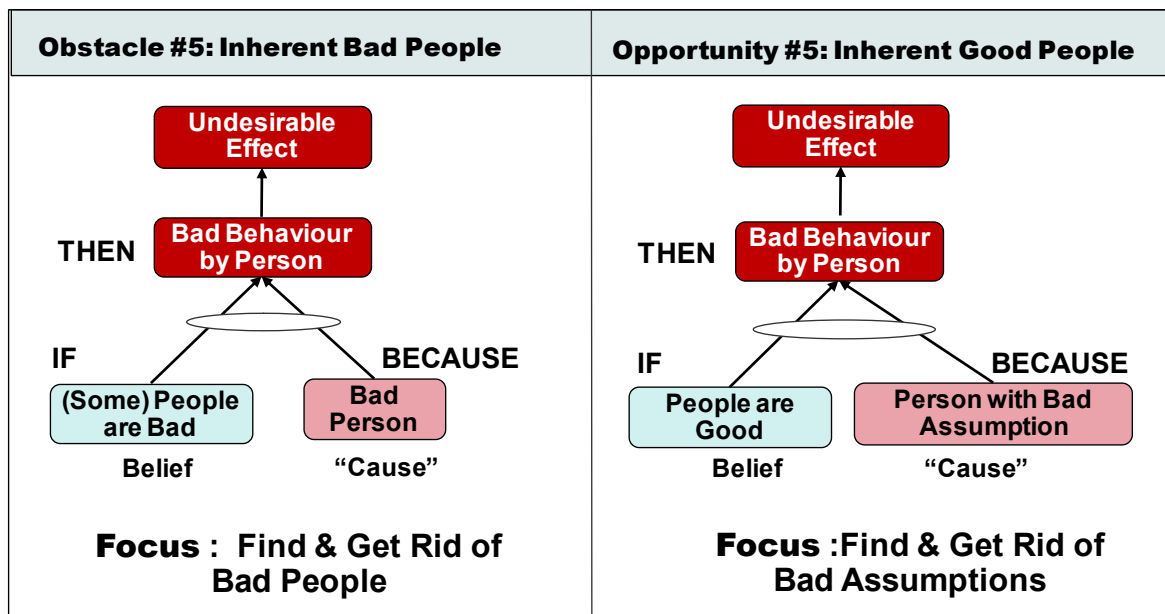


Figure 22 Inherent "Bad" People vs. Inherent Good People (with bad assumptions)

An interesting observation from field experience is that when we find that someone has not taken a “good” action or has taken a “bad” action (where good and bad is defined based on the impact on the system as a whole), there is generally three reasons:

1. The person was not aware of the priority and/or consequences – what Goldratt (1990) calls silo thinking.
2. The person’s manager was not aware or did not act to assist (waited until it was too late).

3. The person intentionally took this action to look/feel good, ignoring the impact on the system as a whole and was not held accountable – what Goldratt (1990) calls local optima.

3.4.6 Summary of the Five Paradigms

My claim is as follows: With the “enabling paradigms” you have a much higher chance of discovering the right process to help capitalise on these. What is the proof for it? Take any successful company that is sustainably successful. The owner is using their version of TOC...When you see opportunities rather than obstacles, because of the motivation you will develop the necessary processes to capitalise on these. Now let’s look at the formal process that I developed in the form of a Focusing Process.

3.5 New Simplified Constraint Analysis Process Design and Innovations

To successfully transform the new conceptual model into a simple and practical step-by-step process (road map), that is applicable to any type of organization (and even to any individual) a number of new thinking processes were invented or adapted to fill gaps or to replace processes that were found to be too complicated or ineffective in the field.

This section provides an overview of each of these innovations created and tested during this research, showing the initial problem and how I solved it.

3.5.1 Innovation to simplify TOC’s Five Focusing Steps

In previous publications, the Five Focusing Steps of TOC were very much viewed as a separate process from the Thinking Processes of TOC. Most TOC authors (not Goldratt) explained that the Five Focusing Steps were created to deal with capacity- or market constraints and that the Thinking Processes were to find “non-physical” constraints such as policy, behaviour or measurement constraints.

With Dr. Eli Goldratt’s apology to the TOC community (Las Vegas TOCICO Conference, 2006) that he made the same mistake, he warned others against allowing the use of one term “Constraint” for two different concepts. Goldratt stated that a system has only one type of Constraint – the limited availability of supply, capacity, cash or market demand that limits the overall Throughput of the system. He warned that we should reserve the word “Constraint” for such a System Throughput Constraint. Any policy,

measurement or behaviour (and related unresolved conflict) that limits or even blocks us from better exploitation and or elevating the System Constraint, should not be called a "Constraint" but rather a core problem.

This new definition allowed me to integrate the Five Focusing Steps and the Thinking Processes into a Strategic Focusing Process of Ongoing Improvement. With this new conceptual model, the idea is that we use the Thinking Process only when we "gut stuck" with the Five Focusing Steps. I.e. if it is clear (due to a build-up of backlog) that the constraint is internal, we move to step 2. If there is good evidence of what is needed to better exploit this internal constraint, we define and measure these and move to step 3. If however, there is no clear data on "How to better exploit the Constraint" we can use the Thinking Processes of TOC for example to identify undesirable effects that make "better exploitation difficult" and then use the "Conflict Cloud" process to understand and break the underlying "Exploitation conflicts" as part of the subordination in Step 3.

The same process can be applied to the Step 4 of the Five Focusing Steps. If we are not sure when or how to "elevate the system constraint" we can use the Thinking Processes, to identify the undesirable effects that make it difficult to know when to elevate or difficult to get approval. We can then use the "Conflict Cloud" process to identify and break these "Elevation Conflicts" so we can focus on the System Throughput Constraint directly related to the large and growing GAP between supply and demand.

Figure 23 shows how I explain, using a graphical presentation of how to move from the Constraint exploitation GAP, to the Undesirable Effects that make up the GAP, to the conflicts that current block the organization from dealing with these UDE's and therefore the conflicts that block better Constraint Exploitation. My way of explaining the link between TOC's Five Focusing Steps and how we use the Thinking Processes to identify and resolve the causes of GAPS in Constraint Exploitation and Elevation is a new introduction into the TOC Body of Knowledge and is now used widely in the TOC community. Goldratt indicated at the 2006 TOCICO conference that my proposed way gives a practical mechanism to link TOC's two processes together to ensure practitioners use them in combination and never in isolation.

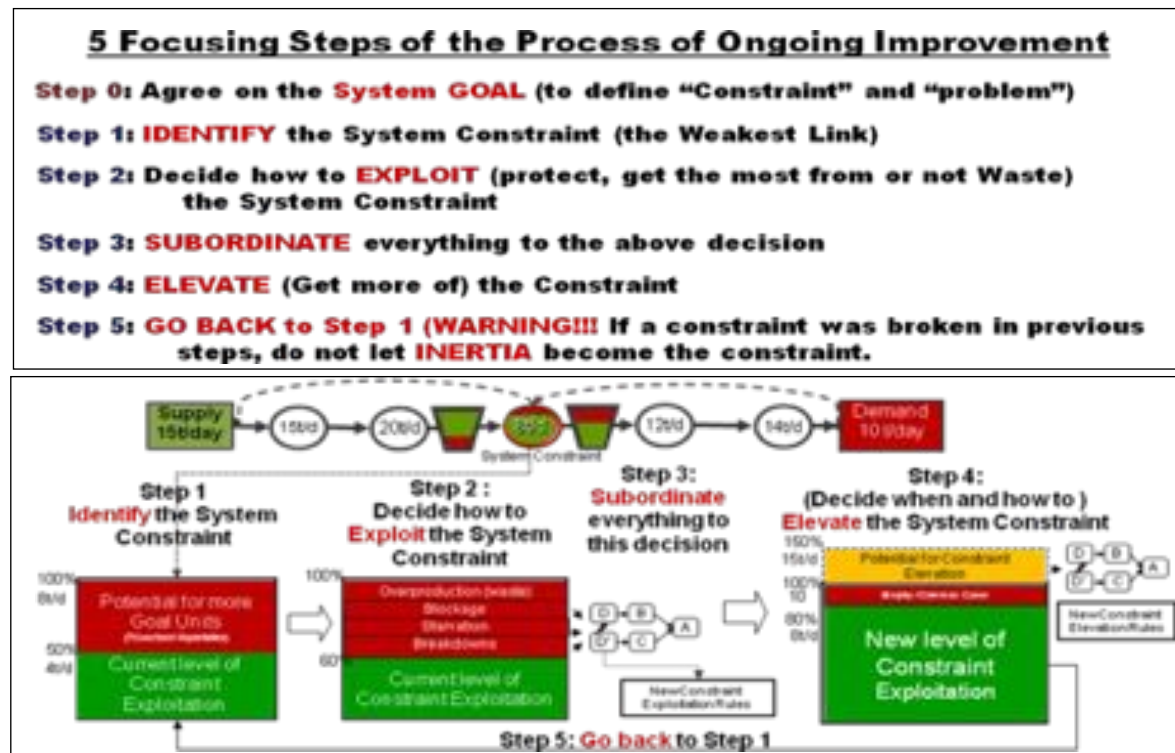


Figure 23 New Explanation of TOC 5 FS and link to GAPS and Conflicts

Source: Barnard, TOCICO Conference Presentation 2003, Cambridge UK

3.5.2 Innovation to make Goldratt’s Change Questions a closed loop.

Goldratt’s three questions start with “What to Change?” This presumes that all stakeholders already agree on the need for change. Since both my literature review (e.g. Kotter, 1990) and field experience show that this is not a reasonable assumption, I added “Why Change?” as Step 1 to my conceptual model. Also, the last question is “How to cause the change?”, which does not link back to “Why Change?” to create a “closed loop” framework for a process of ongoing improvement. To “close the loop” I added, as Question 5, “How to measure the change and achieve POOGI?” to the existing three questions.

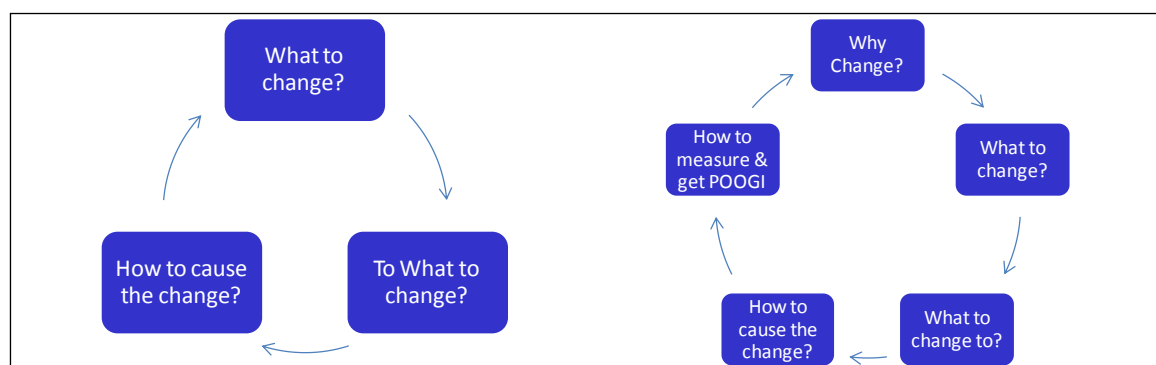


Figure 24 Goldratt's 3 Questions vs. Barnard's 5 Questions of Change

Figure 24 shows the difference between Goldratt's original three questions and the expansion of the questions to a total of five to provide a more logical consensus-based continuous improvement change framework. These additions have now been formally adopted into the TOC Body of Knowledge published by TOCICO and are summarized in Table 8, which provides details on the questions asked to participants within the new 5 Change Question framework.

Table 8 A new Conceptual Model based on 5 rather than 3 Change Questions

Change Question	Implementation Process Questions
Q1: Why Change?	Are there any significant GAPS or VARIATION in the prime measurements of the system? These GAPS and the difficulties we face in closing them are called "Undesirable Effects" in Theory of Constraints.
Q2: What to Change?	How do we differentiate between the many symptoms and the few causes and what is it that really blocks us from addressing these causes (the unresolved conflicts and erroneous assumptions that block us from breaking the conflicts)?
Q3: To What to Change?	What is the direction of the solution that will address the core problem(s) and resolve the core conflict? Also, what are the potential negative effects of the new changes (to solve the core problem) and what can be done to prevent these from happening?
Q4: How to Cause the Change	What are the potential implementation obstacles and what is needed to overcome these? Also, considering limited resources and interdependencies between the required changes, in what sequence should the changes be implemented?
Q5: How to measure the change and achieve POOGI	What measurements should be used to determine whether local changes are in fact resulting in a system/global improvement and also which measurements and process should be implemented that will encourage and enable POOGI? (Process Of Ongoing Improvement)

Figure 25 shows how this 5 Question Change Framework can also be used to capture the essence of a full analysis on a subject matter such as "Managing Operations in a System Approach Way".

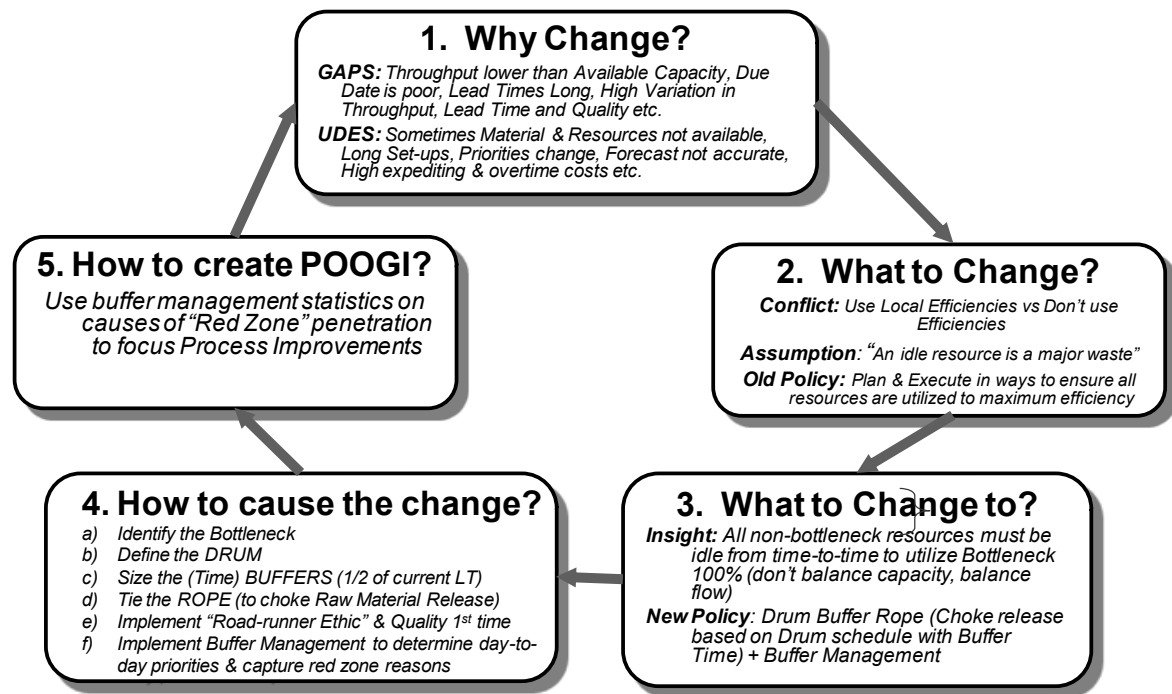


Figure 25 Applying the 5 Questions to capture the TOC analysis on Managing Operations

Source: Barnard, Goldratt "Jonah" Thinking Program, 2005

3.5.3 Innovation within Problem Definition and Root Cause Analysis

From interviews with practitioners and from my own experience, the traditional Root Cause Analysis, like a fish bone diagram, has four weaknesses:

1. It aims to identify all the plausible causes rather than the critical few causes.
2. Frequently there are cause-effect relationships between the "independent causes", which really are not independent but are assumed to be so.
3. It does not show the assumptions under the logical cause-effect arrows.
4. It does not show the conflict relating to why we simply don't change the tactic that resulted in the GAP.

Goldratt said that if we "Define a problem precisely and you are half-way to a solution". But what does this mean?

In the new conceptual model I developed, I show that we can overcome these four weaknesses by defining a problem at five different levels (Figure 26), each level providing more insight and therefore bringing us closer to a solution than the previous level. These five levels are defined as follows:

-
- Level 1: Defining a Problem as a GAP or VARIATION in the Performance of the system as a whole.
- Level 2: Defining a problem as an Undesirable Effects making it difficult to reduce the GAP or VARIATION.
- Level 3: Defining a problem as a "BAD RULE" (policy, process, metric) that is causing the Undesirable Effects.
- Level 4: Defining a problem as a unresolved CONFLICT between changing the "Bad Rule" or Root Cause ("D" in the Conflict) to prevent the Undesirable Effects and moving to a New or Opposite Rule that would remove the UDE ("D' " in the conflict) but would likely cause a new UDE as it jeopardises another need of the system (e.g. go from large batches that make a system unresponsive to small batches that make it responsive but inefficient).
- Level 5: Defining a problem as a wrong assumption – an assumptions about reality that if we change it, would "evaporate the conflict" since we will be able to meet both necessary conditions of the system with a single rule.

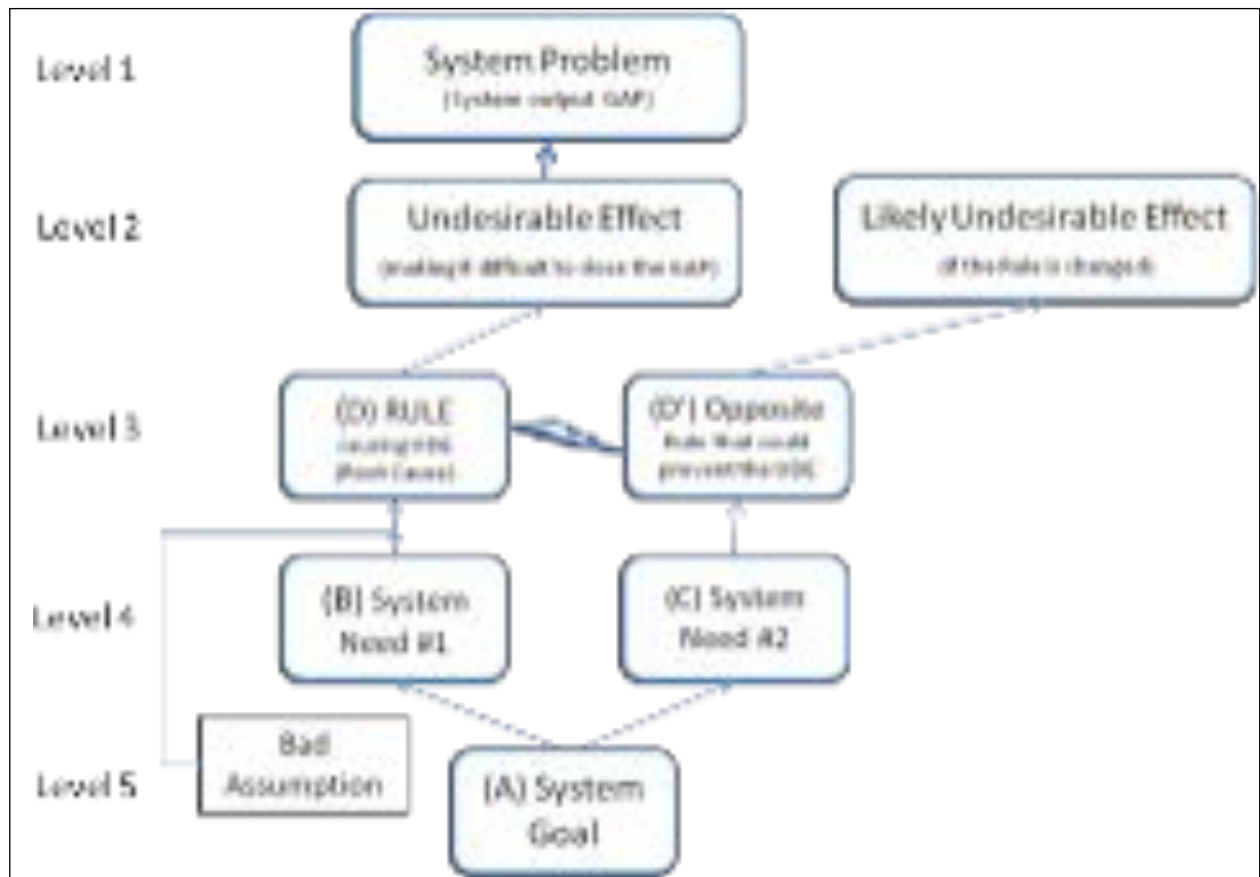


Figure 26 Alan's Proposed Five Levels of "Defining a Problem Precisely"

3.5.4 Innovation within classification of “Problems” or Undesirable Effects

Undesirable Effects (UDE's) are symptoms or negative effects that stakeholders within a system are currently experiencing. These effects are “undesirable” in relation to the goal of the total system and/or their parts' objectives and vision. Usually, people have very good intuition. When dealing with a system whose performance we wanted to improve, TOC experts normally started an analysis by identifying the major Undesirable Effects within each of the parts. An analysis was then done using a “Current Reality Tree” to identify the “Core Problem” (the entity at the bottom of the tree without entry arrows going into it). However, this process was only reliable when used with extreme logical discipline – something not common in either the Private or Public Sector. So, frequently, the output of the process took a long time, was inconclusive or even appeared “forced” – i.e. the TOC expert guided the analysis in a direction where they suspected the core problem to be.

For our 5-day process, we needed a fast and reliable process for identifying UDE's, not just any UDE's, but ones specifically related to the Constraint and/or goal and necessary conditions of the system.

To achieve this objective, I developed a simple method, based on the graphic in Figure 27 that focuses all participants on identifying the GAP (Type 1 UDEs) in the system or their area's goal units and, secondly, to list all the most important causes they think make it difficult to close the GAP (Type 2 UDE's).

Step 1 is similar to what Collins (2006) calls “confronting the brutal facts”. The brutal facts are that there is typically a large and sometimes even a growing gap between reality and expectations.

An example of Type 1 UDE's in Project Management (i.e. simply GAP statements in relation to the primary objectives in PM) is: *“Original due dates are not met, there are budget overruns and sometimes even the scope is not met”*. Type 2 UDE's would be those things that make it difficult to close these three GAPs such as *“...there are too many changes, too often resources are not available when needed, there are fights about priorities between projects, there is too much re-work etc.”*



Figure 27 Identifying Type 1 and Type 2 UDE's with a System

This method ensured that ALL the UDE's were directly related to the system goal being analyzed and also ensured that no expectations were created that would not be met (UN DP reported that in the past, when stakeholders were asked to list and prioritize problems, they still had expectations that even the low priority ones would be solved simply because it was on the list even though it had nothing to do with the UN DP's mandate at the time).

3.5.5 Innovation in the definition of UDE's as Systemic vs. Symptomatic Conflicts

In the late 1990's a new process was developed to go directly from UDE's to conflicts to core conflicts. As described in Chapter 2, Goldratt called this process "The 3 Cloud Process". Figure 27 shows the difference in these two approaches. The original "Current Reality Tree" (CRT) process for answering "What to change?" started with listing all the UDE's, then connecting these via cause-effect to hopefully converge to a single UDE at the base – the "Core Problem". Then the core conflict preventing resolution of this Core Problem was defined. However, frequently, the analysis did not converge or the wrong cause was identified (proven by a solution that did not work). The new 3 Cloud Process started with only 3 UDE's, selected from three different areas of the organization or the individuals' life and the Core Conflict was found by simply generalizing the three conflicts blocking resolution of the three UDE's (the UDE Conflicts). This change in processes is illustrated in Figure 28.

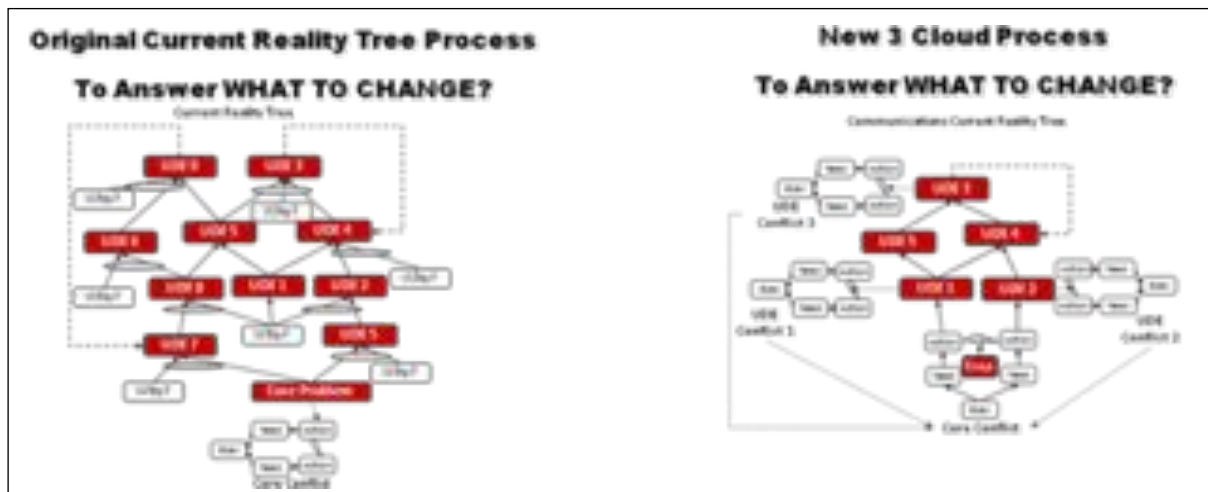


Figure 28 Original Current Reality Tree vs. 3 Cloud Process

Source: Barnard, 2008

Despite its significantly higher level of success compared to the previous “UDE to CRT to Core Conflict” process, other TOC experts and I frequently observed cases within our own analysis, those of students and other TOC practitioners that we supervised, where the 3 Cloud method simply did not converge to a single Core Conflict. My first reaction was that it probably does not apply in all cases – maybe only in the cases where our intuition and cause-effect understanding is good enough to take this “short-cut” approach, which meant we probably already knew the Core Problem but were blocked to address it by a specific unresolved conflict (i.e. the Core Conflict). However, it was considered a breakthrough and there was a compelling theory behind it – the theory developed within Chaos Theory that provided evidence of the fractal nature of complex adaptive systems and that, since organizations are also complex adaptive systems, this meant that it might be possible to discover (if we are prudent enough in the logic) general laws by studying the specific cause-effects within parts of the system - whether these parts are part of a micro view or macro view of the system. Therefore, since the 3-Cloud process did work in a significant number of cases (between 25 and 50 %), I did not want to start by questioning the validity of the 3 Cloud Process, but rather the way in which it was being used.

My starting point was the process being used to convert an UDE into a UDE Conflict.

In the original TOC process provided in the “Jonah Program” (Goldratt and Burton Houle, 1995) and other texts (e.g. “Thinking for a Change” by Lisa Scheinkopf”, 1999)

for converting a UDE into an unresolved conflict, the guideline to students was as follows:

As per Figure 29, to fill in box D, answer the question: “What action, related to the UDE, do you find yourself complaining about?”

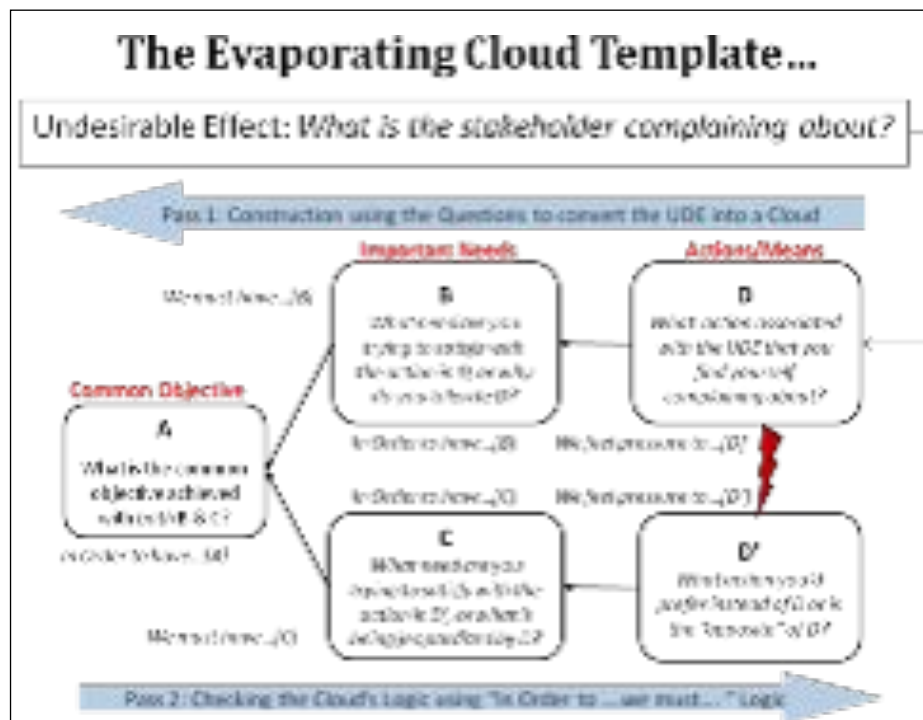


Figure 29 The Evaporating Cloud Template

Source: Barnard, 2007

When reviewing all the work, I realized most were mixing up the answers and then we really struggled to converge the clouds. Sometimes participants were filling into the box the answer to the question “What action are you complaining about that you think is *CAUSING* the UDE?” and sometimes “What action are you complaining about that *YOU* now feel pressure to take to deal with the *CONSEQUENCES* of the UDE?”.

I realized that the first action is a “systemic issue” and therefore part of an unresolved “systemic conflict” - while the second action was a “symptomatic issue” (trying to find a way to deal with the UDE/symptom) and must therefore be part of an unresolved “symptomatic conflict”.

The words “systemic and symptomatic” were probably influenced by the company I was keeping at the time – I had quite a bit of discussions at the time with Prof. Antoine van Gelder, a well-known and very experienced TOC practitioner who also happens to be a

doctor and who heads up the Department of Internal Medicine at the University of Pretoria. We frequently used the “patient” analogy in TOC so I thought the insight into at least two different conflicts related to every UDE, fitted well with the use of systemic and symptomatic issues in the medical world.

I first presented these findings at the TOCICO 2003 conference in Cambridge where I showed how I tested my hypotheses on one of Dr. Eli Goldratt’s own past analysis on Project Management (and found that, for example, in his analysis, Dr. Goldratt was in fact very consistent – but that he wrote all the “symptomatic or consequence conflicts” from the Project Management UDE’s – i.e. (D) always contained the actions the Project Managers felt pressure to take to deal better with the UDE’s once they had happened and therefore, I believe Dr. Goldratt found the Core Symptomatic Conflict (i.e. pressure to compensate for early mis-estimations vs pressure not to compensate).

Well, I tried to find all the CCPM rules from breaking this Core PM Conflict, but simply could not and realized that breaking the symptomatic core conflict gives you only the new execution rule - there is really no way you could get the new planning rules from it. The only way I found was to also do the systemic conflicts for the three or more selected UDE’s and then find the Core systemic or planning conflict. Breaking this would then give you the new planning rules.

So, the instructions I now give are quite simple:

•For the Systemic Conflict: The question for box (D) is *“What action do you think most likely caused the UDE or (if there could be more than one cause) which action/decision caused most of the UDE?”* For example: If the UDE is high inventory, the answer could be “the decision to make to forecast”.

•For the Symptomatic Conflict: The question for box (D) is *“What action do you feel most pressure to take to deal with the UDE?”* For example: If the UDE is high inventory and the person asked to deal with the UDE is the Sales Manager, the answer could be *“pressure to reduce prices in order to reduce high inventory”*.

Why is this new classification so important?

I think the simple answer is that, if my conclusion at the time, that mixing the two methods will have a significantly negative impact on the quality of the TP analysis and that using only the “Symptomatic” process (i.e. using the question “What actions do you feel pressure to take to deal with the UDE” for box D) will at best give us the Execution

Conflict and therefore, breaking it, we will only get what “old” execution rules we should STOP using and what “new” execution rules we should START using. If we want to know both the new PLANNING and EXECUTION rules, we should use both methods.

In summary, the benefits of the new innovation is that by getting TOC practitioners to be consistent in the way they transform an unresolved problem (UDE) into either the unresolved Systemic or Symptomatic conflict, they are far more likely to identify the right “planning core conflict” and “execution core conflict” which, if these could be broken, will identify both the old and new Planning and Execution rules.

This new invention has been adopted into the formal TOCICO body of knowledge and I have received feedback from TOC practitioners all around the world that this “duel-conflict” method to better define the “real problem” as a set of unresolved conflicts rather than a single unresolved conflict has both improved the effectiveness and efficiency of finding the Planning and Execution rules that must be changed and which ones to replace them with.

Figure 30 shows the separation between the Systemic and Symptomatic conflicts.

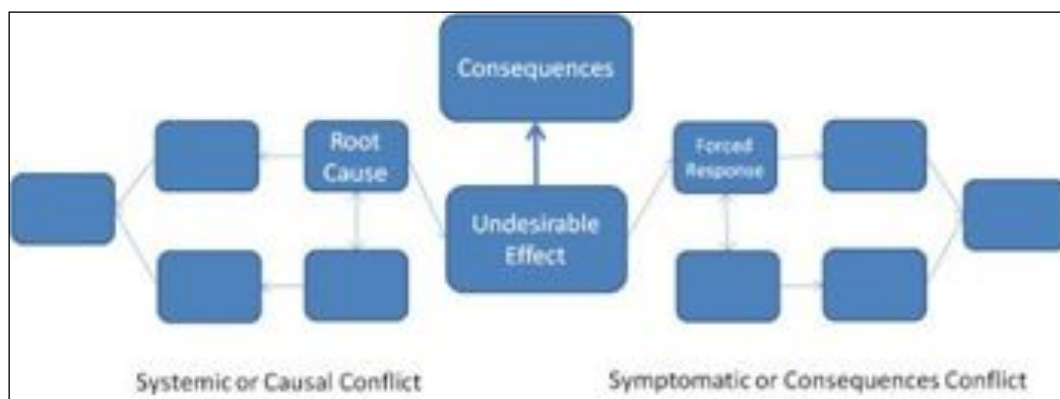


Figure 30 Systemic vs. Symptomatic Conflicts related to an Undesirable Effect

Source: Barnard, 2008

3.5.6 Innovation within breaking Conflicts (The Four Conflict breaking Methods)

Finding the Erroneous Assumption and (win:win) Injection to break Conflict

In the TOC Thinking Processes, the key to finding the breakthrough solution(s) is finding a way to identify and invalidate one or more of the “erroneous” assumptions/rules (e.g. removing a resource/time constraint) that blocks us from breaking the conflict with a better win:win. The “breakthrough” typically involves both “What to STOP doing” and “What to START doing” to achieve more goal units.

In the traditional TOC method to break a conflict, the only advice was to verbalize the assumptions under each of the logical arrows (e.g. between A and B and between B and D) by answering “In Order to have [A] we must have [B] because....[Assumption]”. The idea was to identify as many assumptions as possible and then select from these which you wanted to challenge. This method of breaking conflicts worked well if the person had very good intuition but broke down when the assumption was assumed to be a fact (i.e. the person would never list it as an assumption) or where there were too many assumption, most of which had nothing to do with the conflict.

To solve this GAP in the TOC body of Knowledge, I created four simple methods that immediately target the conflict assumptions – the reason where there is a conflict in the first place. Figure 31 shows these four methods of identifying conflict assumptions and for breaking conflicts with win:wins.

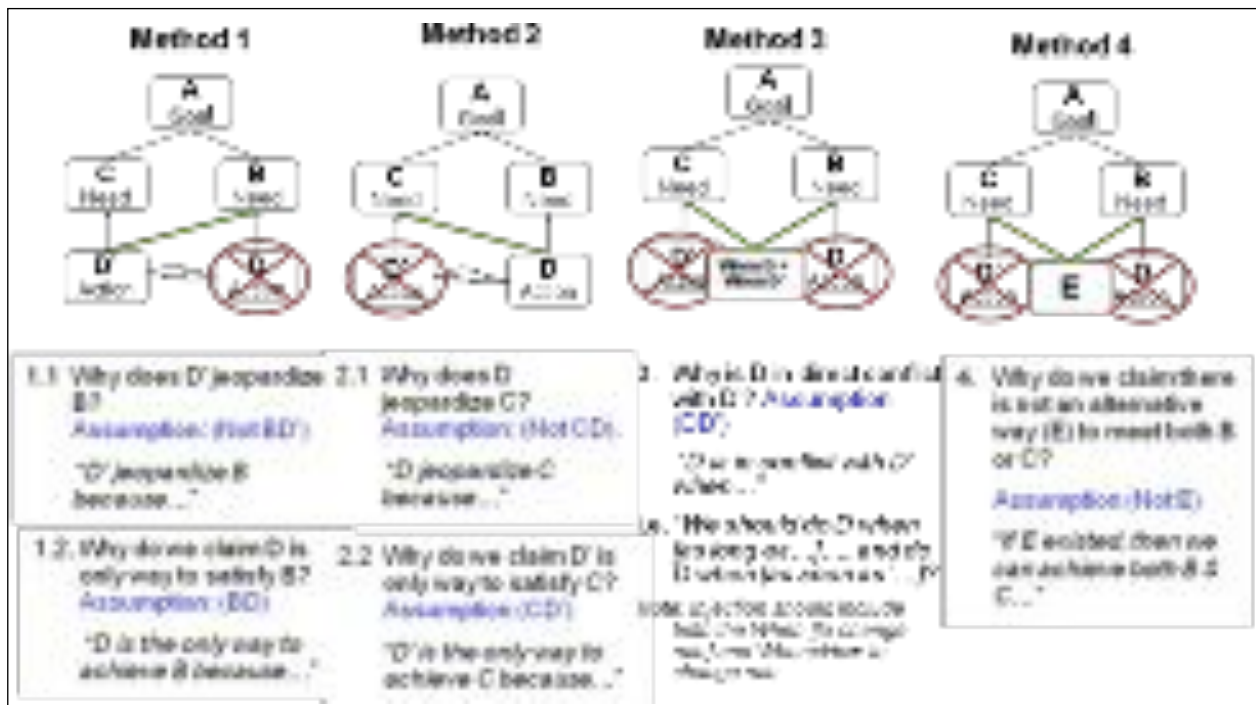


Figure 31 Barnard's new 4 Method Process to break any conflict with a win:win

Source: Barnard, 2005

This new invention has also been adopted into the formal TOCICO Body of Knowledge and has seen wide usage all over the world. Appendix 8 provides a letter of confirmation of its wide use today in Japan by some of the leading organizations in the world (e.g. Toyota, Ministry of Land and Infrastructure) and Appendix 9 provides a letter by Yuji Kishira, the Director of Goldratt Consulting Japan and one of the top business book authors in Japan. In the letter he confirms that my 4 Method Process was included with extensive coverage in his new book released in July 2008 titled "Introduction to Holistic Problem Solving". This book was the number one best seller business book for a few months in Japan and is still in the top 10 on Amazon Japan.

3.5.7 Innovation within identifying and dealing with Negative Side-Effects

"Whenever you come up with a new solution you have to check all the ramifications, otherwise you might miss something important."

The Choice (Goldratt, 2008)

The law of unintended consequences, often cited but rarely defined, is that actions of people—and especially of government—always have effects that are unanticipated or unintended and frequently end up hurting the system more than the original problem they were trying to solve. (“The medicine is worse than the disease”).

My field experience and those of other TOC experts has shown that although “unintended consequences” happen, in most cases these could have been predicted had the “right questions been asked”.

As stated in Chapter 2, TOC is quite unique in the way it deals with resistance to change. Dr. Eli Goldratt, with the assistance of experienced TOC experts from around the world, identified the major triggers of resistance to change and ensured that the TOC “buy-in” process capitalizes on the natural tendency to raise “yes, buts”. Although the existing TOC process has been in use for more than 20 years, I realized we needed to simplify it even further and provide practical examples of why it is important to attempt to predict and prevent as many of the potential undesirable effects (PUDE’s) as possible.

As a result, we introduced, as part of Question 3 (To What to Change?), a simple process where, once the major direction of the solution has been defined, the participants are split into four or five groups - each representing a stakeholder. Each group then makes a list of all the stakeholders they believed could be negatively impacted by the proposed changes, define the logic of what the negative impact could be and then raise suggestions for how to reduce this risk or even eliminate it.

The accompanying report “Appendix 6 Lusaka Constraint Analysis Strategy Workshop – Detailed Report:” to this research dissertation, that documented the outcomes of the Lusaka workshop, provides good examples of how this simple process is applied and how valuable the insights gained were to the stakeholders (they believed it would significantly reduce the risk of failure or resistance).

3.5.8 Innovation within identifying and dealing with Implementation Obstacles

The application of TOC’s “Buy-in” process and prerequisite tree has been used for many years to help stakeholders identify and overcome implementation obstacles proactively. However, the process was still considered by many as quite complicated and lengthy. As a result, I simplified the process and created practical templates that have

speeded up the process significantly. It has been successfully used on all the pilots and we have started receiving requests to facilitate “obstacle based planning” sessions on other initiatives due to its simplicity and ability to focus all stakeholders on creating a plan focused on overcoming only the major implementation obstacles.

3.5.9 Innovation within Execution Monitoring and Management

As previously mentioned, a major insight from the pilots has been the extent to which good “follow-up and follow-through” management practices do not exist within the Public Sector. These practices are commonly referred to as “Execution Management” which is extensively covered within the latest TOC body of knowledge called Critical Chain Project Management.

The innovation related to this aspect of a project’s success, related to the application of a very new TOC Thinking Process tool called “Strategy and Tactics” (S&T).

To assist City Councils and other organizations that are using TOC to “achieve more with less in less time” by eliminating local optima rules, silo thinking and poor synchronization, I have developed software called “Harmony” that enables organizations to convert the output of my 5 day workshop into a holistic S&T Tree and then use the software to plan and monitor the execution of all the necessary and sufficient conditions (all the injections and intermediate objectives from the 5 day analysis).

Chapter 6 provides an overview of the S&T method developed by Dr. Eli Goldratt and how the software I developed can help leaders and managers create a harmonious organization. The software can be downloaded at www.goldrattresearchlabs.com and its free licensing has been granted to the cities on the InWEnt pilot program.

3.6 The Roadmap of the new Constraint Analysis Process

My objective was to create a simple, holistic and consensus driven Thinking Process (roadmap) to enable the answering of the 5 change Questions within a maximum of 5 days.

Whenever we aim to define a simple solution or process for a complex problem or situation, we always face the dilemma represented here in Figure 32.



Figure 32 Solution or Process Design Dilemma: Make it Simple or Complex

In the design of the new roadmap, this conflict was broken through challenging the assumption that “A simple solution/process will not consider complexities of a specific environment/organization or person.” Since the Socratic questions and the related thinking processes are generic and most have been tested in many situations, my initial hypothesis was that a simple process can in fact deliver the same or better results. This hypothesis was validated especially in the cases where the process was used with large and complex organizations and individuals (as shown in Chapter 4 and 5).

Figure 33 shows my new simplified roadmap of the Thinking Processes used over each of the 5 days that includes all my new innovations described in this chapter.

This roadmap, also serves as an agenda for the 5 days. Day 1 aims to get agreement on the new Systems Approach (transition from Limiting to Enabling paradigms) as well as on the answer to “Why Change?” for the system and its stakeholders being analyzed. Day 2 aims to answer “What to Change?” – The wrong assumptions and related policies and measurements while Day 3 is dedicated to answering “To What to Change?” – The “right” assumptions and new policies or measurements that will remove the UDE’s, close the GAP without creating new UDE’s. Day 4 is focused on answering “How to Cause the Change?” by identifying the possible risks and how to overcome these while Day 5 is focused on answering “How to measure the Change and create POOGI?” (Process of Ongoing Improvement) that ends with a commitment from each stakeholder and how on by when their contribution to changing the rules will be complete.

To understand why this new roadmap is considered to be significantly simpler by both the TOC community as well as anyone who has tried to go through the previous TOC TP roadmap, Appendix 2 shows the original TOC roadmap used before.



Figure 33 Barnard’s New Simplified TOC Analysis Roadmap

Source: Barnard, 2008

3.7 Validating the New Process against Success & Sustainability

Criteria

As stated in section 3.2, I decided to use the criteria for “Stickiness” presented in “Made to Stick” (Heath & Heath: 2005). Table 9 shows an assessment by the TOC Expert team (including Dr. Eli Goldratt) with which the new simplified roadmap was first validated and our own assessment of whether the new process met the requirements and, if so, how?

Table 9 Peer Review Evaluation of new Process Design against Stickiness Criteria

No	Criteria	How	Compliance
1	Simple	Focus on Constraint	Yes
2	Unexpected	Multi-tasking Game Gap and Consequences of not closing it Possibility to "Do more with less in less time"	Yes
3	Credible	Results of TOC, Experience of Facilitators, TOCFE	Yes
4	Concrete	Step-by-Step process and concrete examples	Yes
5	Emotional	Passionate Facilitator, Emotional Vision and Team Spirit as group moved from "Me vs. You" to "Us vs. The Problem"	Yes
6	Story	Inclusion of frequent stories by facilitators and participants make it real.	Yes

Source: TOCICO Participant Survey completed after each of the 4 Pilot 5 Day Workshops

In the next chapter, the initial testing of the new conceptual model and 5 day constraint analysis roadmap is detailed. This included exposing the concept to my peers for comment at the annual TOCICO conference of 2003 in Cambridge as well as testing the process within the Private Sector and with individuals.

Chapter 4 Initial Testing of New Conceptual Model and Constraint Analysis Roadmap and Processes

The defined research method required that I first validate the new conceptual model and 5-day simplified constraint analysis roadmap and process with peers, then to test it within the Private Sector (but in environments where the traditional TOC process were not previously tested or did not work) and then to test it in the more complex application of using the 5-day process with individuals to validate whether the same process can help individuals identify and unlock inherent potential within their own lives.

Chapter 4 provides a brief introduction to each of the tests as well as an overview of the results achieved from first presenting my analysis of gaps within existing theory and practices as well as my proposed new conceptual model and 5 day constraint analysis process for peer review at the 2003 TOCICO conference in Cambridge (section 4.1).

Section 4.2 provides an overview of the initial testing of the 5 day process that was done within the Private Sector, first with a Recruitment company in South Africa which, as a service providing company, is a non-traditional application for TOC application (section 4.2.1) and then with a large High Tech company in the USA with the objective to identify and break their strategic Core Conflict (to test process scalability and ability to deal with complex environments).

Section 4.3 provides an overview of the third formal test within the Private Sector with a large Equipment Manufacturer in the USA to validate if the process can also be used to identify and close gaps between an ERP system and an organization's business strategy.

Section 4.4 provides an overview of how the new process was tested with individuals. The chapter concludes with the lessons learned from these tests as well as a brief overview of how my new conceptual model and innovations in analysis processes have been adopted as contributions to the Theory of Constraints Body of Knowledge by both the TOCICO (Theory of Constraints International Certification Organization) as well as authors of new TOC books.

4.1 Testing through Peer Review

The Theory of Constraints International Certification Organization (TOCICO) was founded in Atlanta at IBM's offices with ± 220 attendees. The purpose of TOCICO is to develop certification for TOC practitioners and implementers and to administer the certification process in response to the growing demand for such certifications as TOC is being adopted by more and more organizations and more and more "charlatans" are appearing on the market (those that claim to be experts but are not).

It was also intended that the TOCICO would have an annual international conference (and later regional conferences) for TOC experts to present their latest developments in TOC for peer review.

The first conference in Cambridge, UK, in 2003 provided me with an ideal opportunity to present my latest analysis on the GAPS within the TOC Body of Knowledge, my insights on how to close these gaps as well as the practical tools I invented or adapted to close these gaps.

My presentation started with four questions to which the audience answered through a show of hands:

1. How many of you are trained to use TOC Thinking Processes? (Answer: All participants)
2. How many have achieved REAL breakthroughs using the TP? (Answer: Almost all)
3. How many of you feel somehow guilty that you are not using and encouraging others to use the TP? (Answer: Almost all)
4. Why is there still a gap between our expectations and reality in the number of people using the TOC TP? (Answer: Probably because of our own inability to communicate clearly and the fact that our processes are still not simple, repeatable and scalable enough to work in the majority of cases)

In the rest of the session I shared my specific analysis of why this GAP still exists and my insights and new developments to further **simplify** and/or possibly **improve** some of the key TOC TP tools used to enhance our ability to help **CONSTRUCT** and **COMMUNICATE** simple solutions that can solve complex problems.

In the session I presented by new Conceptual Model of the shift in paradigms needed to get someone to adopt TOC's Systems Approach as well as the new innovations in the Thinking Processes I believed could be used to close the remaining gap (such as the Systemic vs. Symptomatic cloud) and how to combine these into a possibly simpler, faster and better roadmap.

The response from the audience, including from Dr. Eli Goldratt himself, was overwhelmingly positive. Dr. Goldratt claimed that it was exactly this type of continuous challenging based on finding remaining gaps and inconsistencies that would be required to ensure the Systems Approach would be adopted by more organizations. (The next day at the firsts AGM of TOCICO, I was elected as the new Chairman Elect of TOCICO).

One of the benefits of this positive response, especially the response of Dr. Goldratt, was that I was "flooded" with requests from executives of large companies that were already using TOC or considering to use TOC, to be part of the pilot group to validate my Research Hypothesis that it is possible to develop a more generic, simpler, faster and better process to enable an individual or group to see and unlock inherent potential previously hidden due to limiting assumptions.

Section 4.2 reports on the tests within the Private Sector that came from the list of "volunteer" companies received at the TOCICO conference in Cambridge in 2003.

4.2 Testing within the Private Sector: TOC Value Projects

Getting your peers to agree is a significant accomplishment, but the only real "proof" comes from testing it in the field, and especially with organizations that previously did not consider or use TOC.

4.2.1 Pilot Private Sector Project in Africa

The first test was done in South Africa with a large recruitment organization. Their CEO wanted me to facilitate a 5 day workshop with the new simplified roadmap to help define a new business strategy for the group that had been formed recently after a number of mergers and acquisitions.

The CEO was "nervously excited" since he really believed that the process could work but was also concerned whether it would really overcome the distrust between the various new divisional heads (previous competitors) and whether it would really guide

this team to develop a single business strategy for multiple and very different business units.

Although some refinements were made during the 5 days, the basic roadmap and tools guided the participants to effectively and collaboratively answer the five questions. Whenever they got stuck, we would go back to the conceptual model to determine which of the 5 paradigms they might be stuck in. This worked really well.

Although the results cannot be shared in this report due to a confidentiality agreement, the CEO and team claimed that this was the most productive 5 days they had spent and said they really believed that by implementing the agreed business strategy, they would achieve the ambitious profitable growth targets set by the new CEO.

Other organizations in South Africa where the 5 day process was tested include SABMiller, African Explosives, Afrox and one of the Unilever divisions. The results in each of these cases were consistent. At the end of the 5 days, there was full consensus and agreement on the answers to the five change questions.

4.2.2 Pilot Private Sector Project Internationally

With the validation that the process worked within South African organizations, I expanded the testing in 2004 and 2005 to some of the international companies that volunteered to be part of the tests. These included Seagate (Memory Drives), Cisco Systems (Networking), Tata Steel and Ditch Witch. Apart from Ditch Witch, the application of the 5-day constraint analysis all revolved around using the process to develop and get agreement on a new customer and Supply Chain constraint.

Again, the results of the workshops are confidential, but Appendix 7 includes a letter of confirmation from Seagate of the use of the methods and process I developed as part of this research and confirmation of the business benefits achieved.

The Ditch Witch application was quite unique in that the company requested to use the process to close the large gap between the functionality offered by their Business Software (SAP) and their business strategy. The main difference was in the identification of the Undesirable Effects in Step 1 – Why Change? The UDE's all related to gaps between the business requirements and the functionality (or lack thereof) offered in their existing software and how these were limiting the company from building and potentially capitalizing on a significant competitive advantage.

During these tests, a number of insights were gained on how to better communicate the new conceptual model, how to better facilitate the process, and in the case of Ditch Witch, to prove that the 5 day process can also be successfully used to define the software requirements for a business.

Section 4.3 reports on the next test. It was always the aim of the research to develop a process that is universal enough that it can be used by both organizations and individuals to identify and unlock inherent potential.

Appendix 8 and 9 include letters confirming how the new process and my specific innovations around the Dual Cloud Process and 4 Method Process to break conflicts is being adopted by leading companies in Japan (e.g. Toyota) and have been included into the current best seller business book titled *"Introduction to Holistic Problem Solving"*.

In 2004, an opportunity presented itself to validate the Research Hypothesis for its application to individuals.

4.3 Testing with Individuals: The Odyssey Program

The "Odyssey Program" is a program that was initiated by Dr. Eli Goldratt in the early 1990's when he was still the Managing Partner of the Avraham Y. Goldratt Institute (AGI). It was developed after continued requests by TOC practitioners that have been trained by AGI and could see the value of their spouses and children using the TOC Thinking Processes to deal with day-to-day conflicts and, even more important, decisions such as "What to do with the rest of my life? (After I leave school or after my children leave the house)".

This program was considered a major success due both the many reported "life changing experiences" by children and spouses of the TOC practitioners that attended, but also due to the many new developments that originated on this program (e.g. the 3 Cloud Process detailed in Chapter 2.2).

However, in the mid 1990's, after Dr. Eli Goldratt's retirement, the Odyssey Program was stopped due to a dropping level of interest, since many of the examples were still very business focused and, to some extent, due to time constraints of the AGI partners.

In 2004, on request of Dr. Eli Goldratt and a few past Odyssey alumni in, I was approached to lead the re-introduction of the Odyssey Program using my new simplified TOC analysis process. This provided me with the opportunity I was looking for to

validate whether the new “simplified” TOC analysis process and the way of explaining my version of the paradigm shifts required to apply the System Approach to our lives was really simple enough to work for young adults ranging from 16 to 30 years of age (with a particularly short attention span) as well as for spouses of TOC practitioners.

The Odyssey Program for freshmen was also designed to cover 5 days - 1 day per process step with an introduction to the Systems Approach and the TOC processes on the morning of day 1. The only modification we made to the agenda was using more interactive games and “life stories” to show the application of the various concepts and paradigms on the participants’ lives.

Dr. Eli Goldratt agreed to facilitate a 3 day program for alumni after the 5 days, where the participants are given a major problem to solve with their new tools and paradigms.

The first program was run in 2005 and has since become an annual event that normally has around 100 to 120 freshmen and 60 to 80 alumni in attendance. Measured by the feedback from the young adults and spouses that attended as well as from the results reported by alumni every year, all programs have been a resounding success. Figure 34 shows an analysis of pre- and post-program expectation vs. the value received, as done with the 2005 freshmen.

Pre-program Question: How valuable do you think this Odyssey week will be for YOU?

Post-program Question: How valuable was the Odyssey week for YOU?

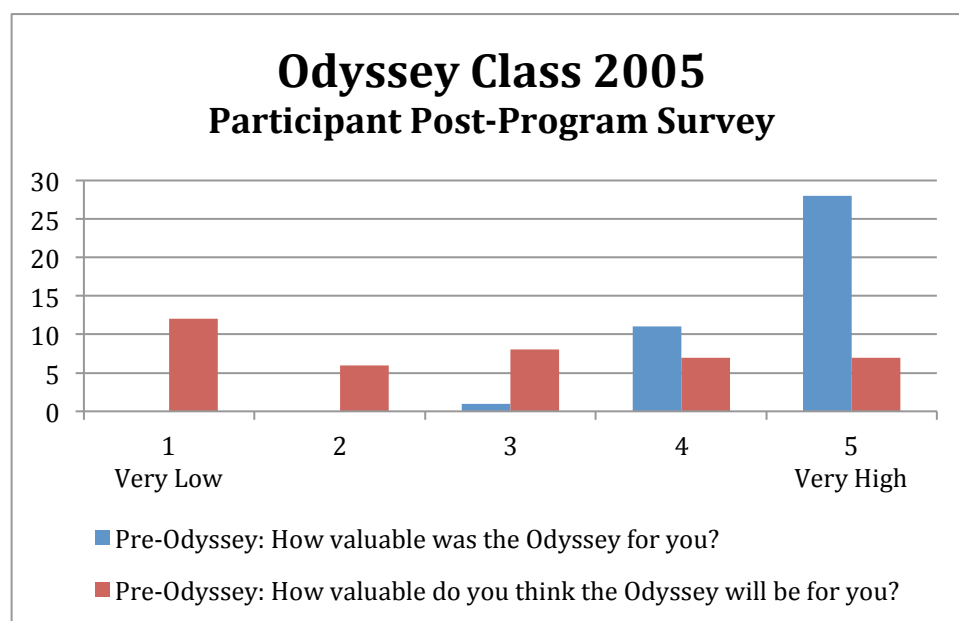


Figure 34 Odyssey Program 2005: Pre- vs. Post Program Value Survey

Some of the comments received from the 2005 participants and their parents on the post-program survey forms are listed below:

- *"Let's see what I learned at the Odyssey 2005 course? I learned how to solve my biggest problems while aligning emotion and logic - how to step back from the conflict and find ways to solve it in a way that there are no winner-loser solutions, only win-win answers..."*
- *"I spoke to my daughter today. She said you guys were "an inspiration" for her, funny, approachable, fun and yet got her to really see how to see and unlock the inherent potential I always knew she had... She said she had such a great week, and I am so glad she was able to learn from you and with you."*
- *"I really had the time of my life at the Odyssey. Didn't think that you could have fun, learn powerful techniques to remove conflicts and constraints and apply what you've learned all at the same time and in just 5 days. You really helped me realize how much potential I have and what is possible if I simply follow the plan I developed. Can't wait to return next year as an alumnus to continue my Odyssey journey, thanks again for everything".*
- *"The Odyssey definitely impacted my life forever. It has changed my way of thinking in such a positive way. I would highly recommend Odyssey and look forward to coming back."*

Table 10 shows the summary of the 2007 and 2008 Odyssey Program evaluations that shows continuous improvement in the percentage of attendees that rate this program as "excellent".

Table 10 Odyssey Program 2007 and 2008 Participant Evaluations

Odyssey Program 2007 - Summary of Post-Program Evaluation by Participants

Post-Odyssey Program Survey Question	Excellent	Very good	Satisfactory	Unsatisfactory
What is your overall evaluation of this program?	20	21	2	0
What is your evaluation of the level of presentation given by the facilitators?	23	20	1	0
At what level did this program meet its stated objectives?	22	18	4	0
Totals	65	59	7	0
% of Totals	50%	45%	5%	0%

Some of the Answers on how this Odyssey 2007 changed participants lives

I am no longer afraid to change anything or even everything

Immense, I've stopped smoking and improved my life.

It helped me to see the core conflict and find a way to break it that had such devastating impacts on all aspects of my life.

I gained so much self confidence.

It has helped me develop a new way of looking at problems and solving them and I got valuable insights on myself and on how I live my life.

Odyssey Program 2008 - Summary of Post-Program Evaluation by Participants

Post-Odyssey Program Survey Question	Excellent	Very good	Satisfactory	Unsatisfactory
What is your overall evaluation of this program?	16	10	1	0
What is your evaluation of the level of presentation given by the facilitators?	20	7	0	0
At what level did this program meet its stated objectives?	15	12	0	0
Totals	51	29	1	0
% of Totals	63%	36%	1%	0%

Some of the Answers on how this Odyssey 2008 changed participants lives

Very applicable, made some real breakthroughs - hope I have the discipline to apply it.

With such a group of youngsters, the teacher could make or brake the program, he really made it!

Odyssey 2008 has revealed that there are a number of generic issues that are true for most that have attended, regardless their age or country

Enables me to better understand the needs which cause parties to take various positions

This is a simple process that can be used in the entire company on issues to bring clarity and resolve it.

Fantastic process for conflict resolution and for identifying opportunities. Looking forward to using it in all aspects of life

Getting it on paper is critical. It is surprising that communicating to yourself can be difficult. This allows me to gain clarity of myself.

I see myself utilizing this in both my personal and professional life. I feel at more peace with conflict.

The Odyssey program is now an annual event and 20 regional facilitators have been trained to facilitate similar regional programs (which only do the 5 days for freshmen) in countries such as Mexico, Germany, Netherlands and South Africa. The Odyssey Program provided me with a valuable "test laboratory" for ensuring that the concepts presented and the process used did meet the Adoption and Stickiness criteria defined in Chapter 3, but also served as great preparation for the most difficult test of all. Can it work within the Public Sector?

Chapter 5 Final Testing of new design in the Public Sector

5.1 Introduction

Leonardo da Vinci said *"I am always impressed with the urgency of doing. Knowing is not enough; we must apply. Being willing is not enough; we must do."*

In October 2006 I was presented with an opportunity to test the new conceptual model and 5 day constraint analysis process in arguably one of the most complex environments – the Public Sector.

In January 2007 a partnership was formed between Goldratt Group and InWEnt (Capacity Building International, Germany) with the objective to test whether a simplified TOC approach, developed by myself as part of this PhD thesis, can be used to help cities close the growing gap between demand and supply of services.

By the time the partnership was formed, InWEnt had already used TOC successfully for years (Funke-Bartz, 2006), but with its application limited to those areas in which their TOC experts already had some expertise. For example, it was used to promote management competencies at municipal water utilities in the Andes and, just recently, to develop the organisation of the Ecuadorian National bank (Banco del Estado). However, the relatively inexperienced, self-taught TOC facilitators had difficulty to get consistent results, frequently getting feedback that their theories were too complex, not practical and lacked participation from stakeholders. Their experience with TOC was that of an expert using TOC to do an analysis and develop a solution after doing interviews and then presenting the solution. If there was good trust the solution would be accepted, if not, it would be rejected.

The initial pilot sites involved "Solid Waste Management" and "Water Supply Management" systems in selected cities such as Zambia, Kenya, Nigeria and Tanzania. For cities that applied to InWEnt as part of their "Sustainable Cities Programme", five day Constraint Analysis and Planning workshops were organised that included, for the first time, representatives of all the stakeholders such as national and local government, public and private service providers, the community and academic institutions.

The objective of these workshops was to enable all participants to work together to develop a common understanding around the cause-effect relationships between the various challenges faced by each of the stakeholders in dealing with the causes and consequences of the large GAP between the amount of waste created and collected on a daily basis. Secondly, the aim was to agree on which necessary and sufficient changes will be required to overcome capacity and policy constraints by focusing their limited resources on those areas that will have the biggest impact on closing this GAP now and in the future.

Prior to the start of this initiative my co-facilitator, Professor Antoine van Gelder (a TOC expert with years of experience in applying TOC in the Public Sector), and I were warned that there is normally quite a high distrust among the groups that will be represented. Additionally, similar “capacity building workshops” had traditionally struggled to get active participation, frequently suffering from quite high drop-out rates within the first few days.

The main hypothesis being test in this PhD research is whether it is possible to design a simpler, faster and better conceptual model and process that will be generic enough to enable both organizations and individuals to identify and unlock inherent potential (for achieving more goal units). The sub-hypothesis is that “The bottleneck is always at the TOP of the bottle.” This hypothesis claims that it is our own beliefs and assumptions that either limit or enable us to see and unlock inherent potential within ourselves, our organisations or even our cities.

5.2 *Selecting the Pilots Sites*

5.2.1 Criteria for Selection

The point of departure for InWEnt was to set priorities according to the priorities agreed annually within the German development cooperation (InWEnt, GTZ, KfW). As a result, InWEnt indicated that they wanted the pilots to focus on one or more of the following: municipal services for water supply, waste water treatment or solid waste management. These focus areas were selected based on the following criteria:

- Likely contribution to poverty alleviation
- Relevance of problems for capacity building

- Level of engagement of the affected local stakeholders, including community groups
- Level of commitment of and support from the relevant stakeholders for implementing the proposed project
- Probability of achieving tangible results
- Expected impact on the national policy framework

The submitting cities were expected to organize a one-week Strategy Workshop with participation of all important stakeholders at some time between the last week of March and the last week of April 2007.

5.2.2 Finding African Cities to volunteer to be Pilot Sites

Through a comprehensive invitation, application and approval process (see Appendix 5: InWent Invitation to City Councils for Participation in TOC Pilots), the following 5 cities were selected for a Constraint Analysis Strategy Workshop focused on Solid Waste Management:

1. Lusaka – population of 2 million people
2. Kitwe – population of 1 million people
3. Kano - population of 35 million people
4. Ibadan - population of 30 million people

5.3 Designing the 5 Day TOC Workshop

5.3.1 Complicating factors within the Public Sector

I was warned by those in the know that it would be much more difficult to help Public Sector Organizations (PSO's) to identify and unlock inherent potential. During extensive interviews with managers within PSO's and managers within Non-Governmental Organizations (NGO's) as well as consultants who work within this area, they identified a number of reasons why they believe PSO's are not only different, but much more difficult to manage, improve and specifically to get consensus and commitment on new changes. Some of the major differences identified by almost all stakeholders were:

- PSO's do not have clear goals.

- PSO's are filled with bureaucrats. Ackoff (2006) defined bureaucrats (in one of his f-laws) as *"someone with the power to say 'no' but not with the power to say 'yes'"*. Those inclined to exerting this power can find an infinite number of reasons for rejecting a proposed change, and seldom any for accepting it.
- PSO's have an even higher resistance to internal change since the consequences and impact of making "bad" policy decisions can be catastrophic and few have the courage to take that risk on themselves so decisions are passed from one committee to another, delaying and sometimes even blocking any decision from being taken.
- They have to operate within significantly "constraining" legislative and political policy frameworks (environment, health, etc).
- Most departments have no way of measuring how their decisions impact the system as a whole, since, in most cases, there is long lags between cause and effect so, generally, there is also little real accountability – people that do not perform are frequently not held accountability due to fears of union response or simply because the consequences of decisions are not immediately measurable.
- In the Public Sector there are so many stakeholders to consider, that striving to achieve a win:win:win will take years.
- Frequently, there are significant levels of distrust between the many stakeholders such as private contractors, community leadership, politicians etc.
- There are many conflicting objectives and agendas that could side-track the focus on the agreed goal.
- It is exceedingly difficult to get all stakeholders together.
- There are many past and ongoing initiatives, in which a major investment of time or money has been made, that might turn out not to have been necessary or even to be in conflict with new direction.
- There is limited funding for external facilitators.

To validate whether PSO's are really unique I did a survey within our current client base where we asked participants to indicated which three factors they believed (out of 10) most significantly impacted their department's ability to contribute to more goal units for the organization as a whole.

Figure 35 shows the results of this survey. Although the perceptions are different within Private and Public Sector organizations regarding to what extent the success of their organizations is impacted by various constraining factors, all of the factors exist in both Private and Public Sector organizations. As a result, it was clear that the new conceptual model and simplified analysis process had to systematically address all of these factors.

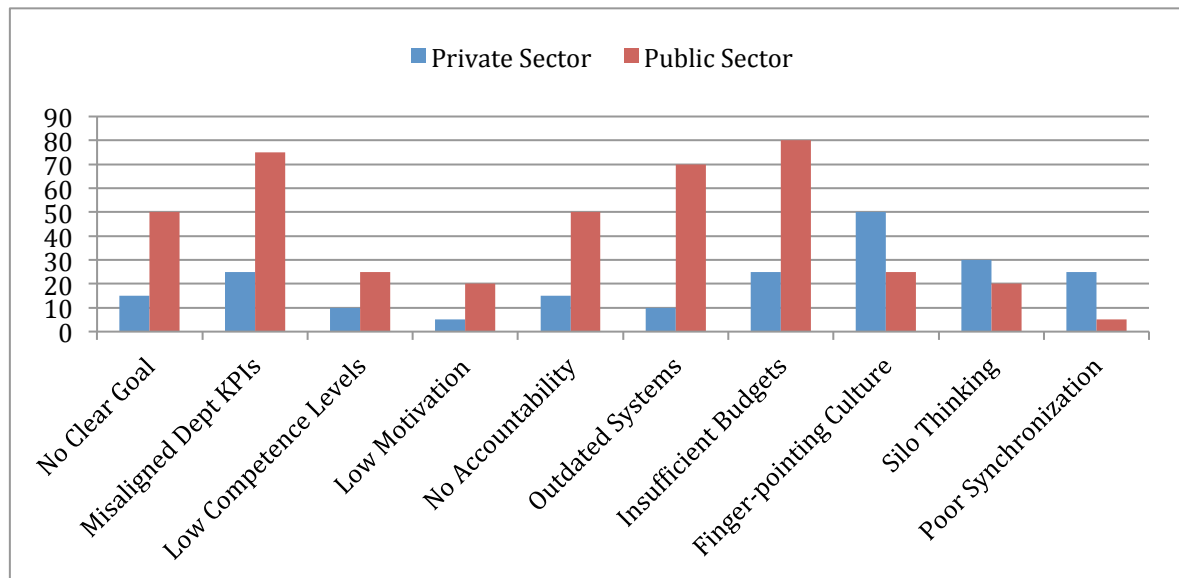


Figure 35 Private vs. Public Sector - Management perception of Major Challenges

5.3.2 Using the Dual Cloud Innovation to rebuild trust

Due to the high levels of distrust that normally exist between stakeholders and Donor/Capacity Building organizations, we realized that gaining the trust of the stakeholders and getting each stakeholder to regain their trust in the intent of the other stakeholders would be key to just get past the morning session.

Steven Covey Jr claims (Covey, 2007) that, simply put, trust means confidence and the opposite of trust – distrust – means suspicion. He argues that when you trust someone, you have confidence in them – in their integrity (intent) and their abilities. Distrust means being suspicious of someone's integrity, their agenda/intent, their capabilities and even their track record. All of these suspicions make progress difficult and lengthy as everything will be checked and double checked for intent.

For a person to accept advice and really open up, TRUST is a pre-requisite. How do we establish TRUST with a group of stakeholders and how do we get them to regain trust in each other and achieve this ambitious objective within a day or two?

We realized that the Dual Cloud process of getting each stakeholder to identify both the conflict they are put into due to some Undesirable Effects they have to deal with as well as the conflict faced by the person they are currently blaming for the Undesirable Effect, provides a very effective way to rebuild trust and respect.

By having to verbalize their Symptomatic conflict they can explain to all other stakeholders that their inaction to date has not been because of apathy but because they are "stuck between a rock and a hard place". Also, by verbalizing and presenting the Systemic conflict of the stakeholder they are currently blaming, they show understanding for that stakeholder's situation. Both go a long way to rebuilding the trust and respect needed to achieve consensus on a clear way to close the frequently large and growing gaps between service delivery and community expectations.

The next step in the design process was to use the TOC Change Management Questions to provide the agenda for the five days.

My proposal to InWent was that the 5 Day Constraint Analysis Strategy Workshop Agenda would follow my Simplified TOC Analysis Roadmap (see Figure 33).

Day 1 AM: Introduction to TOC's Systems Approach and the necessary change in paradigms

Day 1 PM: Consensus on Why Change?

Day 2: Consensus on What to Change?

Day 3: Consensus on To What to Change?

Day 4: Consensus on How to Cause the Change?

Day 5: Consensus on How to Measure the Change and achieve Ongoing Improvement?

5.4 Detailed Case Study: Analysis on Solid Waste Management in Lusaka

This section provides an overview of how the 5 Day Constraint Analysis Process was used in Lusaka, the first pilot study of the InWEnt/Goldratt partnership, and provided a summary of the outcomes achieved.

In most countries like Zambia, governments are responsible for ensuring that garbage (solid waste) is collected, transported and disposed of in a safe and environmentally friendly manner. Common practice is for private contractors to collect waste from private businesses and households in formal areas and for Community Based Enterprises to collect waste from informal areas. But often in developing countries these services are not extended to the very poor because they live in areas that are difficult to access or they cannot pay for the service.

The results of this gap in service delivery can be seen everywhere in these “unserved” areas. Huge piles of rubbish can be found throughout poor settlements, making poverty, persistent ill-health and low environmental quality part of everyday life, especially in cities like Lusaka.

Figure 36 shows what this looks like on the streets.



Figure 36 Build-up of Solid Waste in Lusaka due to Service Deliver Gap in Informal and un-served areas

A detailed report on this workshop is attached (Appendix 6) together with the Participant workbook I created (Appendix 4).

5.4.1 Creating the shift to a TOC/Systems Approach Paradigm

As per the new conceptual model (Table 8) the 5 limiting vs. enabling paradigms were presented and discussed. To show the magnitude of the results that can be achieved, I developed a “Multi-tasking” game (Appendix 3) that shows how, by just changing from a rule of “Multi-tasking” (based on an assumption that the earlier we start the earlier we finish) to a rule of “No Multi-tasking” (based on a realization that the later we start the sooner we finish) we can do double the amount of projects in half the time with the same resources.

Before starting the analysis on the afternoon of day 1, I asked representatives of each of the stakeholders to come forward to draw the “System” we are analysing to define the scope of the analysis. In the Lusaka pilot, the “System” is the Solid Waste Management System within the Lusaka district as shown in Figure 37.

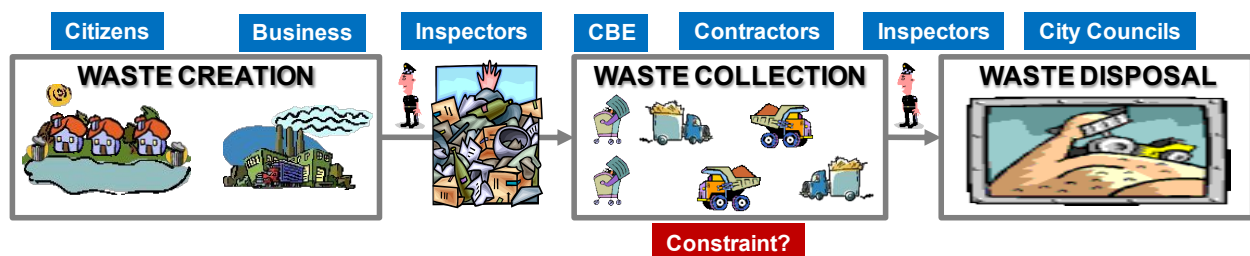


Figure 37 Solid Waste Management “System” in Lusaka

5.4.2 Results from Step 1 - Agreement on WHY CHANGE?

The agreement on WHY CHANGE? was brought about by looking at the current gap. The GAP between DEMAND and SUPPLY in city infrastructure is not only very large but growing at an alarming rate.

To directly reach the core problem, rather than looking at all the Undesirable Effects (UDE's), it is important to understand the UDE's relating to the constraint. There are two kinds of (UDE's):

Type 1: A statement of a GAP in performance

Type 2: A statement of the difficulties to close the GAP

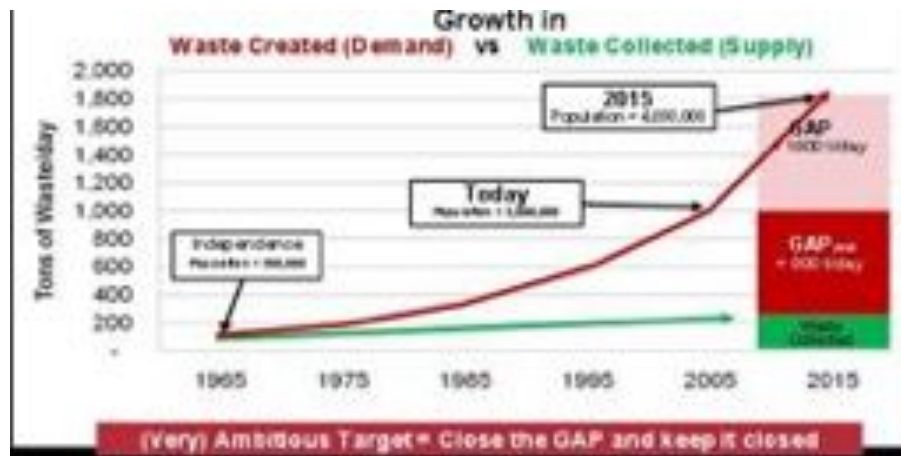


Figure 38 Current and Future GAP of Waste create vs. Collected in Lusaka City

If we try to solve these UDE's by applying traditional solutions (Table 11), the only answer that arises is that the cities require more money and that people need education. This is not very helpful to close the gaps.

Table 11 Summary of Conventional Way to deal with UDE's in Waste Management in African Cities

Problems (UDEs)	Root Cause	Traditional Solution
Government Departments lack budget	Lack of Awareness	Awareness Campaigns
Residents do not want to pay		
Service is too expensive		
People dump / burn illegally	Poor / No enforcement	Stricter enforcement of by-laws
No waste bins available		
Frequent equipment break down	No Equipments or Old Equipments	Get external funding to buy / build necessary infrastructure
Cannot access all areas		
No service in some areas	Low / No Subscription Rate	More awareness campaigns
Actual Waste Collection = 200 to 400 Tons per day (vs. Actual Waste created of 1000 Tons/day)		

5.4.3 Results from Step 2 – Agreement on WHAT TO CHANGE?

A “problem” exists whenever there is a GAP or difficulty to close the GAP. The fact that the problem still exists means that:

- The Action causing the problem DID happen – that is, it is part of an unresolved conflict.
- The Action needed to deal with the problem DID NOT yet happen – that is, it is part of an unresolved conflict.

Therefore, defining a problem precisely must start with understanding both the conflict that blocks us from solving/preventing the problem (SYSTEMIC or PLANNING Conflict) and the conflict that blocks us from better dealing with the problem (SYMPTOMATIC or EXECUTION Conflict). For Lusaka, the four sets of Symptomatic and Systemic Conflicts for each of the four stakeholders (City Council, Community Based Enterprises, contractors and residents) are shown in Figure 39 and Figure 40.

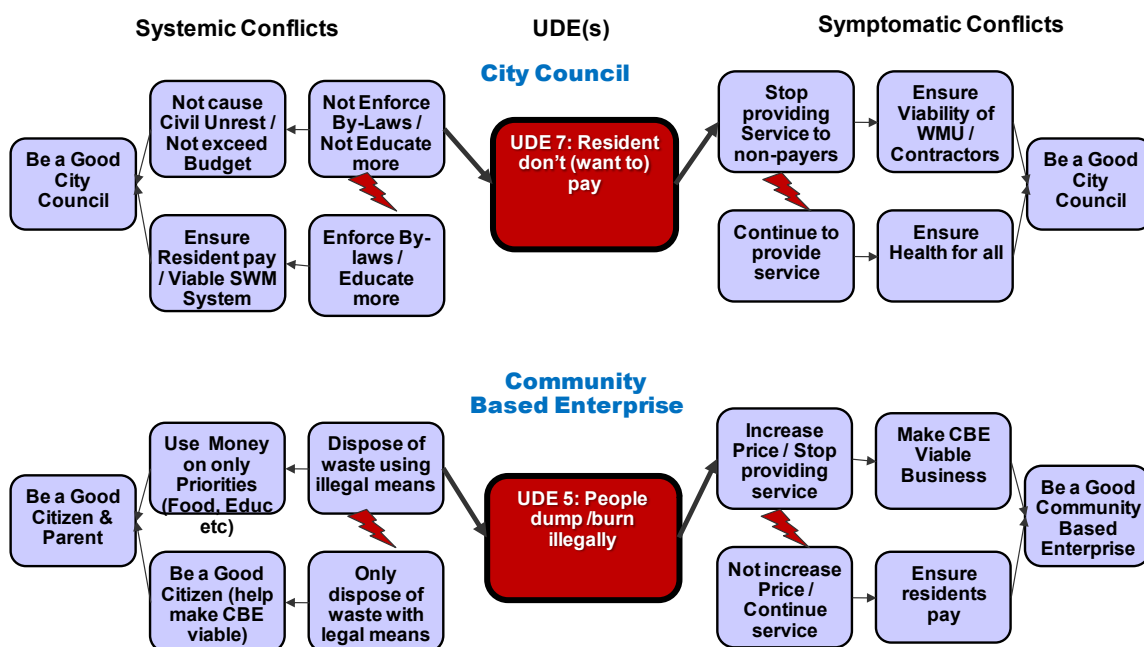


Figure 39 Lusaka UDE Conflicts for City Council and Community based Enterprises

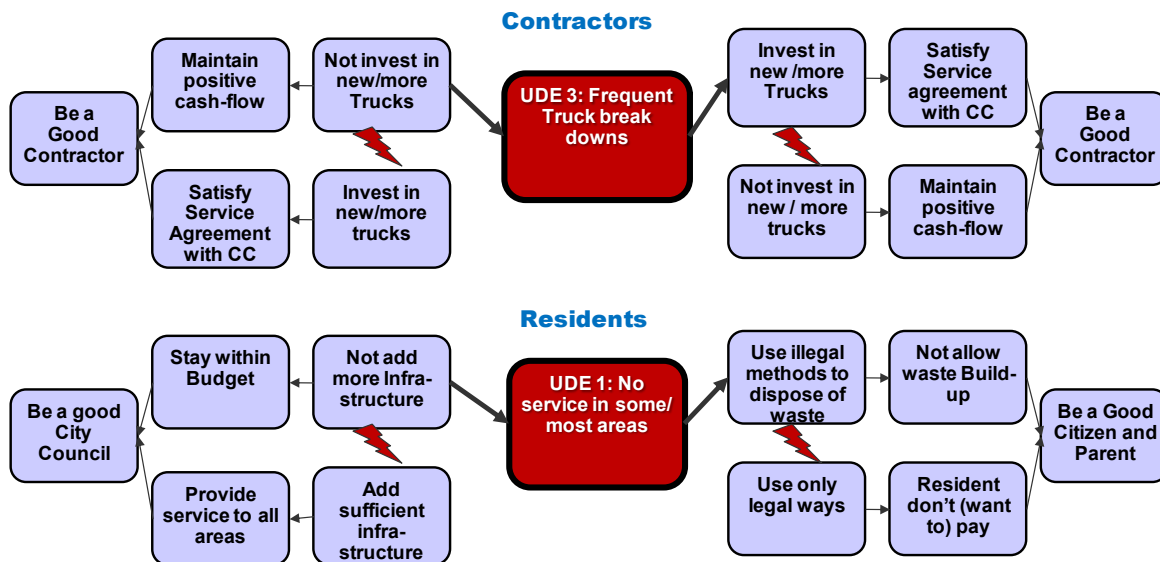


Figure 40 Lusaka UDE Conflicts for Contractors and Residents

Finding the Core Conflict(s) within the System

Typically, each stakeholder would have 3 to 5 UDE's and therefore 3 to 5 sets of Systemic and Symptomatic UDE conflicts. The next step in the process is a convergence step to see if we can find the one or few core (generic) conflict(s) of which each of the UDE conflicts are just examples.

The process of convergence is relatively simple but not necessarily easy since it requires that the TOC expert doing the analysis has the ability to recognize generic patterns by applying inductive logic (going from the specific to the general).

The process starts by identifying the conflicts for each stakeholder – some will be classified as Systemic and others as Symptomatic. Then we list all the "As" or Cloud Objectives underneath each other, the same with all the "Bs" and "Cs" – the necessary conditions and then the "Ds" and "D's" – the conflicting actions.

With these similar entities listed, the TOC expert then tries to combine each list into a single and more generic statement. Once this is completed for each of the lists, the Core Conflict is completed for that stakeholder with the summarized descriptions for A, B, C, D and D'. For the Lusaka analysis, the four Core Conflicts that were identified for each of the stakeholders are shown in Figure 41.



Figure 41 Four Core Conflicts identified in Lusaka for each of the four Stakeholders in the Lusaka SWM System

The work that is done to create the Core Conflicts is normally done during the evening of the second day. On the third day these Core Conflicts are presented to the group by a representative from each stakeholder with whom the Core Conflict was validated/modified prior to the start of the day 3 session.

During these presentations, we received a remarkable level of consensus on the first verbalizations, which definitely elevated the credibility of the process in the eyes of the stakeholder participants as they could, from previous days, clearly identify with the core conflicts of each of the stakeholders. We did experience a few situations where stakeholders suggested better verbalizations, which was immediately accepted by all and incorporated into the final versions.

5.4.4 Results from Step 3 – Agreement on WHAT TO CHANGE TO?

In the third step of the analysis the groups work on the conflicts and invalidate assumptions to arrive at a breakthrough and win-win solution. Table 12 shows an example of one of the outcomes of applying the 4 Method Process for breaking conflicts for the Service Provider's Investment Conflict (Figure 42).



Figure 42 The Service Provider's Investment Conflict

Table 12 Summary of Assumptions challenged in Core Conflicts and proposed Injections

Arrow	Assumption	Injection	How to...	Benefit
M1 – D'B	Current Capacity insufficient to meet current demand	Current capacity sufficient to meet demand	Ensure we do not commit to supply more than our capacity to deliver Know Demand and compare against total capacity in region (before investing)	Meet demand at minimum cost and risk
M2 - DC	If you spend more you increase cost and risk of business	We have a way to Invest more and not increase cost & risk	We approach Business man to help prepare business plan to get low interest loan from bank	Meet demand at minimum cost and risk
M3 - DD'	Both cannot be done at the same time	We agree when to invest and when not to and also where to invest	Use backlog as early warning indicator. If backlog starts growing, we know when to invest and invest only in "Bottleneck" resources	Meet demand at minimum cost and risk
M4 - E	Only way to increase capacity is through investment	Find way to increase capacity without increase cost	Use TOC to help better utilize capacity we have before getting more (exploit before elevate)	Meet demand at minimum cost and risk

The generic injections to break the four Core Conflicts, as identified with the above method, provide the answer to the "To What to Change?" question for each stakeholder. The four generic injections for the four Core Conflicts are shown in Figure 43. (See Appendix 6 Lusaka Constraint Analysis Strategy Workshop – Detailed Report).



Figure 43 Four Injections to break the Four Core Conflicts for the Lusaka SWM System Stakeholders

Once the injections (providing the direction of the solution) and some of the high level “How to” and benefits had been identified by each of the stakeholders for their Core Conflict, they were ready for the next step – raising and overcoming reservations verbalized as “Yes, but...” that can block the implementation.

5.4.5 Results from Step 4 – Agreement on HOW TO CAUSE THE CHANGE?

Step 4 on day 4 deals with the identification of the two types of “Yes, but...” reservations – reservations on why the new injections/solutions might hurt one or more of the stakeholders or why it might be too difficult to implement.

Type 1 reservations: Potential Undesirable Effects (PUDE’s) of the new Injection(s) on any of the stakeholders.

Type 2 reservations: Likely Implementation Obstacles (OBS) that can block the implementation of the next injection(s).

In the traditional TOC Thinking Processes, the Type 1 “Yes, but...” will be identified and shown in the “Future Reality Tree” (FRT) process that uses “Sufficiency Logic” to show

the cause-effect logic of how each of the injections should result in the desired outcomes (the Desirable Effects or DE's) as well as what Potential Undesirable Effects (PUDE's) these injections can cause if the injections are implemented as they were originally defined in Step 3. Part of the process to build an FRT was therefore to identify these PUDE's as well as the additional requirements (that would be added to the main injection) to prevent these PUDE's.

In the traditional TOC thinking processes, the Type 2 "Yes, but..." reservations were identified in the "Pre-Requisite Tree" (PRT) process that uses "Necessity Logic" to show the Necessary Conditions for achieving the successful implementation of the main injections. To identify these necessary conditions, the TOC Expert and/or group of stakeholders tried to identify likely implementation obstacles (OBS) and how to overcome these with "Intermediate Objectives" (IO's) which will serve as implementation milestones?

To simplify the above processes without jeopardizing the completeness of the analysis, I invented a new simplified process (done in groups) to get each stakeholder to help contribute "Yes, but..." reservations and suggestions on how to overcome these. All stakeholders are asked to participate in this process with the justification that the more of the "Yes, but..." reservations we can identify and pro-actively prevent during the analysis phase, the less surprises we will get in the implementation and therefore the higher the probability of success.

To obtain the contribution of all stakeholders, they are divided into cross functional groups. The members of each group are then encouraged to identify all the stakeholders that can be affected negatively or whose help will be required for the implementation. For each of these stakeholders, participants are then encouraged to contribute as many Potential Undesirable Effects (PUDE's) of the planned changes and how these can be prevented (to ensure new solutions are really win: win) as well as to contribute as many potential Implementation Obstacles (OBS) and how to overcome these. Figure 44 shows the new simplified framework I developed to enable participants to identify and overcome both of the "Yes, but..." reservations in a single step.



Figure 44 New Simplified Framework to enable participants to identify and overcome "Yes, but..." reservations

The answer to the question "How to cause the change?" is provided by an "implementation plan" where all the inputs from steps 3 and 4 are sequenced into a Implementation Roadmap (Pre-requisite Tree) showing the necessary and sufficient milestones to achieving success (closing the GAP and keeping it closed). The details of these answers for Lusaka can be reviewed in Appendix 6.

5.4.6 Results from Step 5 – Agreement on HOW TO MEASURE THE CHANGE AND ACHIEVE a POOGI?

The last day is typically spent on agreeing exactly how each of the stakeholders can contribute to making the changes happen, how the impact of these contributions can be measured and what additional capacity building support each stakeholder will require to achieve a Process of Ongoing Improvement (POOGI) within their organisation or community.

On day 5, a smaller group of stakeholder representatives agreed that they wanted to continue with the process and, as a result, wanted the measurements to cover two areas. It was agreed that the overall measurement should be whether the GAP in the system goal is reducing, remaining the same or increasing (i.e. GAP between waste created and collected). The second type of measurements would monitor whether the agreed injections and detailed requirements were being implemented or not. These measurements would then be reported at a monthly steering committee meeting with

representatives of all stakeholders who could collaborate to identify recovery plans in the case where GAPS are not closing at the desired rate.

On completion of the formal analysis steps, the Project Director from InWEnt asked the participants to share their “what went well”, “what can be improved” and “how I can apply the lessons learned in my life and in my organization”. The responses of participants were very positive and showed that many of the paradigms and TOC Processes did “stick” - even after only 5 days. The other positive feedback was from other observers such as InWEnt, UN DP and other donor organization stakeholders.

Below is a sample of open comments from participants captured by the InWEnt scribe after the first two 5 day Constraint Analysis Workshops in Lusaka and Kitwe:

- *“I’m very grateful for my being able to fully participate. We have seen that with TOC, Goals are possible (even if they look impossible) and that the key is to find win-win solutions and focus on the weakest link” – City Councilor*
- *“I did not expect much but now have seen it is possible to work with all the stakeholders as our real goal (to improve the lives of everyone in our community) is the same” – Private Contractor*
- *“Discovered that we had a very big gap in our system. Previously thought we can only close it by getting more/new equipment. Now learned that I get more with the same equipment using the TOC approach” - Private Contractor*
- *“I learned that the ‘cost of doing nothing’ can be very high. In the health sector the ‘cost of doing nothing’ is a matter of life and death. TOC showed that optimizing our capacity can be achieved even with less resources by improving the efficiency of available resources” – Doctor*
- *“I learned the need for planning and that the impossible can be possible” - Chairman of a community settlement*
- *“TOC can even help to address the political issues” – Councilor*
- *“My expectation was low at the start of the workshop, but have learned the need and benefit for everybody’s participation using this TOC process”- Council officer*
- *“I learned that TOC is a window that gives a chance to look at the challenges we face in a different perspective... learned the importance of defining the problem precisely before dealing with it” - Deputy mayor*

- *"Learned that the best solution comes by asking the right question"* – Councilor
- *"Learned that the solution to our constraints is within ourselves"* – Contractor

The overwhelmingly positive response triggered this quote from me before the workshop was ended (as captured in the notes of the Lusaka Workshop):

"Today, I am so proud to be an African. What this team has achieved in only a few days and the spirit in which it was achieved was truly inspiring and should serve as a benchmark to the rest of the Public Sector of what is possible if the right people are put in a room together, reminded that we have a common goal and that it is always possible to find win:win ways to break conflicts and overcome constraints, especially when lives depend on it."

Figure 45 shows selected photos of the active participation over the 5 days of the workshop.



Figure 45 Selected Photographs from the Lusaka Pilot workshop

5.5 Validating the New Process against Success and Sustainability

Criteria

After the success of the Lusaka pilot, three additional cities were selected for the 5 Day Constraint Analysis Workshop. These included Kitwe, Ibadan and Kano.

Ultimately, we wanted to see if it was possible for each of the test cities, in 5 days or less, to achieve active contribution and consensus on each of the 5 Change questions.

Table 13 shows that, in all cases except for Lusaka (see footnote), a positive response was received on all five questions from all stakeholder representatives – some that amazed even the biggest sceptics of the process.

Table 13 Comparative results of outcomes from four Pilot TOC Workshops

No	Success Criteria	Lusaka (Baseline)	Kitwe	Ibadan	Kano
1	Agreement in the Goal and GAP	Yes	Yes	Yes	Yes
2	Agreement on the Problem, System Constraint, Major UDEs and Core Conflicts ...by stakeholder	Yes	Yes	Yes ²	Yes
3	Agreement on the direction of solution to better exploit/elevate constraint – the injections needed to break core conflicts for each stakeholder	Yes	Yes	Yes	Yes
4	Agreement on the most significant negative side effects and how to prevent these	Yes	Yes	Yes	Yes
5	Agreement on the implementation obstacles and how to overcome these	Yes	Yes	Yes	Yes
6	Commitment by Top Leadership to fully support TOC initiative and take ownership to drive implementation	No ³ (Did get it later)	Yes	Yes	Yes

Source: Post-Workshop de-briefing results (by show of hands from all stakeholder representatives)

² The Pilot projects in Nigeria included representation from Politics and therefore the UDE's and Core Conflicts of Politicians expanded the previous four Core Conflicts found in Zambia to five.

³ Although there was much excitement from all stakeholders, the City Council wanted to first receive approval from the Council to commit to proceed.

5.6 Current Status of Lusaka Project

Since the initial workshop, many of the injections that were developed to break Core Conflicts and/or better exploit the System Constraint at the time (waste collection – truck capacity). The progress made to date includes:

- A Waste Management Unit has been established to manage the implementation of the agreed injections.
- A new Waste Management Monitoring System is in place. Citizens can call a call-centre to request service and will be quoted the appropriate service fee and informed which contractor will pick up waste and when it will start.
- A new environmentally friendly landfill has been created (with help of DANIDA) to ensure landfill capacity does not become a constraint.
- A scalable and repeatable WM model has been defined and disseminated to other pilot towns and cities.
- There has been evidence that, although there is no reliable way to measure tons of waste created and collected yet (there has been Capex approved to repair and install more weigh bridges), the number of trips done by Waste Collection Trucks – due to better “Constraint Exploitation Rules” has increased by between 30 % and 100 %. Also, private contractors have reported significant increases in their revenues, due to more trips and higher levels of payment by the communities they service.

At the same time, there are some remaining challenges that are being addressed through follow-up “Constraint Exploitation” and “improving management skills and decision making” workshops. The remaining challenges include;

- Despite significant revenue increases to both the City Council and private contractors (typically up by 25 % to 50%), in some areas there is still not enough revenue (not enough citizens and businesses paying) for the system to be financially sustainable. The injection for improving viability is that private contractors operating in these areas will be assigned additional areas (outside their normal licensing area) to make them viable. This change of the City Council taking responsibility for ensuring the viability of the private contractors has made

a significantly positive impact on re-establishing the trust and spirit of win:win (and recognition that a lose for one is a lose for all).

- In some areas contractors were complaining that, even though the fee has been reduced, some citizens still don't pay since enforcement is not yet in line with expectations. The injection was to put water, electricity and waste removal fees on one bill. If citizens do not pay, you cut off all the services. The City Council and private contractors believe this injection can potentially have the biggest impact on long term system viability. The injection has also spread to national government. The Zambia government, struggling to get people to pay TV licenses, have now included it as part of the electricity bill.
- The unwillingness to put measurements and short term targets in place. There is a tradition within the City Councils to not commit to achievement of targets (for political reasons). The injection here was to show how critical feedback measurements are to ensuring that scarce resources are not wasted on areas doing well or moved to areas where the gaps are growing. The primary measurement that will be introduced in 2009 will be "Tons of Waste Collected". For this, infrastructure such as weigh bridges etc. would have to be upgraded or replaced. Funding for this, based on the likely benefit of doing this, has already been secured.

What are the Next Steps in Lusaka?

There have been a number of workshops with all stakeholders since the initial 5 days Constraint Analysis Strategy Workshop. Many lessons were captured on what really worked well and where we still needed to improve on.

As a next step, the City Council has requested that the Goldratt/InWEnt team assists (using TOC) in doing a review on all the current strategic projects where there is a large gap between actual and expected/promised results. They are also interested in discussing possible assistance with the monitoring of the execution by TOC Experts to coach the project teams on how to "follow-up and follow-through".

5.7 Future application of TOC within InWEnt and the UN DP

Both InWEnt as well as the UN DP have indicated their satisfaction with the results achieved to date and have given their commitment to continue to roll-out to other applications.

5.7.1 Feedback on results achieved by InWEnt

In a report from Michael Funcke-Bartz, InWEnt's Senior Project Director of Capacity Building, he stated the following after the Lusaka TOC Workshop:

My impression was that, for all of us, it was a very useful experience of how to apply TOC in infrastructure management, bringing together stakeholders from the Public and Private Sector.

What has been achieved during the one week workshop in Lusaka?

One of the big achievements of this working process was that a group of people who, at the beginning, were blaming each other for the existing problems of municipal waste management in Lusaka, came to a problem-oriented approach, focussing on concrete entry points for own activities, which contribute to overcoming the existing problems.

It has become evident that the main constraints for a sustainable municipal waste management system, which is economically viable in a mid- and long-term perspective, are internal and interrelated among each other (pricing-, payment-, service provider and enforcement conflicts). This can facilitate their solution but, on the other hand, the political and social implications related to these conflicts are serious and require the closing of the existing enforcement gap.

Another problem which might come up when starting concrete work in Lusaka can be the following: From a TOC perspective, it would be necessary to reduce/reuse as much as possible volume and weight of waste which has to be transported and tipped at the landfill. Although it was not mentioned, such a strategy could jeopardize the local government's interest to collect as much fees for tipping as possible in order to be able to subsidize for example waste collection in unplanned settlements (and possibly also serves for other purposes).

The methodological decision to not to go into the current and the future reality trees but to concentrate on the thinking process and the conflict resolution

diagrams for filtering out the key conflicts was very helpful for this type of workshop and should be maintained for the next occasions. Nevertheless, the extent to which the methodological background of TOC is explained in that phase can probably be reduced for the next workshops.

The fact that nearly the whole group of participants attended the workshop, which was scheduled originally for three days, for five days underlined the relevance of the workshop for the participants. Only in a few occasions I have seen participants working in such a concentrated way – the facilitators even felt sometimes uncomfortable for having to insist in breaking for lunch.

The expectation to reach on the fifth day an agreement on the way forward was ambitious and has not been achieved. What we have the entry points from the discussion at the end of the workshop which now can be the basis for a discussion with Lusaka City Council/Waste Management Unit. Based on these results and the bilateral discussion we had afterwards, I worked out a tentative roadmap which is also enclosed (and not yet discussed with Mike and his team).

Thank you very much to Alan and Antoine for their excellent facilitation and to Stanley and Jonathan for their very good draft of the documentation of the Lusaka workshop.

As far as the project in Africa is concerned, the water utility from Arusha/Tanzania in the meantime has also applied. Based on this request, we will be able to start the process there soon.

5.7.2 Feedback of Results achieved by UN DP

The UN DP's Capacity Building director for Africa, in their 2008 feedback session, said that TOC language is now accepted within the governments that formed part of their pilot – e.g. they stated that if you use "TOC" with Nigerian politicians, they will know it as a Management Philosophy that can enable us to "do more with less in less time".

The UN DP has formally adopted TOC as part of their engagement and analysis process with countries. The UN DP believes that for sustainability it is critical to build in TOC Thinking (how to set goals based on inherent potential, how to deal with complexity, how to deal with conflict). The UN DP has also started with a TOC Health Initiative working with the African Council of Health, on projects in Uganda etc.

5.8 Specific Lessons learned from all the Public Sector Pilots

5.8.1 Does the process really work within different environments?

Although the primary focus of the research was to create a conceptual model and Simplified Constraint Analysis and Solution Development Process that could cope with the added complexities and uncertainties of the Public Sector, I wanted to validate as quickly as possible whether the method is as successful in other similar systems within different countries (e.g. would culture impact the findings?) and then with different systems (e.g. private organizations and individuals). As far for the first objective, we validated that both the process as well as the style of the facilitators worked equally well in Nigeria – the second round of pilots - despite the significant cultural differences between Zambia and Nigeria. With regards to testing in other environments, Chapter 4 gives an overview of how the process achieved similar results (full agreement on all 5 questions and a commitment to implement) within both Private Sector organizations as well as with individuals (Odyssey Program).

5.8.2 Are there really a few similar types of Core Conflicts and Constraint(s) for the same type of system?

My expectation after the first workshop with Lusaka was that we will find very similar, if not identical, Core Conflicts and Constraints elsewhere since the same (erroneous) rules were used to manage these systems. This expectation was validated as we rolled out the process to Kitwe, then Ibadan and then Kano. The only observed deviation is when additional stakeholders are introduced this could add one more Core Conflict (for that stakeholder) that needs to be broken. We will soon get to a point where “analysis/discovery” becomes more of a “validation” against known causes and solutions. Already, after the second workshop (when we proved that the same generic Core Conflicts existed), I could hand over the facilitation to a co-facilitator, something that would not be possible so quickly if a “new discovery” was needed each time.

5.8.3 Is it possible to train-the-trainer with the new process?

One of the major concerns after our first success in Lusaka is whether someone else could take over the facilitation, especially someone without years of TOC experience. The realization, therefore, that we really did identify generic Core Conflicts at Lusaka was very good news, since the scalability of this type of initiative is to a large extent

governed by the availability of experienced TOC experts that are also good facilitators – a resource that is generally quite scarce. By showing that the major emphasis will move to validation rather than analysis and discovery, it meant that good facilitators could be trained relatively quickly through “train-the-trainer” programs.

5.8.4 What is needed to ensure a successful implementation of the agreed changes?

Thomas Edison said “Vision without execution is a hallucination.”

In this research project, we realized, through each “de-briefing”, that Capacity Building (without follow-up and follow-through) will not deliver any significant and sustainable results (to close the GAP and keep it closed).

As a result, we’ve had discussions with InWEnt and other donor organizations to consider expanding the scope of their mandate, which is currently limited to “Capacity Building” and in some cases “Financing of Projects”. However, they agree that if it is results they are interested in (and they are interested to really see the GAP closing), they would have to expand their mandate to offer practical methods for City Councils and other stakeholders to ensure the Capacity Building efforts deliver real results through assisting stakeholders with the challenge of execution of “follow-up” and “follow-through”.

As a result of this lesson learned, a joint InWEnt/Goldratt de-briefing and strategy workshop was held in Arusha in September 2007. The following decisions were taken:

1. Each 5 Day Workshop will end with the “self-selection” by all participating stakeholders of an Implementation Steering Committee. This committee will be responsible for identifying, through at least monthly interactions with all the stakeholders, what additional assistance (training, coaching, expert advice on TOC or Solid Waste Management etc.) is needed from the Goldratt and InWEnt teams. This committee will also, together with one representative from Goldratt and one from InWEnt, serve as the Program Audit Committee that will monitor progress and make decisions around recovery plans.
2. The 5 Day Workshop, that has proven to be successful in all the pilots, will retain the same agenda and structure of participative analysis and solution development. The workshop will start with an Introduction to TOC and the Old vs. New paradigms of a Systems Approach (½ day), then proceed with the answering

of the 5 Change questions - one question per day - ending on the fifth day with a high level implementation roadmap of the total solution and a commitment by each stakeholder as to their responsibility and measurement on the roadmap.

3. For those City Councils that want to continue with the implementation, a follow-up, 2 x 2 day Workshop will be facilitated by Goldratt and InWEnt. The first (facilitated by Goldratt) will be a 2 day workshop on how to better exploit constraint resources (day 1) and when and how to best elevate constraint resources, including how to do the financial Return on Investment (ROI) calculations (day 2.). The second 2 day workshop (facilitated by InWEnt), will entail day 1 focusing on how to practically reduce the tons of waste created (that needs to be collected) and day 2 focusing on how to practically increase the incentive for recycling.
4. For those City Councils that apply for "Execution Management Support", Goldratt will use their newly developed "Strategy & Tactic" Design, Planning and Execution Management Software (called Harmony – developed by myself) to plan and monitor the execution.

5.8.5 Where are there still GAPS or complexity in the process?

There is an inherent dilemma within Capacity Building Organizations such as the UN Development Program and InWEnt that was highlighted in our first four pilots.

In the past, Capacity Building has focused on teaching people the possible causes and alternative solutions for problems and left the decision up to them on whether to implement these and, if so, which one(s) to implement.

Frequently however, the consequences of deciding on one rather than another, is quite significant (i.e. this requires expert opinion) and there are also practical implementation obstacles that, unless address, could block an implementation or cause the implementation to be a half-baked solution with potentially significant negative consequences.

The decision about the goal for Capacity Building organizations such as InWEnt could and probably should challenge their future focus - if their goal is simply to build capacity or, rather, if it should be to help governments achieve, sustain and continuously improve results.

The growing frustration of the Capacity Building teams and their donors with the small percentage of projects that deliver results, could provide sufficient pressure for these organizations to add to their assumed responsibility, requested mandate and organizational capacity to also provide the “follow-up and follow-through” until the results are delivered.

The team also learned there are two important steps in the analysis which should not be skipped:

1. Recognizing past achievements (but then to show the large current and future GAP)
2. Validating the impact of current/planned strategies (that is, can they help break Core Conflicts/Constraints or will they be in conflict with the new strategy?)

In retrospect, we did not make it clear enough at the beginning that this workshop is “*not simply a theoretical exercise*” (i.e. not just capacity building). We also did not give proper opportunity for Lusaka WMU and DANIDA (Danish International Development Agency) to present their existing strategy and plans and how these related to the agreed Constraint and Core Conflict. Only if we find that the existing plan is not sufficient or contains parts no longer necessary, should we continue to find NEW INJECTIONS (changes of what to STOP and or START doing).

If either (1) or (2) are not done, the workshop will not achieve its objective of reaching full consensus and commitment from all stakeholders on Why Change? What to Change?, What To Change To? And How to Cause and Measure the Change to close the GAP?

Chapter 6 provides an overview of the solution we are busy developing and testing to ensure that the agreed strategies are implemented and if field experience shows that some of the original assumptions are not valid or no longer valid, how these gaps can be quickly detected and escalated to the appropriate levels for corrective action.

Chapter 6 Further Research Developments in Planning & Execution Management

The introduction by Dr. Eli Goldratt a few years ago of a new "Theory of Constraints" based Thinking Process called a "Strategic & Tactics" Tree (S&T) is being viewed by more and more executives and managers around the globe who have been exposed to it as one of the most important breakthroughs in ensuring that agreed business or organization strategies are implemented and to achieving harmony within organizations. The S&T, they believe, can for the first time provide them with a practical process and logical structure for defining and communicating all the necessary and sufficient changes as well as the sequence of implementation of these changes to achieve more goal units for the organization – not just what to change, but more importantly, what not to change.

As with many breakthroughs, this breakthrough started with a simple question by Dr. Eli Goldratt:

If "Strategy" is really at the highest level of an initiative or organisation and defines the direction that dictates all activities, and "Tactics" are lower down in an initiative or organisation and define the activities that are needed to implement the Strategy, then where does "Strategy" end and where do "Tactics" begin?



Figure 46 Traditional View of Strategy & Tactics

Dr. Goldratt realized that answering this question required that the words "Strategy" and "Tactic" had to be defined more clearly than before. His new definitions were inherently simple, yet powerful. He decided to define "Strategy" as, simply, the answer to the question "What for?" (The objective of a proposed change) and "Tactic" as, simply, the answer to the question "How to?" (The details of a proposed change). From these definitions, it is clear that every Strategy (What for?) should have an associated Tactic (How to?) and therefore Strategy and Tactic must always exist in "pairs" and must exist at every level of the organization.



Figure 47 Goldratt's View of Strategy & Tactic Tree

An S&T can therefore be viewed as simply a logical tree of the proposed changes that should be both necessary and sufficient to ensure the synchronized achievement of more Goal units for the organization. However, any logical tree is only as valid as the assumptions on which it is based. Therefore, it is the responsibility of managers at every level in the organization to not only contribute to defining and communicating the Strategy and Tactic for each proposed change, but also to define and communicate the logic of the proposed change – why the proposed change is really necessary to achieve the higher level objective and ultimately the goal of the company, why they claim it is possible to achieve the objective (Strategy) of the change (especially considering it has probably never been achieved before), why they claim their proposed change (Tactic) is the best or even the only way of achieving the Strategy of the change and finally, what advice/warning they would give to their subordinates to ensure the sufficiency of the implementation of the proposed change.

Each S&T node in the S&T is therefore simply a proposed change that should answer:

- Why is the change needed? (Necessary Assumption)
- What is the specific measurable objective of the change? (Strategy)
- Why do you claim the Strategy is possible and what must be considered when selecting from the alternative ways of achieving the Strategy? (Parallel Assumptions linking Strategy with Tactic)
- What is the specific Change(s) being proposed to a process, policy or measurement? (Tactic)
- What advice/warning should be given to subordinates, which, if ignored, will likely jeopardize the sufficiency of the steps they would take to implement this tactic? (Sufficiency Assumption)

How much of the above knowledge is really properly defined, documented, communicated and systematically validated/invalidated within a typical organization?

The need for an S&T Expert System

As mentioned in Chapter 5, we discovered that in Public Sector organizations, as with Private Sector organizations, the fact that we reach full consensus on what need to

change and how the change will be implemented and even who will be responsible, does not mean it will be done – it needs a mechanism to enable managers at all levels to follow-up and follow-through. Edison’s famous quote, “*Vision without execution is a hallucination*”, is a reminder of this simple fact of life.

To enable the key stakeholders and facilitators to capture the outcome of the workshop in this excellent S&T format, described in the previous section, and to use the S&T to provide the basis for an implementation plan and to monitor execution, I developed an S&T Expert System called Harmony (in reference to the desired outcome of achieving harmony within organizations and in our own lives with a single Constraint focused Strategy) . Harmony is currently being tested by Goldratt Group and InWEnt as well as other leading organizations such as Toyota, Tata, Random House Publishing and Premier Foods (South Africa).

The free Harmony S&T viewer and a 30 day trial of the Harmony S&T Developer/Implementer can be downloaded from www.goldrattresearchlabs.com.

Figure 48 shows one of the S&T’s created in Harmony for the Lusaka project.

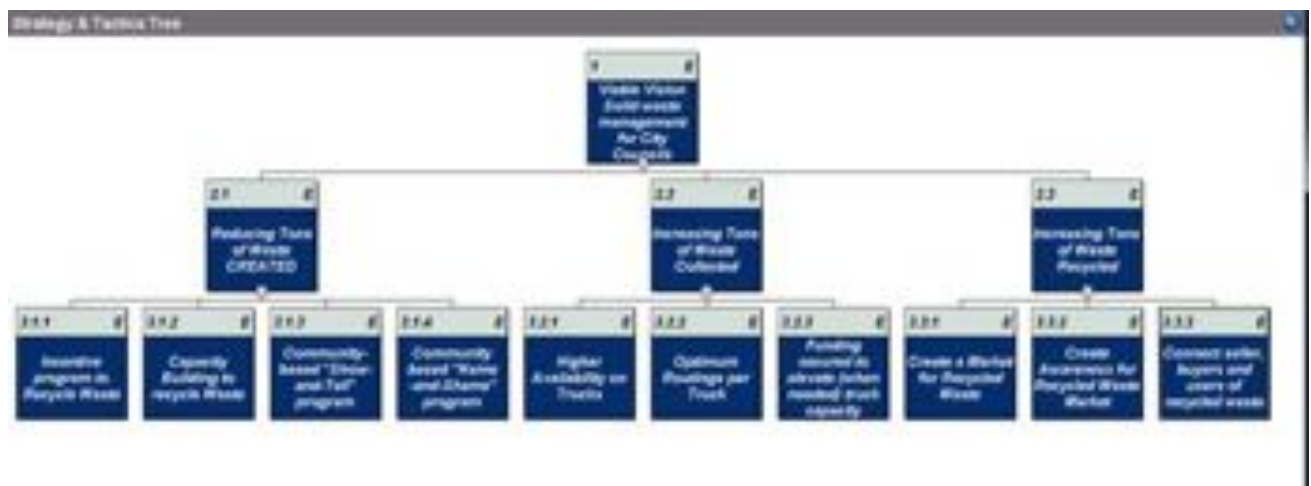


Figure 48 Example of a Public Sector S&T created in Harmony

Chapter 7 Research Conclusions and Recommendations for Future Research

The aim of this research was to validate or invalidate the Research Hypothesis that ***"It is possible to design a simpler, faster and better conceptual model and process that will be generic enough to enable both organizations and individuals to identify and unlock inherent potential (for achieving more goal units)"***.

The proposed Research Method was to confirm the extent, consequences and causes of the Research Problem through a literature review and to search for a gap or gaps within the existing theories and methods that could explain why, despite much effort within the field of Systems Thinking and specifically Theory of Constraints, the results achieved and the level of adoption of the "Systems Approach" as a new way to manage and improve organizations and individuals did, not yet meet expectations.

The literature review confirmed a number of gaps that could be addressed with a new and simplified conceptual model for shifting from limiting to enabling paradigms and a practical step-by-step process to capitalize on these new paradigms to systematically identify inherent potential and find new innovative ways to unlock this potential with the minimum investment and/or risk.

Once the new design was completed, the Research Method called for validation with peers, which was successfully done at the TOCICO conference in 2003. The next step in the Research Method was to test this new model and "5 day constraint analysis process" within the Private Sector, which was done successfully within organizations both in South Africa, and internationally. One example of this is Seagate (a computer hard drive manufacturer) that confirmed the benefits they received with a letter in Appendix 7.

The next step in the Research Method was to validate the Research Hypothesis with the application to individuals. The result was the resurrection of the Odyssey Program that has become an annual international event and is now being spread through the world as regional events facilitated by people that have been trained through a "train-the-trainer" program. The response received from the young adults that attended the program surprised sceptics by proving that it was possible to create a generic and yet simple process that can be applied by individuals to identify and unlock inherent

potential within their own lives by challenging assumptions that previously blocked them from setting or achieving ambitious goals.

The next test with the defined Research Method was to validate the Research Hypothesis within probably the most complex environment – the Public Sector. Through a partnership with InWEnt and the UN DP, we proved that the process is effective even within an environment with multiple stakeholders, each with their own objectives and with large variations in their levels of education or “business experience”. The tests were successful in each of the four pilots done in Zambia and Nigeria and the programs that were initiated from these continue to make significant progress towards closing the large and previously growing gaps between waste created and waste collected.

The final test was to see whether the new invention and innovation of new methods from this research would be adopted into the formal TOC Body of Knowledge (published by TOCICO) and would be used by TOC practitioners around the world. This objective has also been achieved as the new methods developed within this research have been adopted by the TOCICO as part of their published TOC Body of Knowledge and, after being included in a best seller Business Book in Japan, is now being used by organizations such as Toyota to identify and unlock more inherent potential.

Recommendations to Theory of Constraints Practitioners and Managers of Organizations

1. Use the five limiting vs. five enabling paradigms to provide a simple explanation of the fundamental difference between the traditional and Systems Approach needed to identify and unlock inherent potential.
2. Use the Multi-tasking game as an effective and efficient method for showing the potential that can be unlocked and how it is our own assumptions that block us from seeing and unlocking this potential.
3. Use the diagrams presented in Chapter 3 (Best vs. Average performance and Constraint vs. System performance) for explaining why inherent potential exists within most organizations and individuals.
4. Use my five questions rather than Goldratt’s three questions as an Analysis and Change Framework.
5. Use the Goal and Constraint GAP method to identify relevant UDE’s, rather than getting stakeholders to list any UDE that currently bothers them.

6. Use the Systemic and Symptomatic UDE process to define the problem more precisely.
7. Use my 4 Method Process as a faster and more reliable method to break conflicts with win:win solutions, rather than the previous process of trying to verbalize as many assumptions as possible (without any real framework to judge which assumptions are important and which are not important in relation to break the conflict).
8. Use the simplified process for raising and dealing with "Yes, but..." reservations.
9. Do not assume that because a group leaves excited and motivated that action will be taken. Whether working in a Private or Public Sector organization or with individuals, in most cases, unless there is follow-up and follow-through by leaders, real actions are likely to not be taken and/or efforts to move towards the goal will not be sustained.

Chapter 8 Glossary

Conflict Diagram:

"Clearly define a problem and you are half-way to a solution". In TOC this means defining an unresolved problem or Undesirable Effect as an unresolved conflict. The "Conflict Diagram" is a graphical representation of the unresolved conflict between the tactics that block us from resolving the problem. The Conflict Diagram is used both to better understand why Undesirable Effects exist as well as help to surface the hidden and frequently "erroneous" assumptions that block us from breaking the conflict with a win/win. The most frequently observed conflicts in organizations are "Local vs. Global Optima" and "Short term vs. Long Term Optima".

The structure for verbalising an unresolved problem as an unresolved Conflict is as follows:

D: A Prerequisite to Satisfy (B) in order to deal with the "problem"

B: A Requirement/Need of the System

A: The Goal of the System

C: Another Requirement/Need of the System that will be jeopardize by (D)

D': A Prerequisite to Satisfy (C) that are also in conflict with (D)

The conflict is read as "In order to have (A), we must have (B)" and "In order to have (B) we feel pressure to do (D)". On the other side, "In order to have (A), we must also have (C)", but "In order to have (C) we feel pressure to do (D')" - which is in direct conflict with (D). No wonder we feel like we are stuck between a rock-an-a-hard place.

System Constraint.

A scarce source of supply or demand (part of physical starting conditions) or set of assumptions, policies or measurements (logical "rules" by which we manage the starting conditions of a system) that limits a system from achieving a higher level of "Goal units". There are very few constraints in any complex system.

Odyssey Program:

A program originally created by Dr. Eli Goldratt to teach the principles of TOC and the TOC Thinking Processes to children of TOC practitioners to help them set life goals, make important decisions (such as "What to do with the rest of my life?") And/or identify and overcome constraints or unresolved conflicts that could limit or block them from reaching their goals. The Odyssey Program was resurrected after 10 years in 2005 by Alan Barnard and John Thompson. The Simplified TOC Roadmap developed as part of Alan Barnard's PhD research is now used in this program.

Paradigm:

A set of assumptions we believe are valid. These assumptions influence the "rules" we use by which we manage systems.

Theory of Constraints.

A set of processes, analysis tools and proven constraint management solutions that have been developed to identify, better exploit and or elevate the few constraints within complex systems such as organizations.

Assumption:

In the TOC TP, an "Assumption" is the answer to the question "Why?" we make a logical connection (if...then...because or in order to... we must because..." The general definition is something that is believed to be true without proof; a hypothesis that can be falsified or proven to be wrong, but never proven right.

Banana:

The flat ellipse that connects two or three cause arrows that enter an effect entity. Also known as a 'Logical And'. All causes must occur for the effect to result.

Bottleneck:

A resource (e.g. facility, function, department, machine or person) in a process flow with less capacity than the average demand placed on it.

Buy-in Process:

The process steps we must follow in order to overcome each layer of resistance to change in order to gain active support and contribution.

Buffer:

Time, inventory, cash or capacity used to protect the performance of the system.

Categories of Legitimate Reservation (CLR):

In the TOC TP, these set of rules of logic that are used to scrutinize necessity and sufficiency-based logic in a non-threatening way. The types of CLR are entity existence, clarity, causality existence, predicted effect, additional cause, cause insufficiency and tautology.

Chupchick:

Small, insignificant fact that is not essential in the analysis. Or a small insignificant "improvement/contribution" that is not essential and can even jeopardize improvement of the system as a whole.

Complexity:

The common definition is something that is complicated to understand and has many interrelated parts. Therefore, the complexity of a system is determined by the amount of data needed to describe the system.

The definition used by the 'hard' sciences of complexity is described by the number of degrees of freedom in the system or the numbers of factors that must be considered when trying to predict the impact of a change in the system.

Constraint:

A constraint in the physical sense is either an external scarce source (e.g. source of supply, demand or cash/funding) or internal scarce resource that limits the system from achieving higher performance versus its goal.

Core conflict (also referred to as the generic cloud):

The unresolved strategic conflict that explains why all or most of the UDE's still exist.

Core Problem:

A limiting assumption that prevents us from resolving a conflict which causes most, if not all, of the UDE's in the system. An entry point or root cause in a cause-effect logical diagram.

Cost World:

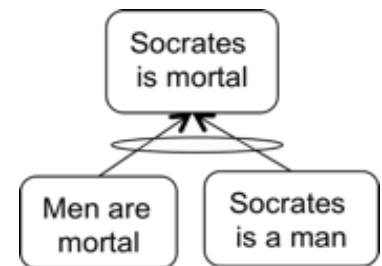
A frame of reference based on the following assumptions that include: 1) the sum of the local improvements is equal to the improvement on the whole, and 2) reducing costs [rather than increasing throughput] is a more effective and efficient method to improve the performance of the system as a whole.

Current reality tree (CRT):

In the TOC TP, the CRT is a sufficiency-based logic tool to map cause-and-effect relationships to determine root causes(s) of observed UDE's of the system.

Deductive Arguments:

A deductive argument is an argument in which it is thought that the premises provide a guarantee of the validity of the conclusion. In a deductive argument, the premises are intended to provide support for the conclusion that is so strong that, if the premises are true, it would be impossible



for the conclusion to be false. Therefore, deductive arguments Begins with the hypothesis: leads to predictions, proceeds (typically but not always) from the general to the specific and Provides a method of verification.

In the deductive argument example included here Socrates concludes that "IF men are mortal AND IF Socrates is a man THEN Socrates is mortal"

Desirable Effects (DE's):

The positive effects in the future reality tree that replace the UDE's from the current reality tree.

Effect:

An entity representing the result of one or more causes.

Entity:

In the TOC TP, used to represent a cause, effect or condition that exists.

Evaporating cloud (also referred to as a Conflict Resolution Diagram):

In the TOC TP, a necessity-based logic tool consisting of five entities that is used to understand unresolved problems and which can be used to identify limiting assumptions and to develop win-win solutions. The five entities are the common objective/goal, and

a strategy/need and tactic/action/want for each side of the conflict.. In using the tool, assumptions are surfaced related to the conflict or problem.

Five focusing steps (also referred to the Process of Ongoing Improvement or POOGI):

A process to continuously improve a system (to achieve more goal units like "Make more money now and in the future") by focusing on what is necessary to improve, protect and elevate the system constraint. The steps consist of: (1) Identify the system constraint, (2) Decide how to exploit the system constraint, 3) Subordinate everything else (all rules, measures, training, behaviour, etc.) to the above decision, (4) Elevate the system constraint and (5) If the system constraint moved, then to go back to Step 1, thus not allowing inertia to become the constraint.

Future Reality Tree:

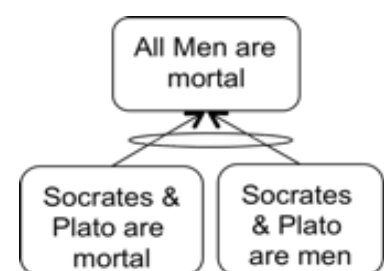
In the TOC TP, a sufficiency-based logic tool for constructing and testing potential solutions before implementation. The objectives are to 1) develop, expand, and complete the solution and 2) identify and solve or prevent new problems created by implementing the solution (See Negative Branch Reservations).

Global Measures:

That set of measurements that refer to the overall performance of the company. The global financial measures are Net Profit (NP), Return on Investment (ROI) and Cash Flow (CF). The global operational measures are Throughput (T), Investment (I), and Operating Expense (OE).

Inductive Logic:

An inductive argument is an argument in which it is thought that the premises provide reasons supporting the probable truth of the conclusion. In an inductive argument, the premises are intended only to be so strong that, if they are true, then it is unlikely that the conclusion is false. Therefore, inductive arguments begins with observations:



leads to hypothesis, proceeds (typically but not always) from the specific to the general and provides a method of discovery....but the hypothesis can only be proven wrong, never right!

In the inductive argument example included here Aristotle concludes that "IF Socrates & Plato are mortal AND IF Socrates and Plato are men THEN All Men are mortal.

Injection:

In the TOC TP, a new idea or solution requirement, which, if "injected" into the future reality, will enable the achievement a set of desired effects.

Intermediate Objective (IO):

In the TOC TP, the necessary condition or requirement to overcome one or more implementation obstacles.

Inventory:

The physical stock buffers of materials, spares, bought-out/purchased components, work-in-process and finished goods used to support operations, logistics, support functions and customer service. In TOC, it is all the money invested in things purchased for sale, valued at the purchase price with no value added for applied labour or allocated overhead.

Investment (I):

Goldratt defines Investment as "All the money tied up in the organization." This includes the land, building, equipment, accounts payable & receivables as well as inventory.

Layers of Resistance:

Lack of agreement regarding the goal and metrics, the need for change, the symptoms, the core problem, the direction of the solution, the potential negative consequences (1st yes, buts), the implementation obstacles (2nd yes buts) and the necessary leadership support and "what is in it for me?" which can prevent complete buy-in.

Local Measures:

The set of measurements that relates to a resource, operation, process, or part which usually has low correlation to global organization measures.

Logical Arguments:

All logical arguments / analysis (including the logical trees on the TOC Thinking Process roadmap) are only as valid as the underlying assumptions. Any logical argument

consists of a set of propositions, one of which is the conclusion (the prediction or hypothesis) and the rest premises. In the study of logic, it is often said that there are only two types of logical arguments: Those arguments using deductive and those using inductive logic. From an analysis view, it is important that we are aware which we are using. [See definitions for Deductive and Inductive logic]

Negative Branch Reservations (NBR's):

In the TOC TP, a sufficiency-based logic tool that shows how the solution in the future reality tree might lead to UDE's. NBR's can be used to do a risk assessment on the solution and to develop additional requirements to minimize or prevent negative consequences on any of the key stakeholders.

Non-bottleneck:

A resource (e.g. facility, function, department, machine or person) whose capacity, if properly scheduled, is greater than the demand placed upon it in a comparable period of time.

Obstacle:

Something that prevents or reduces the ability to implement a solution requirement or injection, therefore blocking the achievement of the DE's.

Operating Expense (OE):

Goldratt defines OE as "The money the system spends to turn investment into throughput."

Paradigm:

A set of assumptions we believe to be true (at least to the level of "good enough" to make decisions on.

Policy:

A written or unwritten rule that guides decision-making and influences behaviour. Policies are based on assumptions made regarding reality.

Prerequisite Tree:

In the TOC TP, a necessity-based logic tool for determining the obstacles that block implementation of a solution or idea. Once obstacles have been identified, intermediate objectives for overcoming obstacles can be determined.

Problem:

The common definition of a problem is a gap between the expected and actual results or something that bothers us. The definition used by the 'hard" sciences, is that a problem is an unresolved conflict between two conflicting prerequisites deemed necessary to satisfy different necessary conditions of the system.

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11. Corbet, Thomas, *Throughput Accounting*, North River Press, New York, 1998)
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Appendices

Appendix 1 Bibliography on Theory of Constraints

This appendix provides a list of all TOC-related books that have been published and is applicable to section 2.6.

No.	Author(s)	Title	Publisher	Release Date	Category
1	Goldratt, Eliyahu M.	The Goal: A process of ongoing improvement (1st Edition)	North River Press	1984	Ops Mgt
2	Goldratt, Eliyahu M.	The Race	North River Press	1986	Ops Mgt
3	Goldratt, E and Fox, R	The Theory of Constraints Journal [Volume 1, Numbers 1 - 6]	Avraham Y. Goldratt Institute	1987	TOC
4	Burgess & Srikanth	Regaining control: Get me to the shipping dock on time	Spectrum Publishing Co.	1989	Ops Mgt
5	Umble and Srikanth	Synchronous manufacturing: Principles of World Class Excellence	South West Publishing Co,	1990	Ops Mgt
6	Srikanth, Mokshagundam L.	Synchronous manufacturing: Principles of World Class Excellence Workbook	Spectrum Publishing Co.	1990	Ops Mgt
7	Goldratt, Eliyahu M.	The Haystack Syndrome: Sifting information out of the data ocean	North River Press	1990	TOC
8	Goldratt, Eliyahu M.	What is this thing called theory of constraints and how should it be implemented?	North River Press	1990	Accounting
9	Srikanth & Cavallaro	Regaining competitiveness: Putting The Goal to work 2nd revised edition	North River Press	1993	Ops Mgt
10	Lockamy and Cox	Reengineering performance measures: How to align systems to improve processes, products, and profits	Irwin/APICS Series	1994	Accounting
11	Srikanth and Robinson	Measurements for effective decision making: A guide for manufacturing companies	Spectrum Publishing Co.	1995	Accounting
12	Noreen, Smith, Mackey	Theory of constraints and its implications for management accounting	North River Press	1995	Accounting
13	Covington, J. W.	Tough fabric	Chesapeake Consulting	1996	Supply Chain
14	Acord, Terry	A Better Way: Manufacturing Techniques for The Leading Woodworking Companies	FDM Bookstore	1997	Thinking Processes
15	Goldratt, Eliyahu M.	Critical chain	North River Press	1997	Proj Mgt
16	Dettmer, H. William	Goldratt's theory of constraints : a systems approach to continuous improvement	ASQC Quality Press	1997	Ops Mgt
17	Kendall, Gerald I	Securing the future: Strategies for exponential growth using the theory of constraints	St. Lucie Press	1997	Ops Mgt
18	Umble and Srikanth	Synchronous manufacturing: Profit-based manufacturing for the 21st century Vol. 1 and 2	Spectrum Publishing Co.	1997	Ops Mgt
19	Stein, Robert E.	Theory of constraints - Applications in quality and manufacturing	Marcel Dekker, Inc.	1997	Strategy

20	Rodgers, Waymond	Throughput Modeling: Financial Information Used by Decision Makers Vol 6	Elsevier Limited	1997	Accounting
21	Dettmer, H. William	Breaking the constraints to world-class performance	ASQC Quality Press	1998	Thinking Processes
22	Goldratt, Eliyahu M.	Essays on the theory of constraints	North River Press	1998	Thinking Processes
23	McMullen, Thomas B.	Introduction to the theory of constraints (TOC) management system	St. Lucie Press	1998	Proj Mgt
24	Goldratt, Eliyahu M.	Late night discussions on the theory of constraints	North River Press	1998	Ops Mgt
25	Levinson, W. A. E.	Leading the way to competitive excellence: The Harris Mountaintop case study	ASQ Quality Press	1998	Ops Mgt
26	Bell, Swain, Bel Ansari	Management accounting: The theory of constraints and throughput accounting	Irwin McGraw Hill	1998	TOC
27	Schrageheim, Eli	Management dilemmas: The theory of constraints approach to problem identification and solutions	St. Lucie Press	1998	TOC
28	Newbold, Robert C.	Project management in the fast lane: Applying the theory of constraints	St. Lucie Press	1998	TOC
29	Cox and Spencer	The Constraints Management Handbook	St. Lucie Press	1998	Accounting
30	Bell, Swain, Bell, Ansari	The Theory of Constraints and Throughput Accounting	McGraw-Hill/Irwin	1998	Accounting
31	Corbett, Thomas	Throughput accounting	St. Lucie Press	1998	Accounting
32	Lepore and Cohen	Deming and Goldratt The theory of constraints and the system of profound knowledge	North River Press	1999	Thinking Processes
33	Goldratt, Eliyahu M.	Goldratt Satellite Program Workbook (TOC Holistic Approach)	Self-published	1999	Proj Mgt
34	Glatter, Gila, Nava Wiess, and Mali Talek	Solving day-to-day conflicts (3 workbooks) (Hebrew)	TOC for Education Israel	1999	Strategy
35	Leach, Lawrence P.	The Critical Chain Project Managers' fieldbook	Quality Systems	1999	TOC
36	Institute of Management Accounting	Theory of Constraints Management System Fundamentals: Practices and Techniques	IMA Process	1999	TOC
37	Scheinkopf, Lisa J.	Thinking for a change : Putting the TOC thinking processes to use	St. Lucie Press	1999	Accounting
38	Mabin and Balderstone	World of the theory of constraints: A review of the international literature	St. Lucie Press	1999	TOC for Educ
39	Ptak C. and E. Schrageheim	ERP: Tools, techniques and applications for integrating the supply chain	St. Lucie Press	2000	Supply Chain
40	Schrageheim/Dettmer	Manufacturing at warp speed: Optimizing supply chain financial performance	St. Lucie Press	2000	Supply Chain
41	Smith, Debra	Measurement nightmare: How the theory of constraints can resolve conflicting strategies, policies, and measures	St. Lucie Press	2000	Supply Chain
42	Goldratt, E. M. with C. Ptak & E. Schrageheim	Necessary but not sufficient	North River Press	2000	Accounting
43	Glatter, Gila, and Shirly Kobalssky	The way of achieving a target (Hebrew)	TOC for Education Israel	2000	TOC for Educ
44	Wiess, Nava and Mali Talek	A method of dealing with consequences- results of practical ideas & everyday decisions. (2 workbooks) (Hebrew)	TOC for Education Israel	2001	Proj Mgt
45	Hutchin, Ted	Enterprise-focused management: Changing the face of project management	Thomas Telford Pub.	2001	Ops Mgt

46	Woepfel, Mark J	Manufacturer's guide to implementing the theory of constraints	St. Lucie Press	2001	People
47	McMullen, Thomas B.	Theory of Constraints	CRC Publishing	2001	TOC
48	Hutchin, Ted	Unconstrained organizations: Managing sustainable change: Unlocking the potential of people within organizations	Thomas Telford	2001	TOC for Educ
49	Hutchin, Ted	Constraint management within manufacturing: Optimising the global supply chain	Taylor and Francis	2002	Supply Chain
50	Woehr and Legat	Delta T-selling: Unblock the power of our sales force!	Neuer Wissenschaftlicher	2002	Sales
51	Halliburton, Cal	Stop and think! With the evaporating cloud	TH?NK! Publishing	2002	TOC for Educ
52	Grienbert, Mira, Rami Goldratt, and Gila Glatter	The rainbow in the cloud (Hebrew)	TOC for Education Israel	2002	TOC for Educ
53	Kendall & Rollins	Advanced product portfolio management and the PMO: Multiplying ROI at warp speed	J. Ross Publishing	2003	Thinking Processes
54	Anderson, David J.	Agile management for software engineering: Applying the theory of constraints for business results	Prentice Hall	2003	Proj Mgt
55	Immelman, R. E.	Great Boss, Dead Boss	Stewart Philip Intl.	2003	Ops Mgt
56	Cox, Blackstone, Schleier	Managing operations: A focus on excellence Vol 1 and 2 (academic text)	North River Press	2003	Ops Mgt
57	Edwards, Cheryl and Kathy Suerken	Never ending story (workbook) (English)	TOC for Education USA	2003	Ops Mgt
58	Goldratt, Eliyahu M.	Production: The TOC way Revised edition (Windows version)	North River Press	2003	Strategy
59	Stein, Robert E.	Re-engineering the manufacturing system: Applying the theory of constraints, 2nd edition	Marcel Dekker, Inc.	2003	Strategy
60	Dettmer, H. William	Strategic navigation: A systems approach to business strategy	ASQC Quality Press	2003	Accounting
61	Putz, R. C. and Spellman	The uncorrupted stock picker: Analyze stocks without being influenced by brokers, analysts, and money managers	North River Press	2003	TOC for Educ
62	Suerken, Kathy and Cheryl Edwards	TOC--Thinking skills for children--The story of Yani's goal (computer software)	Accelerated Learning	2003	TOC for Educ
63	Klapholz & Klarman	Cash machine: Using theory of constraints for sales management	North River Press	2004	Supply Chain
64	Northrup, C. Lynn	Dynamics of profit-focused accounting: attaining sustained value and bottom-line improvement	J. Ross Publishing	2004	Ops Mgt
65	US Dept of Defence	Extending the Aircraft Availability Model to a Constrained Depot Environment Using Activity-Based Costing and the Theory of Constraints	Storming Media	2004	Ops Mgt
66	Ronen & Pass	Focused operations management (Hebrew)	Hod-Ami Publishing Ltd.	2004	Ops Mgt
67	Stein, Robert E.	Integrating the Theory of Constraints and TQM	CRC Publishing	2004	Strategy
68	Caspari & Caspari	Management dynamics: Merging constraints accounting to drive improvement	John Wiley & Sons	2004	Sales
69	Kinsey, Jeff "Ski"	Purple curve effect	Throughput Press	2004	Accounting
70	Woepfel, Mark J	The Agile Value Chain: The Theory of Constraints Applied to Supply Chain	St. Lucie Press	2004	Accounting

		Management			
71	Goldratt, Eliyahu M.	Beyond the Goal: Eliyahu Goldratt speaks on the theory of constraints (your coach in a box)	Audiobook	2005	Supply Chain
72	Leach, Lawrence P.	Critical chain project management	Artech House, Inc.	2005	Proj Mgt
73	Leach, Larry P.	Lean project management: Combining critical chain project management and Lean tools to accelerate project results	Advanced Projects, Inc.	2005	Proj Mgt
74	Covington, J. W.	Let's don't pave the cow paths: Lessons in disruptive leadership	Tate Publishing LLC	2005	Ops Mgt
75			TH?NK!	2005	Strategy
76	Halliburton, Cal Roff-Marsh, J.	Making decisions: Stop and think series Reengineering the sales process	Publishing Ballistix Pty Ltd	2005	Strategy
77	Ronen, Boaz (Ed.)	The theory of constraints: Practice and research: Book edition of human systems management journal	IOS Press	2005	Sales
78	Ean, Khaw Choon	Thinking smart: you are how you think (English)	Pelanduk Publications	2005	TOC
79	Tripp, John	TOC executive challenge: A Goal game	North River Press	2005	TOC for Educ
80	Kendall, Gerald I	Viable vision: Transforming total sales into net profits	J. Ross Publishing	2005	TOC for Educ
81	Lang, Lisa	Achieving a Viable Vision: The Theory of Constraints Strategic Approach to Rapid Sustainable Growth	Throughput Publishing	2006	Proj Mgt
82	Ronen, Pliskin, Pass	Focused operations management for health services organizations	John Wiley & Sons	2006	Proj Mgt
83	Techt, Uwe	Goldratt und die Theory of Constraints (German)	Lulu Verlag	2006	Strategy
84	Lang, Lisa	Maximizing profitability: The theory of constraints approach to maximizing profitability (workbook plus CD)	Throughput Publishing	2006	Strategy
85	Woepfel, Mark J	Projects in less time: A synopsis of critical chain	Pinnacle Strategies Pub.	2006	Health
86	Cavallaro, H. E. and C. A. Ptak	Theory H. O. W.: How organizations could work	Specialty Publishing Co.	2006	Health
87	Ean, Khaw Choon	Thinking smart: you are how you think (Korean)	Dongyang Books	2006	Accounting
88	Wright & King	We all fall down: Goldratt's theory of constraints for healthcare systems	North River Press	2006	TOC for Educ
89	Eden, Y. & Ronen, B.	Approximately right, not precisely wrong: Cost accounting, pricing and decision making	North River Press	2007	Thinking Processes
90	Levinson, W. A. E.	Beyond the Theory of Constraints: How to eliminate variation and maximize capacity	Productivity Press	2007	Services
91	Jamieson, N. R.	Breaking the bottleneck! 10 profitable ways to make the "theory of constraints work in services	ChangesNRJ Ltd	2007	Services
92	Techt, Uwe and Lorz, Holger	Critical Chain - Beschleunigen Sie Ihr Projekt management (German)	Haufe Verlag	2007	Proj Mgt
93	Ronen & Pass	Focused operations management: Achieving more with existing resources (academic text)	John Wiley & Sons	2007	Strategy
94	Bragg, Steven M.	Management accounting best practices: A guide for the professional accountant	John Wiley & Sons	2007	TOC
95	Case, DuMoulin, Spalding, Dissanayake	Service Management Strategies That Work - Guidance for Executives	Van Haren Publishing	2007	Accounting
96	Gonzalez, Sirias, Guerra, Rodrriguez and	Success: An adventure (with TOC)	Self-published	2007	Accounting

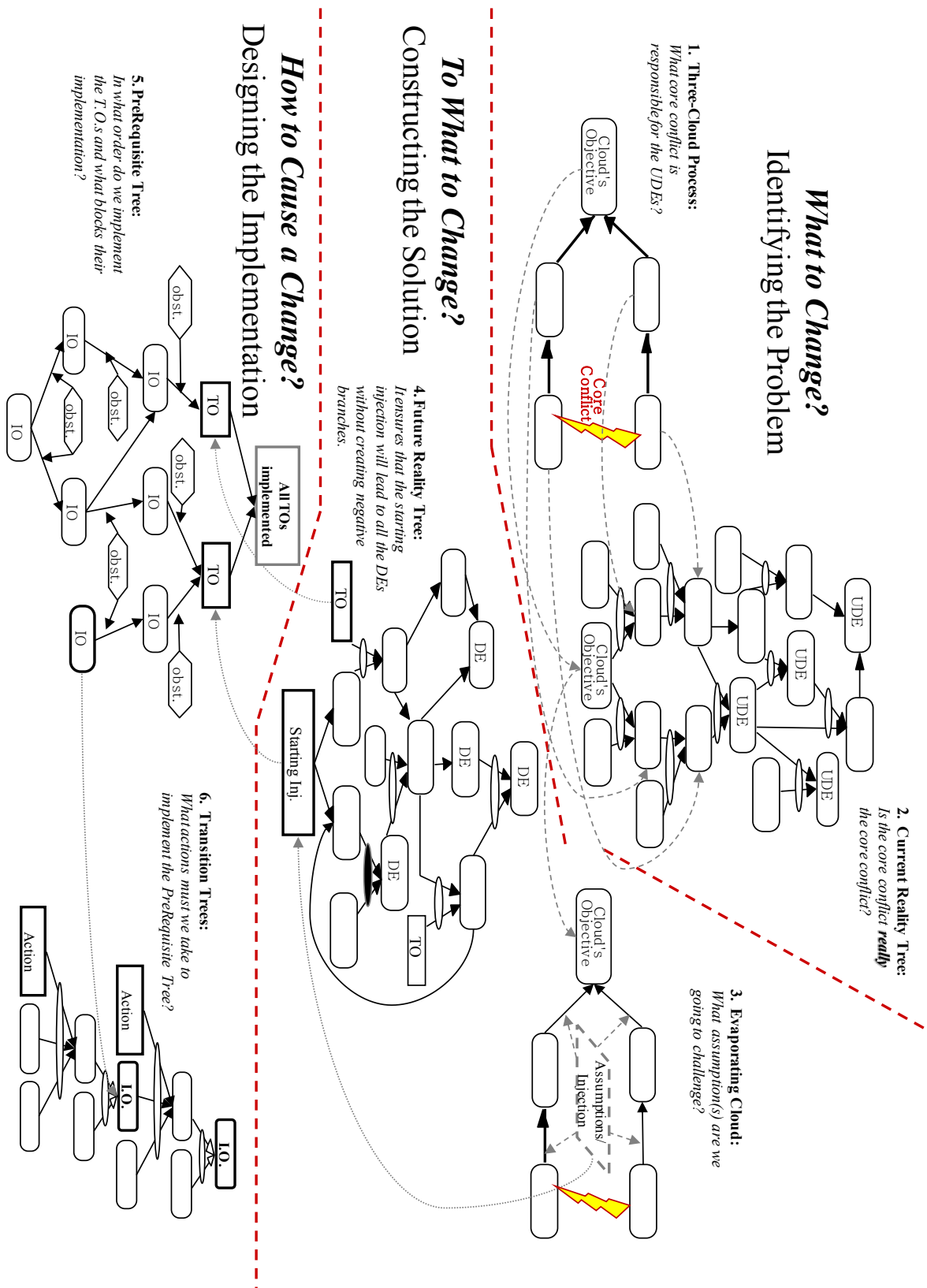
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97	Dettmer, H. William	The Logical Thinking Process: A systems approach to complex problem solving	ASQC Quality Press	2007	Accounting
98	Bragg, Steven M.	Throughput accounting: A guide to constraint management	John Wiley & Sons	2007	TOC for Educ
99	Ricketts, John A.	Reaching the goal: How managers improve a services business using Goldratt's theory of constraints	IBM Press	2008	Services
100	Goldratt, Eliyahu M.	The Choice	North River Press	2008	TOC
101	Mukhopadhyay, S	Theory Of Constraints	Jaico PUBLISHING House	2008	TOC
102	Kishira, Yuji	Introduction to Holistic Problem Solving (Japanese)	Diamond Publishing	2008	Thinking Processes
103	Sproull, Bob	The Ultimate Improvement Cycle: Maximizing Profits through the Integration of Lean, Six Sigma, and the Theory of Constraints	CRC Publishing	2009	Strategy

Appendix 2 Traditional Theory of Constraints Thinking Processes Roadmap

This appendix shows the original TOC Thinking Process (applicable to section 2.6.7).

What to Change?

Identifying the Problem



Appendix 3 Multi-tasking Simulation Game used to show impact of moving from a limiting to an enabling paradigm

This appendix details the Simulation Game referred to in section 5.4.1.

This Simulation Game was developed as part of this Research to be used in workshops in both the Private and Public Sector as well as with individuals to show the potential damage of using the “wrong” rule and the inherent potential that can be released when the “right” rule is applied without changing the “starting conditions”. It has proven to be a very powerful technique to assist in the critical change from a set of limiting to a set of enabling paradigms and beliefs of which probably the most important are that there is significant potential to unlock in all organizations and individuals and the solution is actually quite simple. This game is played with any size group and can be done within just 10mins. The steps are listed below:

Step 1: ASK THE FIRST QUESTION:

Can changing the RULES we use in doing tasks or projects really help to DO MORE WITH LESS IN LESS TIME...

Step 2: EXPLAIN THE CHALLENGE

You are giving three projects to complete for your organization. Each of the 3 Project consists of 20 simple tasks each taking 1 second each (Project 1 = writing 20 numbers, Project 2 = writing 20 letters and Project 3 = 20 symbols). Each project is for a different "Customer" and each of these customers want you to finish their project as soon as possible and is asking for a "reliable estimate of completion". Which RULE should you use to do these projects?

Work on all of them at the same time (Multi-task), or

Start one, finish it, then start the second and finish etc... (No Multi-tasking)?

Step 3: ASK THE SECOND QUESTION:

Which of the two rules do you think will give the best results and if you feel one will be better than the other, how much better do you guess (in terms of the time to complete each one and all three)?

The answers normally vary from “Multi-tasking will be faster but not by much” to “About the same” to “Not Multi-tasking will be faster but not by much”...

Step 4: RUN THE SIMULATION WITH RULE 1 (Multi-tasking)

In this run, participants must do task 1 of Project 1 (write a “1”), then task 1 of Project 2 (write a “A”) etc.

Record the results and ask whether the participants felt "in-control" during execution.

Normal results vary from 90 to 180 sec (target was 60 sec at 1 sec x 60 tasks) and participants complain how frustrating and time-consuming it was to move from one project to another...

Step 5: RUN THE SIMULATION WITH RULE 2 (No Multi-tasking)

In this run, participants must do task 1 of Project 1 (write a "1"), then task 2 of Project 1 (write a "2") etc.

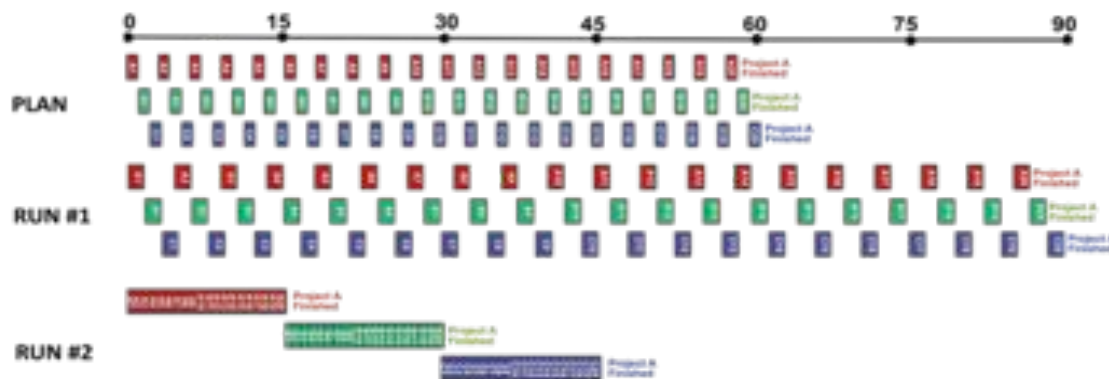
Record the results and ask whether the participants felt "in-control" during execution.

Normal results vary from 35 to 50 sec (target was 60 sec at 1 sec x 60 tasks) and participants explain how "in-control" they felt compared to the 1st run.

Step 6: ASK THE THIRD QUESTION

Which gave better results, how much better was it, why and what assumption did we break?

Run #2 was the best at less than ½ the time of Run #1 (which means we could have done double the projects), there were no time losses in switching over and projects never waited for resource. The assumption challenged as "the sooner we start the sooner we finish". The diagram below is then presented to show why Rule #2 was so much better a



Step 7: ASK THE LAST QUESTION

What can block you from implementing this solution immediately in your life and in your organization?

Appendix 4 Constraint Analysis Strategy Workshop "The Red Curve Program Workbook"

I created this workbook, which is used by participants in the 5 Day Constraint Analysis Strategy Workshop (which we call "The Red Curve Program" , to capture their analysis, during the research and upgraded after completion of each pilot as part of a process of ongoing improvement during the Pilots in Lusaka, Kitwe, Ibadan and Kano. It is referenced in section 5.4 and is attached as a separate electronic document titled:

THEORY OF CONSTRAINTS

Constraint Analysis Strategy Workshop "The Red Curve Program Workbook"

Discover how to use Theory of Constraints to

Identify and Unlock inherent potential

Within your organization to get back on the Red Curve by

"Achieving MORE with LESS in LESS TIME"

Appendix 5 InWent Invitation to City Councils for Participation in TOC

Pilots

This appendix contains the letter that was sent to various City Councils by InWent in invitation to participate in the workshops. This letter is referenced in section 5.2.2.



InWEnt • Capacity Building International, Germany

P.O. Box 12 06 23 • 53048 Bonn • Germany

<p>Capacity building for sustainable and inclusive urban infrastructure management</p>

This letter provides supplementary information for City applications for a capacity-building process with InWEnt

CONTENTS

- I. POSSIBLE CAPACITY-BUILDING CO-OPERATION FIELDS WITH INWENT
- II. APPLICATION PROCESS
- III. LOCAL CONSTRAINT ANALYSIS STRATEGY WORKSHOP
- IV. NOT CHOSEN CITIES

I. POSSIBLE CAPACITY-BUILDING / CO-OPERATION FIELDS WITH INWENT:

In this **municipal solid waste management co-operation and capacity building initiative**, the focus will be generally on using a constraint focused collaborative process to improving collection, separation, recycling/reuse of waste, including exploring best practices related to the role of the informal sector, the extension of services to informal settlements, the formulation and enforcement of by-laws, strategic investments in the waste sector etc.

In the **water-supply sector**, the entry point is going to be the strengthening of the local water providers in order to improve their capacities to ensure better and affordable services for all groups of the urban population.

The **focus for waste-water management will be on decentralized methods**, at a publicly manageable scale, with simple operation and maintenance systems, minimal or no need of chemicals and minimal or no need of external power supply.

II. APPLICATION PROCESS:

Cities receive InWEnt's application forms through SCP-LA21 country representative.

InWEnt makes a selection of cities with which the co-operation process will start and discusses it with UN-Habitat/UNEP Nairobi and Fukuoka offices.

Duly filled application questionnaires are sent to InWEnt **BOTH** per e mail and per courier.

InWEnt's deadline for **receiving** the application questionnaires:

February 6, 2007: in digital version (Word document without signatures and no scanned pdf) sent to:

michael.funcke-bartz@InWEnt.org; maria.sague@InWEnt.org;

February 12, 2007: in hardcopy, signed from:

- **In all cities:** the head of the relevant department (water, waste-water **or** waste management), the head of the relevant ministry and the city mayor;
- **In SCP cities:** all persons mentioned before plus SCP city and country coordinators

Applications should be sent per courier to Mr. Michael Funcke-Bartz, InWEnt, Friedrich- Ebert-Allee 40, 53113 Bonn, Germany). **The** Deadline for InWEnt to inform the cities selected (via e mail) will be the latest during the first week of March. Cities selected for the first working / co-operation agree to participate in a local one-week Strategy-Workshop with all important stakeholders before the end of April. Please see more about this under III.

III. LOCAL CONSTRAINT ANALYSIS and STRATEGY WORKSHOP

A local one-week Constraint Analysis and Strategy-Workshop is the second step towards the capacity-building co-operation process between the selected cities and InWEnt. The purpose of the workshop is to analyze and to define together with all stakeholders the problems and constraints related to the chosen working-field (water supply, waste water **or** solid waste management), to identify practical solutions, the necessary changes in working procedures or policies and to obtain commitments and timeline to implement these. The method which InWEnt

favours is a participative approach called "Theory of Constraint" (TOC), which will be introduced within the workshop. For further information see <http://www.goldratt.com/toctpwp1.htm>

InWEnt will send to the applying local authority of the selected cities the one-week Strategy-Workshop's programme / contents. The dates for the workshop are decided together (within the time-frame mentioned under II. 6).

Selected cities are responsible of ensuring the attendance of stakeholders and for the selection of the venue. Participants bear local and national transportation costs. InWEnt is responsible for the facilitator, which will be chosen out of a TOC experts-pool, will cover participant's full board and (when necessary) lodge. No daily-allowances will be paid.

IV. NOT CHOSEN CITIES:

Cities not chosen for the first co-operation turn may be taken into a second turn which will be defined during the first half of 2007. With cities not chosen to participate in the second turn either, InWEnt will discuss the possibility of their partial inclusion in the co-operation process of a chosen city of the same country. This could be for example through short-term practical training / exchange for selected stake-holders.

Appendix 6 Lusaka Constraint Analysis Strategy Workshop – Detailed Report

This document is attached as a separate report and provides a detailed account of the process used over the 5 days in Lusaka as well as the outcomes and the next steps to be taken

This report is referenced in sections 3.5.4, 5.4, 5.4.4 and 5.4.5 and is titled:

STRATEGIC CONSTRAINT ANALYSIS WORKSHOP

A CAPACITY BUILDING COLLABORTIVE PROCESS WITH LUSAKA'S SOLID WASTE MANAGEMENT STAKEHOLDERS

Appendix 7 Letter from Seagate confirming use of Barnard's new methods

This appendix contains confirmation of the use of the new methods developed in this research by Seagate and is referenced in section 4.2.2.



12/24/2008
Seagate
Mailstop SV02-148
920 Disc Drive
Scotts Valley, CA 95066

To Whom It May Concern:

This letter is provided in support of the PhD thesis submitted by Alan Barnard, to confirm that we at Seagate have used and benefited from the new Theory of Constraints (TOC) analysis and thinking processes developed by Alan as part of his PhD Research.

My name is Christopher Zephro. I'm a Director of Business Excellence within the Finance and Supply Chain at Seagate Technology, the largest manufacturer of hard disc drives. My duties include implementation of best practices in manufacturing, distribution and financial decision support. I use a variety of business process improvement tools from Six Sigma, LEAN and Theory of Constraints.

I have known Alan Barnard for over eight years now and he is the point person that I always turn to for suggestions and best practices in implementing the TOC initiatives we have going on at Seagate. Alan is considered by us as one of the top experts and implementers of TOC practices throughout the world. He is a wealth of information and has helped Seagate discover solutions to a number of challenges we face in the business using the TOC techniques he adapted and/or invented during his research. Alan is continually on top of what is going on in the TOC community, given his association with Dr. Eli Goldratt and being former chairman of the Theory of Constraints International Certification Organization.

Although Dr. Eli Goldratt is the founder of TOC, Eli will be the first to admit that he is a better educator than implementer - this is not the case with Alan. Alan has helped a number of the best technology companies in the world realize value leveraging TOC, including Cisco Systems. Alan is not only a great implementer, but he is also a great teacher.

United States companies are at a critical point in this very competitive market environment and will benefit greatly in the use of Alan's research and innovative yet simple analysis and solution development processes that are generic enough to apply to any part of our organization and as shown in the Odyssey Program, can even be applied to help individuals identify and unlock their own inherent potential.

Best Regards,

Chris Zephro

Director, Finance
Six Sigma - Principal Black Belt
Seagate Technology

Appendix 8 Letter from Japan confirming use of Barnard's new methods

This appendix contains confirmation of the new methods developed in this research by companies in Japan and is referenced in sections 3.5.6 and 4.2.2.



TO: ALAN BARNARD
FROM: YUJI KISHIRA
SUBJECT: YOUR "4 METHODS" TO BREAK CONFLICTS WITH WIN:WIN" – IT REALLY WORKS IN JAPAN!!
DATE: 14/04/2008
CC: DR. ELI GOLDRATT

Dear Alan-san,

Please let me cc to Eli-san too.

Your four methods to break conflicts really works here in Japan!
During discussion with you on Skype a few weeks ago, the discussion with you really reminds me many many lessons which I learned from my parents and grand parents.

Your four methods can be explained in nice and smooth way by using Japanese culture. In fact, we, Japanese have very common sayings/cliché which are equivalent to the four methods.

To make things better, in business world, we almost of all Japanese management stress the importance to have very high vision in order to have bigger gap between current status and ideal status which we believe reveal more fundamental Kaizen opportunity to make big leap. Also, "ever-flouring" is Japanese management favourite cliché.

In fact, yesterday, I was requested to introduce TP for Toyota and Toyota group people. I introduced your four methods and S&T tree by connecting lots of Japanese cliché in daily life. There was one guy who really actively reacted during presentation.

He immediately came to me to exchange business card. He happened to be executive vice president of Toyota. He expressed deep appreciation to TOC and he said he learned a lot and really liked your four methods for breaking conflicts with win:win. He requested me to visit Toyota to make the same presentation. He said the beauty of your 4 methods is that it is exactly in line with Japanese culture. It is great verbalization of WA (Harmony) creation without any confrontation.

This is all thanks to you! Thank you very much Alan-san indeed!

Warm regards
Yuji

Director, Japan
Goldratt Group

Appendix 9 Letter confirming publication of Barnard's new TOC methods in Japanese Best Seller

This appendix contains confirmation of the inclusion of the methods developed in this research in a bestselling business book published in Japan and is referenced in section 4.2.2.



TO: ALAN BARNARD
FROM: YUJI KISHIRA
SUBJECT: YOUR “4 METHODS” IS IN MY NEW BOOK
DATE: 11/08/2008
CC: DR. ELI GOLDRATT

Dear Alan-san,

As I mentioned before, my new book is titled “*Introduction to Holistic problem solving*”, published by Diamond Publishing and was released on 31 July 2008 (while you were facilitating the Odyssey Program in the USA).

Your “*4 methods to break conflicts with win:win*” appears on p31 to p52 and your name is on p31 and p182 (See attached photo)

As you know, my book is now a best seller in Japan. So, your 4 methods is everywhere in Japan. It is so in common with our Japanese culture. In Fact, your 4 method is a great verbalization of what we aspire our culture to be.

Attached, also a photo of the typical display space my book enjoys in most book stores since becoming #1 in Japan.

I hope to publish it in English soon. But since it was written for Japanese, I must re-write it completely. Maybe, it would be great if we co-write it. Probably, it would be great idea to publish it from Random house where you are doing the TOC implementation now.

Warm Regards
Yuji

PS: I am working on next book with very famous university professor of economy (organization behaviour). This book will be released in Feb 2009. It is about TOC and people's motivation. I am now reviewing final draft. It will be great book!

