

Challenges and Opportunities



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Applying the TOC Thinking Processes in Public Sector Organizations

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Thinking Process Application Insights

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- **Understanding managerial dilemmas**
- **Identifying strategic direction**
- **Implementing organizational improvements**
- **Unique public sector ‘work-arounds’**
- **TP pitfalls in a service-oriented subsystem**
- **‘Out-of-the-box’ thinking by public sector managers**



Background

During the past decade, the systemic-based TOC TP concepts and its set of logic tools have been available to provide a framework to help (1) understand the major relationships underlying existing managerial dilemmas, (2) identify a strategic direction and an effective leverage point for changing the current undesirable effects into a more desirable future, and (3) implement specified improvements within organizations.

Many of the TP tool applications have addressed managerial challenges in private sector firms and often the resulting diagrams and findings have not been released in the public domain. Even fewer TP applications have been reported in the public and/or service sectors where a physical product is not the major focus.



Overview

This presentation briefly describes the application of the TOC TP at governmental agencies in three locations, namely, a New Mexico city water utility department, waste collection and disposal in several African countries, and various municipal services in the Philippines.

Issues and their resolution along with opportunities and their exploitation are presented and analyzed for each of these public sector organizations.



Examples Around The World

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Background: Albuquerque Water Division

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Study System:

1. The AWDMS (Albuquerque Water Division Maintenance System) is *the major subsystem* in AWD that resided in the City's Department of Public Works.
2. Purpose – repair and maintenance of Albuquerque's water system
3. Stated Goal – to have all water supply and distribution facilities in an operational state ready to meet customer demands at minimum cost.

Some Characteristics:

- Among the top 100 utilities in US
- Pumping & delivering 34B gal. drinking water to ~500K people/year.
- 92 deep wells, 44 storage tanks, 27 pumping stations, & 13M ft pipe.
- Operating budget = \$23M; Capital Project budget = \$15M
- 175 technical/support staff; 15 supervisors; 9 senior managers.

Subsystem Goal Alignment with System Goal

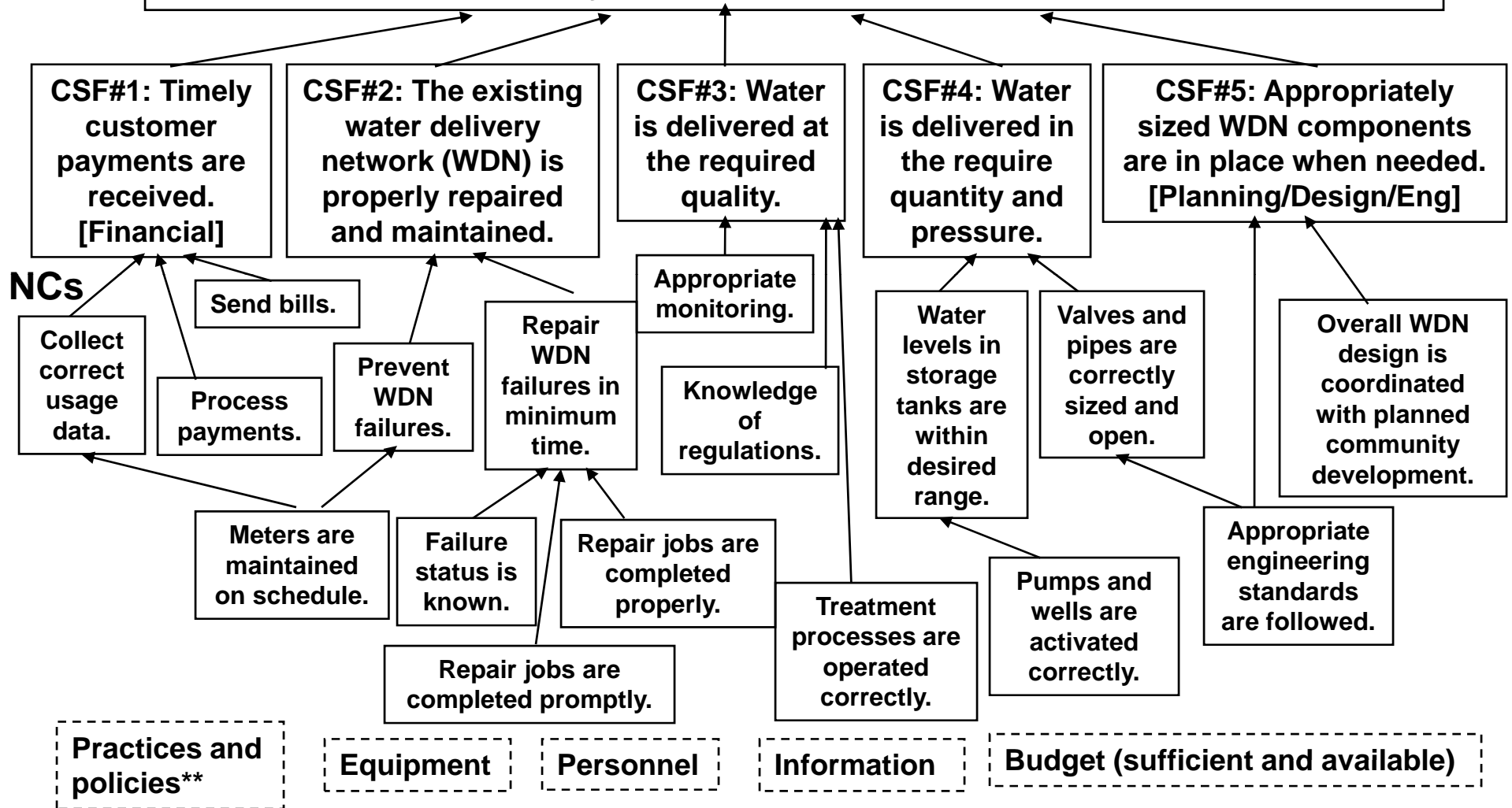
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Study Organization is the Albuquerque Water Department Maintenance System (AWDMS):

1. As a subsystem of the Albuquerque Water Department (AWD), the Albuquerque's Water Department Maintenance System (AWDMS) is a public service unit designed to help the AWD satisfy its customers in an effective manner. Although never having a formal stated goal, the consensus among the management team yields the following statement descriptive of its purpose: **“to have all water supply and distribution facilities in an operational state ready to meet customer demands at minimum cost.”**
2. The AWDMS is the major component of the AWD whose **stated goal** is: **“to provide quality water service to our community in a reliable, responsive, and efficient manner.”**
3. Thus, the informal **goal** of AWDMS is **aligned with** the formal **goal** of AWD.

IO Map for Albuquerque's Water Department

GOAL: The Albuquerque community and its individual residents have uninterrupted availability of (potable) water now and in the future*



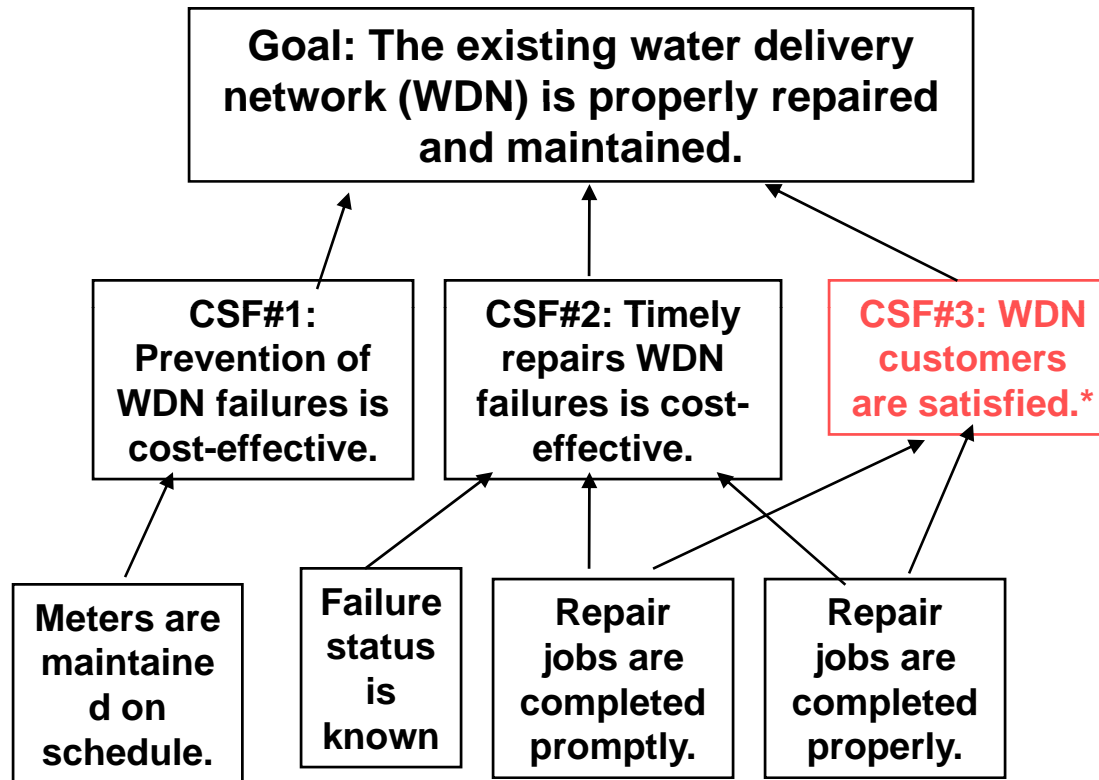
* While not explicitly stated, all entities, including the Goal and Critical Success Factors (CSFs) plus all Necessary Conditions are to be achieved in a cost-effective manner.

** Entities with dashed line borders are assumed to be available for use, as needed, to achieve any Goal/CSF state or facilitate any

IO Map for a Subsystem:

Albuquerque's Water Department Maintenance System (AWDMS)

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* "Customer satisfaction" along with "workforce safe and secure job environment" and "financial solvency" are high level CSFs within the City's Department of Public Works. Hence, they are implicitly embedded in each subsystem (division) goal statement, yet they may need to be explicitly stated at the subsystem level.



Global Metrics & Issues: Private/Public Sector

System TOC Metrics	Manufacturing/Production-Private Sector Systems [Adapted: Goldratt, 1992]	Public Sector and Not-for-Profit Systems [Adapted: Dettmer, 1997]	Albuquerque Water Division Maintenance System (AWDMS) [Study Subsystem]
Manager's System Goal	Make more money now and in future	Often non-financial such as: satisfied stakeholders	Satisfied elected officials (via minimal customer complaints)
Throughput (T)	Rate (\$/unit time) at which the system generates revenue through sales	Rate at which system improves stakeholder satisfaction (perhaps via survey scores)	Rate at which AWDMS jobs are completed FY2003: 44,005 jobs completed
Inventory (I_1)	Investment (\$) in purchasing things the system intends to sell in short term	<u>Active Inventories (\$)</u> RM, WIP, FG, & MRO <u>Passive Inventory</u> Customers or their possessions waiting to be processed	<u>Active Inventories (\$)</u> MRO~\$100K: not a current focus <u>Passive Inventory</u> Jobs in queue at end of FY FY2003: estimated ~16,000
Investment (I_2)	Investment (\$) in purchasing things that eventually the system intends to sell	Current Capital Budget plus Present Value of All Past Capital Investments	Assumed to be constant for study subsystem at an estimated ~\$500M
Operating Expense (OE)	System cost (\$) of turning inventory ($I_1$) into throughput (T)	Actual operating expenses(\$)	Annual operating expenses (\$) FY2003: \$14.208M

AWDMS Issues, Focuses & Priorities

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Four TOC Issues

1. Alignment of T with WUD's overall goal.
2. Physical Inventories (I_1 & I_2) are not a focus.
3. OE to be controlled, not necessarily reduced.
4. Global TOC metrics provide a baseline.

Managerial Focus and Priorities

- Not exceed annual Operating Budget.
- Identify and manage the Constraint that limits Throughput (T).
- Reduce active and passive Inventory (I_1) levels while managing Investment (I_2).
- Control Operating Expense (OE).



Core Conflict Cloud: Assumptions & Potential Injections

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Assumptions Underlying Entity Links	Considerations	Possible Injections for Invalidating Assumptions
<p style="text-align: center;">A ⇔ B</p> <ol style="list-style-type: none"> 1. An effectively managed AWDMS completes its work in a waste-free manner. 2. Managerial effectiveness is closely associated with efficient workflow and operations performance. 3. Completing work in a waste-free manner satisfies all stakeholder groups 	<ul style="list-style-type: none"> • Few stakeholders care about our effectiveness; customers don't care if we are wasteful as long as their job gets done promptly and without causing rate increases. 	<ol style="list-style-type: none"> 1. AWDMS increases its operating budget. 2. AWDMS focuses on productivity, not efficiency. 3. AWDMS only does complainers' work promptly.
<p style="text-align: center;">B ⇔ D</p> <ol style="list-style-type: none"> 1. Implementing improvement efforts promotes performing work in a waste-free manner. 2. Working in a waste-free manner requires embracing the CI management philosophy which, in turn, requires a significant and ongoing investment in training human resources, enhancing the functionality and utility of the CMMS, and improving repair work flows, procedures, and operations. 3. Having a significant number of dedicated resources is the only practical way to assure that AWDMS infrastructure is continuously 	<ul style="list-style-type: none"> • Recognize that not every procedure or policy needs to be changed to achieve some improvements in work processes. 	<ol style="list-style-type: none"> 1. AWDMS hires people who embrace continuous improvement in their work. 2. AWDMS selectively targets dysfunctional procedures & policies. 3. AWDMS works first on changes that have largest and/or fastest efficiency payback. 4. AWDMS pays (via an incentive system) for people to adopt new ways. 5. AWDMS hires outside resources for training, etc. using already

resources is the only practical way to assure that AWDMS infrastructure is continuously (Table is continued on next page)

Core Conflict Cloud: Assumptions & Potential Injections

Assumptions Underlying Entity Links	Considerations	Possible Injections for Invalidating Assumptions
<p style="text-align: center;">$A \Leftrightarrow C$</p> <ol style="list-style-type: none"> 1. Being responsive to customers is critical to managing AWDMS effectively. 2. An effective AWDMS must be able satisfy customers requests for service promptly. 3. Officials expect the AWDMS to satisfy customer complaints & refrain from spending above budgeted amounts. 	<ul style="list-style-type: none"> • Being responsive to officials is really <i>the</i> critical aspect to effective AWDMS management. 	<ol style="list-style-type: none"> 1. AWDMS redefines responsiveness by reducing customers performance expectations. 2. AWDMS focuses on performing complainers' work promptly. 3. Intercept telephone calls from complaining customers to officials.
<p style="text-align: center;">$C \Leftrightarrow D'$</p> <ol style="list-style-type: none"> 1. Completing repair work promptly satisfies most customers. 2. Being responsive to official's requests to reduce customer complaints and control costs is sound managerial practice 3. Allocating the vast majority of AWDMS human resources will allow the AWDMS to perform its repair and maintenance work in a timely and correct manner. 	<ul style="list-style-type: none"> • AWDMS is doing all that it can do with available resources to reduce job backlogs. 	<ol style="list-style-type: none"> 1. AWDMS contracts-out some work to reduce repair job backlogs and hence customer waiting. 2. AWDMS only accepts work that is legitimately our responsibility. 3. AWDMS allocates appropriate personnel costs to non-operating budget. 4. AWDMS stops doing work that our customers can do for themselves.
<p style="text-align: center;">$D \Leftrightarrow D'$</p> <ol style="list-style-type: none"> 1. Since the quantity of AWDMS human resources is fixed, it is not possible to dedicate more to each of the major AWDMS responsibilities. 2. Recent reductions in the number of human resources will not permit AWDMS to effectively address both improvement efforts 	<ul style="list-style-type: none"> • Operating budget may not be only source of funding. • Other available resources/funding can be converted to 	<ol style="list-style-type: none"> 1. AWDMS gets more resources either temporary or via other funded sources. 2. AWDMS uses budgeted, yet vacant positions, funding to pay for overtime or contracting-out work. 3. Officials approve filling authorized, but unfilled, employee position vacancies.

AWDMS Strategic Injection (SI)

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- 1. Individual injections (bold print) focused on different, often very focused, approaches to obtaining additional resources.**
- 2. *Core Driver*: Lack of sufficient resources to manage AWDMS effectively.**

Thus, SI becomes: ‘Management interprets current AWDMS policies and contracts more broadly to expand its capacity through the use of existing, yet non-traditional, resources.’

3. The 6 component injections are:

Refocus existing BPR consultants to implement CI efforts in defining efficient work flows & conducting CMMS user training.

Encourage utility technicians to complete self-paced skill enhancement training on their own time.

Empower capable home owners to turn their own water shutoff valves off and on when performing household plumbing repairs.

Require or allow new home owners to hire private plumbers to connect to AWD distribution system.

Use private contractors to handle age-related failures in AWD distribution system.

Reprioritize specialized contractor’s assignment to reduce existing repair backlog.

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FRT Implications: A Paradigm Shift for AWDMS Management

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Use policies to guide behavior rather than prescribe behavior ala longstanding interpretation.

Example: Empower homeowners to turn their water off/on when making their own plumbing repairs.

Accept new work only if it is within the AWD's mission.

Example: Require organizations causing damage to AWD distribution system to arrange and pay for all necessary repairs.

Be creative in identifying potential AWDMS resources.

Example: Refocus priorities for outside contractors within existing agreements.



Some Specific Results from Implemented Policy Changes in the AWDMS

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Eliminate Wasteful Practices: Barricade rental expense reduced by over 50% in 5 months as number of sites with barricades decreases from 947 to 431.

Revised Policy 4 (Required new home owners to hire private sector plumbers to connect to municipality water distribution system.) Backlog of over 50 jobs, resulting in a 5 month delay, was eliminated within weeks and the assigned 4 man work crew was released to help reduce the backlog of repair work.

Revised Policy 5 (Use private contractors to handle age-related failures in AWD distribution system.) Released 2 AWDMS repair crews who were able to remove over 200 long-pending jobs from backlog.

Revised Policy 6 (Reprioritize specialized contractor's assignment to reduce existing repair backlog.) More than 30 major backlogged repairs were addressed.



Some General Observations

TOC TP tools provide discipline and structure to:

- 1. Some potential solutions,**
- 2. Assess Develop and analyze Think deeply about current situation,**
- 3. Impact of proposed change on the AWDMS subsystem performance,**
- 4. Begin to implement a set of policy revisions.**

Insights for public service organization managers:

- 1. Personnel concerns are a dominate issue when customer satisfaction is critical,**
- 2. Often, existing policies constrain system performance,**
- 3. New ways of thinking yield new interpretations of existing policies and breakthrough in constraint management.**



A Practical Insight

Effective communication of the existing situation (CRT) is a function of the target audience background or knowledge.

For example – Less familiarity with an organization’s culture, operating policies and work practices means additional CRT entities are needed to understand prevailing relationships operating in the organization’s current reality.

- Advantages: additional information requirement frequently forces managers to examine basic assumptions or scrutinize its prevailing framework more carefully; this added effort can be productive in developing potential solutions if informed team members are patient.
- Disadvantages: Logic trees becomes ‘cluttered’ or unwieldy and the basic direction of the presentation can become lost.



An African Experience

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Credits

- Alan Barnard at TOCICO 2007
- Michael Funcke-Bartz at InWEnt (Capacity Building International, Germany):

Background

- 2007 Goldratt Group - InWEnt partnership
- Objective was to test a simplified TOC approach
- Cities from Zambia, Kenya, Nigeria, and Tanzania
- Involved the Solid Waste and Water Supply Systems
- The gap in city infrastructure is very large and growing
- Major negative consequences for millions of citizens and the environment



Some Challenges

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- **Low income nature of the location**
- **Taking into account 4 stakeholder perspectives in determining the UDEs**
 - **served population: no service in many areas**
 - **city council: residents don't/can't pay**
 - **potential service providers: people dump/burn illegally**
 - **franchise contractor: frequent equipment breakdowns**



Africa Experience Insights

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- **Use of symptomatic and systemic evaporating clouds to differentiate between conflict management and conflict elimination.**
- **Importance of the role of paradigms in understanding and breaking conflicts.**



Insights on Defining UDEs as Unresolved Conflicts

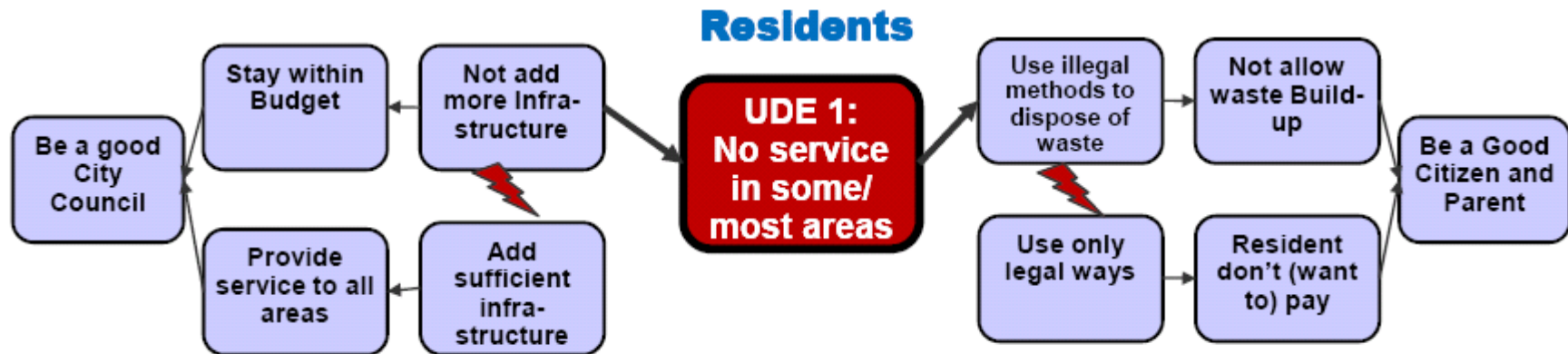
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If a UDE (or problem) exists, then the action causing it has occurred (part of a unresolved conflict) and further, the action needed to address the UDE has not yet occurred (part of the same (or another) unresolved conflict).

Thus, we must understand both (1) the conflict that is responsible for creating the UDE (**systemic conflict**) and (2) the conflict that prevents its effective resolution (**symptomatic conflict**). Barnard, 2007



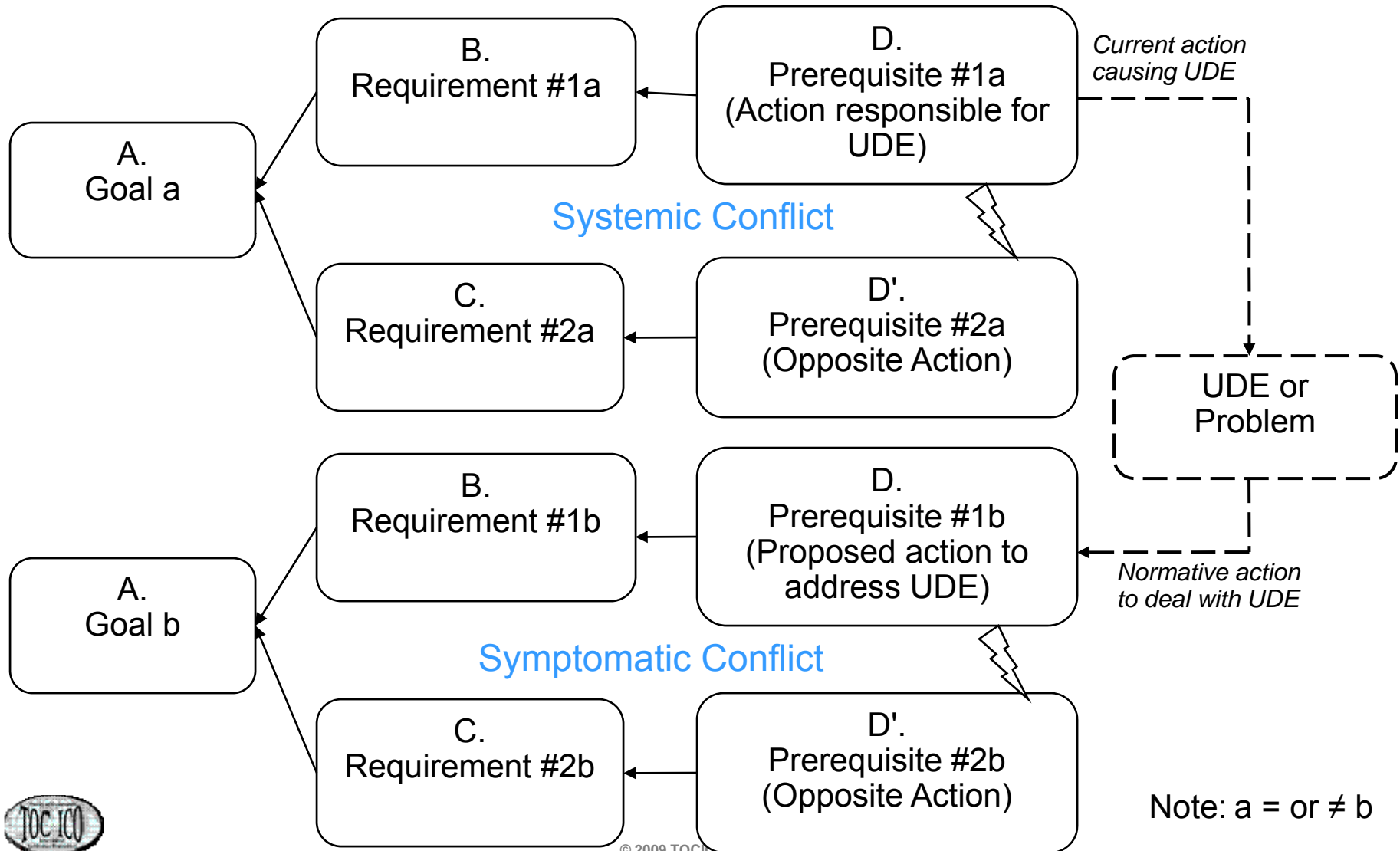
Africa S-S Cloud Example



From Barnard, 2007

Systemic-Symptomatic Conflict Pair

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Note: a = or ≠ b

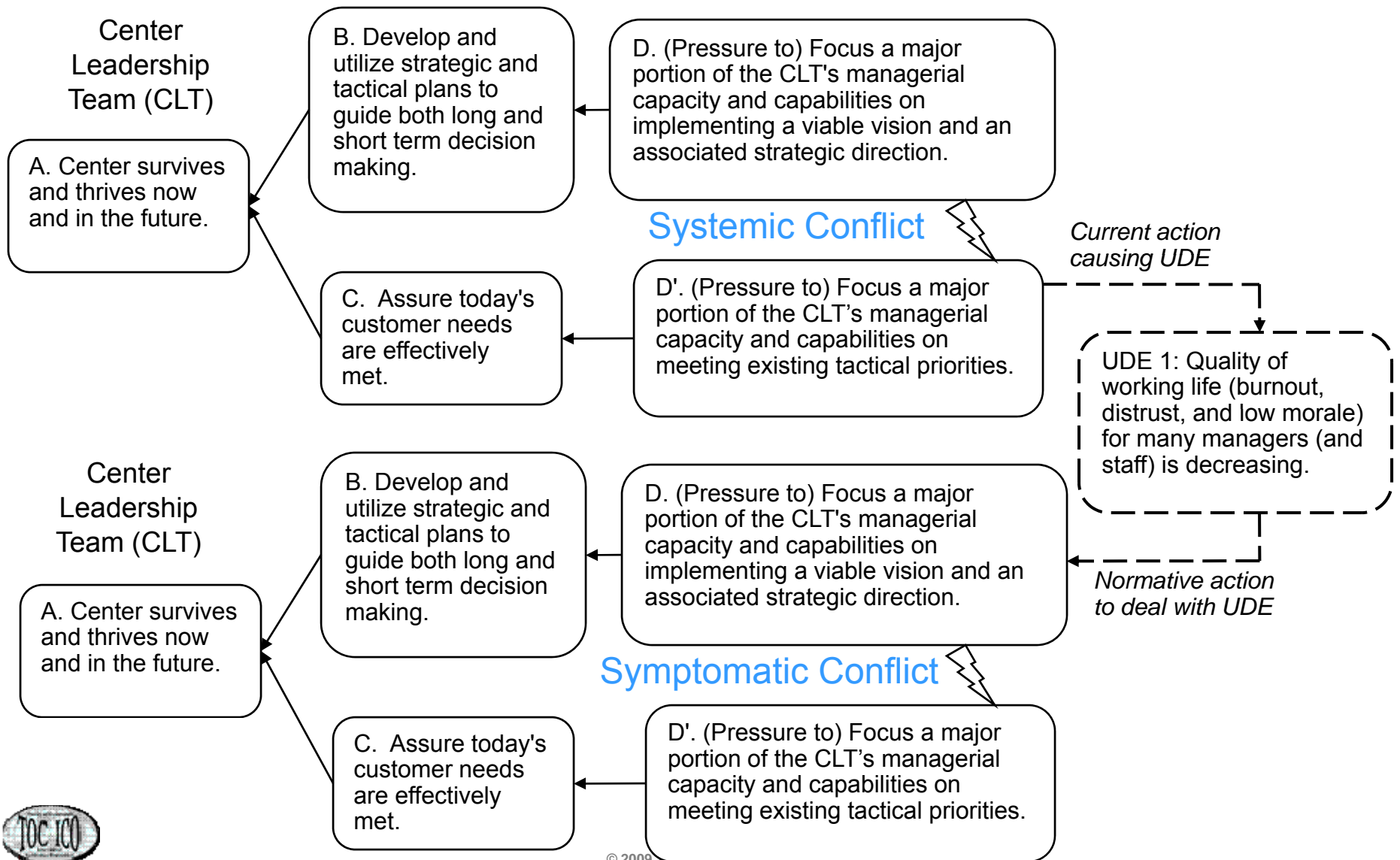


Two Cases

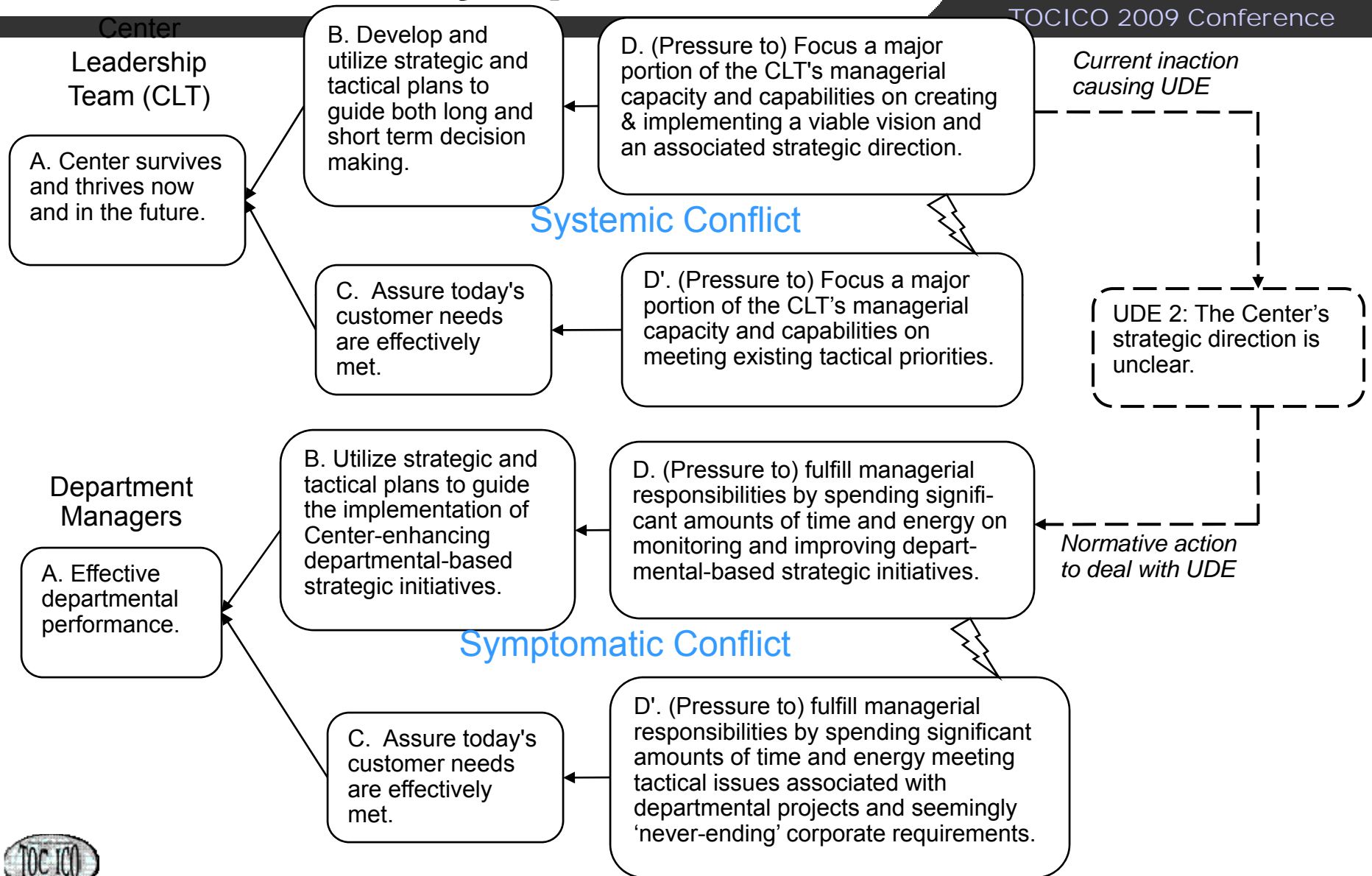
- **Case 1 - Systemic Conflict is the same as Symptomatic Conflict (Occurs when the stakeholder causing problem is the same as the stakeholder addressing/working around problem)**
- **Case 2 - Systemic Conflict is not the same as Symptomatic Conflict (Occurs when the stakeholder causing problem is different than the stakeholder addressing/working around problem)**



Case 1 - Systemic Conflict is the same as Symptomatic Conflict



Case 2 - Systemic Conflict is not the same as Symptomatic Conflict



Some Thoughts on Paradigms

(Adapted from Barnard, 2007)

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The decisions about **When To Change** and **What To Change** are influenced by our individual managerial “paradigms”.

In Theory of Constraints, “Paradigms” are defined as simply sets of assumptions about our values and we believe are valid.

A ‘paradigm shift’ occurs when it is realized that several of the major assumptions that underlie our managerial philosophy are no longer valid.

Paradigms are either “limiting” or “enabling” relative to their inherent potential for facilitating effective management.



Managerial Challenges*	Limiting Paradigms (Traditional Perspective)	Enabling Paradigms (The TOC Perspective)
Constraints	Most “constraints” are “out of my/our control”, thus, they are to blame for my/our poor performance.	Most “constraints” are “within my/our span of control or influence” thus, seek to ‘work around’ or eliminate them.
Complexity	All systems are complex, thus, effective managing is only possible by breaking them up into simpler parts and optimize each part.	Simple solutions do work in complex systems. Embrace the concept of ‘inherent simplicity’, thus, focus all efforts on finding and capitalizing on it.
Conflicts	‘Zero sum’ where one either wins or loses prevails in conflicts, thus, seek to win while others lose or find a compromise where each party ‘wins (or is it ‘loses’) a little.	‘Non zero sum’ means genuine ‘win-win’ alternatives are always possible, thus, ‘hidden assumptions’ underlying conflicts must be identified and understood to create true ‘win-win’ solutions.
Uncertainty	Simplify (or ignore) my true reality by assuming certainty and use mathematical models to compute precise parameter values that yield optimal performance.	Uncertainty is real, thus it is futile to seek precision without recognizing the inherent ‘noise’ in metrics. Find ‘good enough’ guidelines and use feedback to improve and sustain performance.
Bad Behavior	Some people are basically ‘bad’, you want only the ‘right people on board your bus (team/organization)’ thus, you must get rid of ‘bad’ ones.	People are innately ‘good’, thus, create an environment that supports the best from everyone. Only ‘bad’ assumptions need to be eliminated.



*Adapted from Alan Barnard (2007)

Some Paradigm Considerations

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- **Hard to expose because part of our culture**
- **Outsiders may have their own cultural blind spots**



Iligan City, Philippines

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- **Credits**
 - **InWEnt – self-sustainable results**
 - **Cities Development In Asia (CDIA) - co-sponsor**
- **Background**
 - **Located on the northern edge of Mindinao**
 - **Selected a mid-level staffer for TOC training**
 - **Provided support with follow-up workshop series**
 - **City presentations encouraged spread to cities throughout Asia**



Opportunities & Challenges

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- **Typical of those found in not-for-profit entities**
- **Challenge:**
 - **Produce results without investment**
 - **Paradigms are the biggest challenge**
- **High impact results can be achieved with minimal investment**



Challenges

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- **Identifying the goal**
- **Defining suitable throughput measures**
- **Dealing with resistance to change**
- **Policy/paradigm constraints**
- **“Shoot the messenger” mentality**



Focus Water Supply Project

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- **Water delivery project focused initially on physical throughput (delivery of more water)**
 - **First solution: new supply source with large line**
 - **Revised solution: increase use of existing source by removing restrictions & diverting flow into new line**
- **Design & bidding revealed costs above funding**
 - **First solution: reduce extent of project (serve fewer people)**
 - **Revised solution: eliminate large storage tanks and control flow using valves already included in project**
- **Early (pre-election) throughput demanded**
 - **First solution: bid as several projects**
 - **conflicts with national “bid splitting” regulations**
 - **Revised solution: specify project construction sequence**



Water Department

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for want of a nail ...

- **UDE: customers don't pay because contest metering**
- **Expressed issue: insufficient staffing**
- **Finding: testing machine in operable**
- **Single 9V battery (\$1) required but “unbudgeted”**
- **Annual Procurement Plan specifies allowed quantities (down to the number of batteries!)**
- **Asking “Why?” exposed procedural options to enable purchase**



A Missed Opportunity

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- **Implement “half-day” service**
- **Level of service paradigm**
- **Similar to South American situation reported by Held TOCICO 2007**
- **Citizens now only get water a few hours each day**
- **Hours long outages are the norm (no one complains many have storage tanks)**
- **Instituting “even-odd” hourly service would have delivered full service throughout the community “instantly” with no need for major project**



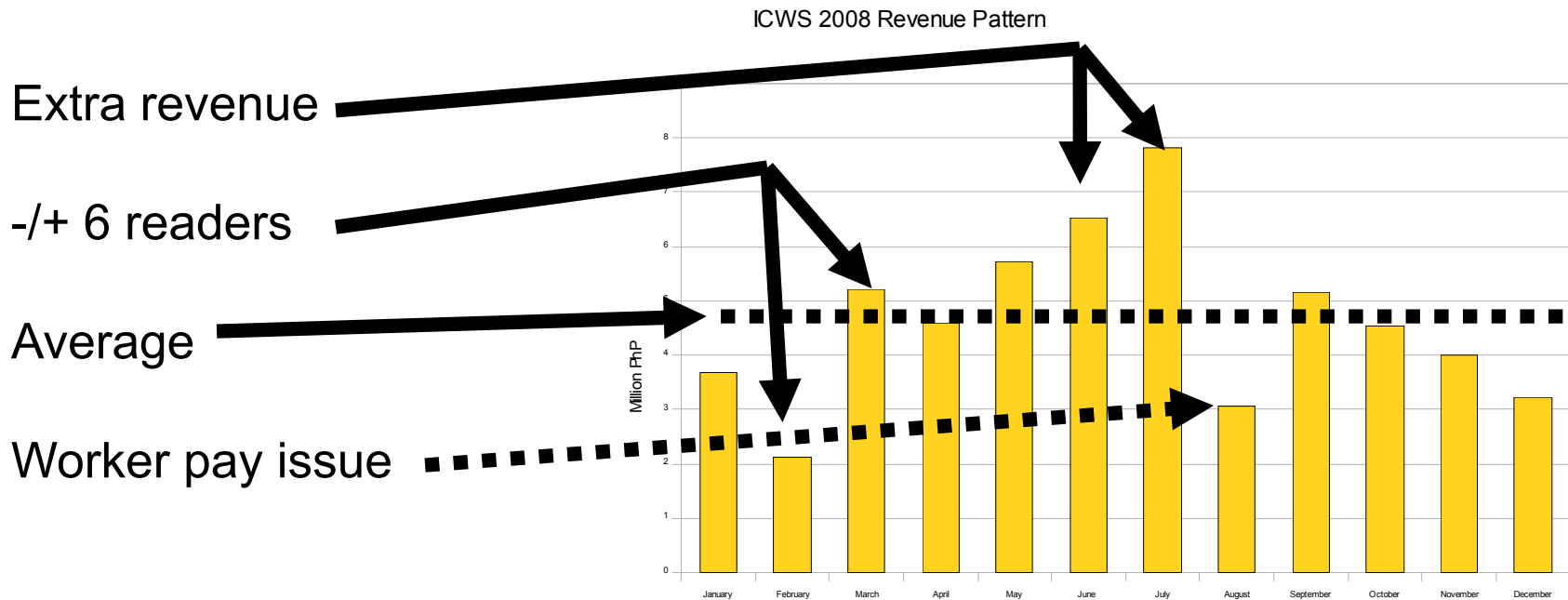
Revenue Generation Issues

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- **One-fourth of customers not receiving bills because of reduction in number of meter readers**
 - Add back generated P500,000/per reader (cost was P26,000 for restored readers)
- **30 to 50% of billed customers don't pay**
 - Some pay late because bus fare exceeds water bill
 - Initial solution: use geographic clusters for efficiency
 - Throughput solution: collect from largest debtors using additional staff
 - Generated P250,000 per added person
 - Not completely resolved
- **Illegal connections around 15%**
 - First solution: disconnect for non-payment
 - Throughput solution: get them to pay – even if reduced amount



Bottom Line Impact



City Hospital - Funding

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- **Approximately 85% of patients are indigent**
- **UDE: large annual general fund subsidy required**
- **Finding: national health insurance available to indigents for nominal amount**
- **Injection: hospital pay indigents' insurance premium**
 - Presently funded by another agency
- **Concern: competition with private sector**



City Hospital - Shortages

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- **Many areas for improvement**
water supply, sanitation, laundry, medicine shortage
- **UDE: frequent medicine shortages**
- **Assumed cause: inadequate funds**
- **Actual finding: medicines budget unspent**
- **Injection: replenishment solution**
 - now applied citywide for purchase of copy paper
- **Side Issue: records management and purchasing irregularities identified**
 - reassign the analyst



Engineering Department

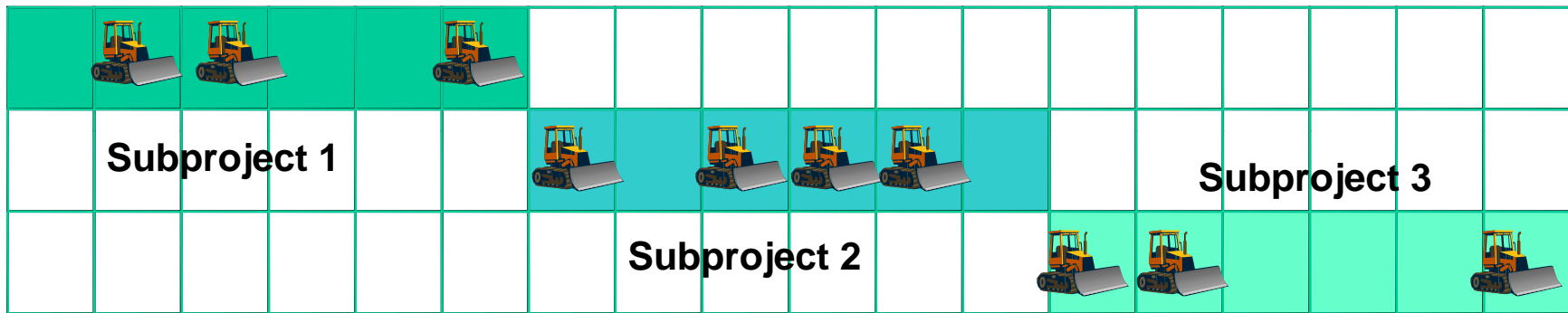
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- **UDE: Street maintenance projects delivered late**
- **Injection: apply Critical Chain Project Management**
- **Paradigm consideration: Local Reality**
 - **People are available in surplus**
 - **Equipment is the resource constraint**
- **Solution: schedule around equipment contention**

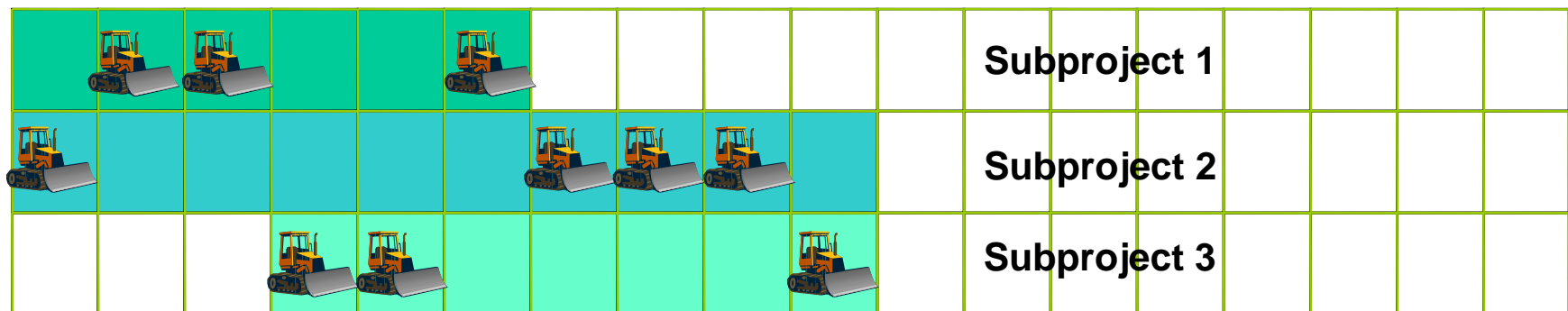


A Resource Scheduling Solution

Previous Practice: Many short projects have long total time



Now: Longer individual project duration, earlier total completion



Economic Development Dept.

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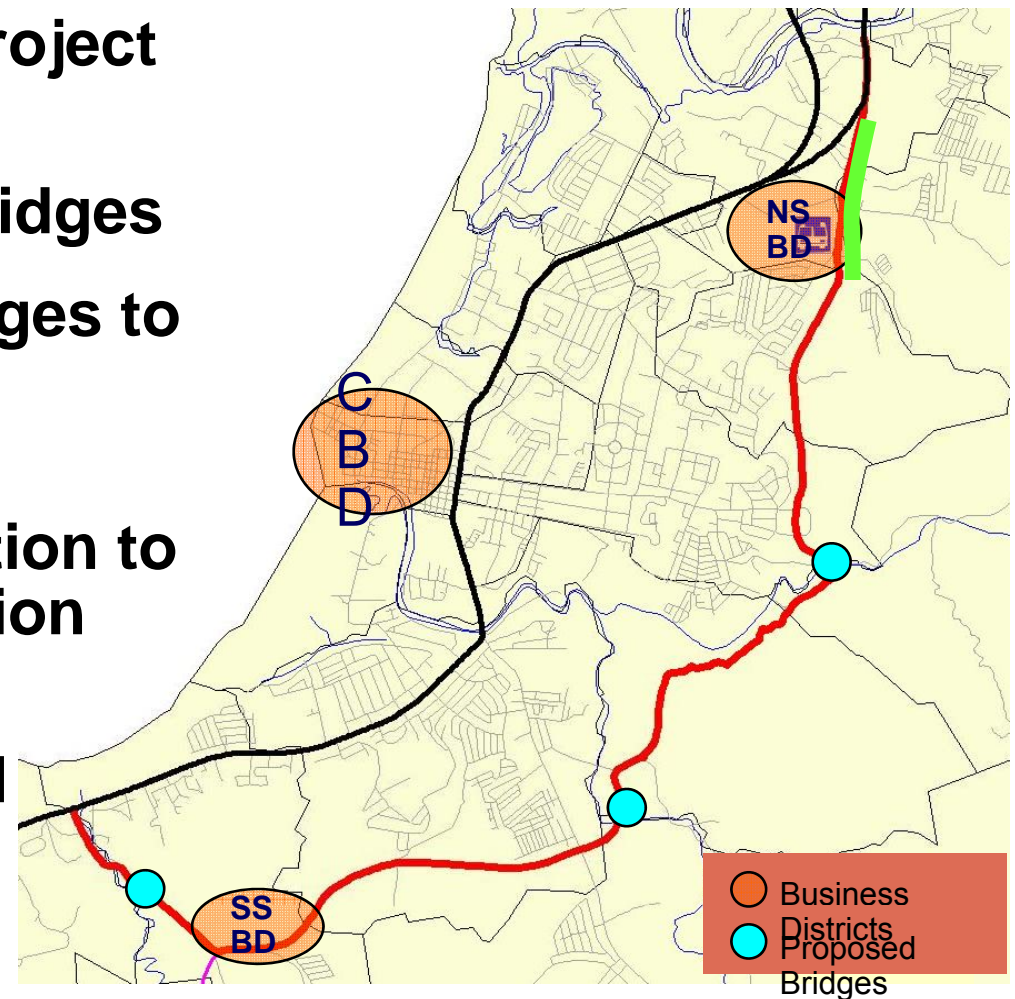
- **Income generating agencies within the government bus terminal / central market / slaughterhouse**
- **UDE: number of head processed dropped 50%**
 - **Presumed constraint: Dehairing machine**
 - **Paradigm symptom: “can't convince with the facts”**
 - **Real constraint: time of delivery**
 - **Injection: dual use of existing vehicles**
 - **Added constraint: Budget cuts require staff reduction**
 - **Injection: use outside butchers**
 - **Dehairing machine follow-up: fixed but not used**



Planning Department

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- **Circumferential Road Project**
- **Limited funding & time suggested building 3 bridges**
- **Would have led to “bridges to no where”**
- **Throughput suggested building short road section to serve major transportation center**
- **Federal Department had to be convinced**



Conclusions & Synthesis

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From All 3 Public Sector Situations

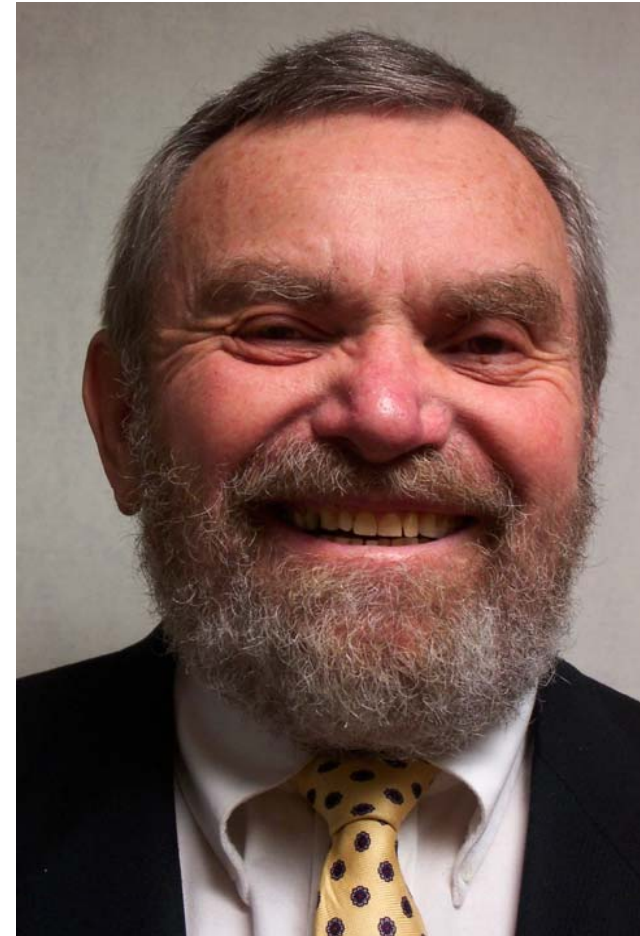
- Many stakeholder perspectives to be satisfied
- Goal frequently undefined
 - government official satisfaction
 - voter/citizen satisfaction
 - government department remains viable
- Politics always plays a role (e.g. must happen prior to officials' re-election campaign)
- T is not easily expressed (voter/citizen satisfaction is difficult to measure)
- I is frequently not quantifiable (data lacking)
- OE is well documented and comparable



About Richard A. Reid

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Richard A. Reid recently retired from the University of New Mexico where he taught systems thinking, operations management, and operations research for 34 years. He received a BSME from Case Western Reserve University, and an MBA and Ph.D in Systems Research from Ohio State University. Dr. Reid enjoys applying conceptual frameworks such as TOC TP to performance improvement opportunities in both the manufacturing and service sectors with students in the classroom and when consulting with organizational managers. He has written one book, three chapters in other books, and has published over 125 articles in referred national and international journals.



About Tom Shoemaker

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Thomas E. Shoemaker
PE, MS, MBA

Tom is principal of Operations Innovation LLC in Albuquerque, New Mexico which specializes in assisting organizations facing difficult choices find unique solutions to improve their situation.

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