



**THEORY OF CONSTRAINTS**  
INTERNATIONAL CERTIFICATION ORGANIZATION

2019 TOCICO Webinar

# **Using the Theory of Constraints to solve ill-structured (wicked, messy) problems: A healthcare example**

**Presented by: James F. Cox III**

**Date: 28 September 2019**



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# Abbreviations used in the presentation

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**ISP ill-structured problem**

**PHD Principal of Hierarchal Decomposition**

**PTD Principal of Time-based Dependencies**

**LUA logical unit of analysis**

**PASS Provider Appointment Scheduling System**

**PCPP primary care provider practice**

**MSP medical specialty provider (P practice)**

**SSP surgical specialty provider (P practice)**

**NAS no appt scheduled**

**WSP well-structured problem**

**IC Inherent classification**

**IS Inherent Simplicity**

**AU assessment unit**

**PCP primary care provider**

**ED emergency department**

**Appt appointment**

**Pt patient**

**CMA certified medical assistant**

**M million**

**CQS change question sequence**

**5FS five focusing steps**

**TP thinking processes**

**CRT current reality tree**

**UDEs undesirable effects, symptoms**

**DBR drum buffer rope**

**T I OE throughput, inventory (investment), operating expense**

**B billion**

**POOGI process(es) of on-going improvement**

**BM strategic buffers & buffer management**

**EC evaporating cloud**

**FRT future reality tree**

**DEs desirable effects**

**VATI part flows in manufacturing facility**



# An analogy: My productivity journey is a journey of exploration

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*We shall not cease from exploration and the end of our exploring will be to arrive where we started and know the place for the first time. T.S. Eliot*

*Hopefully, our journey through this presentation not only provides insights into how to approach ill-structured problems but also into how to identify and address our global healthcare problem.*





# Acknowledgements

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**If I have seen further it is by standing on  
the shoulders of others.**

**Isaac Newton 1675**



# Acknowledgements

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**Eli Goldratt: a full life BUT what of setting a life goal?**

**Laurie & Tim Robinson MDs: starting my journey**

**Alex Knight: sharing their health care knowledge**

**Vicky Mabin**

**Boaz Ronen**

**Roy Stratton**

**Baha Inozu**

**Russ Johnson: encouragement in changing the goal.**

**Eli Schragenheim**

**Gustavo Bacelar: the new breed of TOC healthcare expert**

**Michael Curtis**

**Christina Cheng: recidivism.**



**John Wood (use of Mudpuppy puzzle)**

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# My productivity journey: Pt A to Pt B goal

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ISP

**2019 Time-based Dependencies Principle, Strategic Leverage Point**

**2018 Inherent Classification/Inherent Simplicity,  
Multi-framing, Hierarchal Decomposition Principle**

**2015 Ill-structured (Wicked) Problem, Satisficing**

**2012 Literature Review:14 generic UDEs**

**2010 Practice  
Implementation**

**2011  
Schedule  
Design**

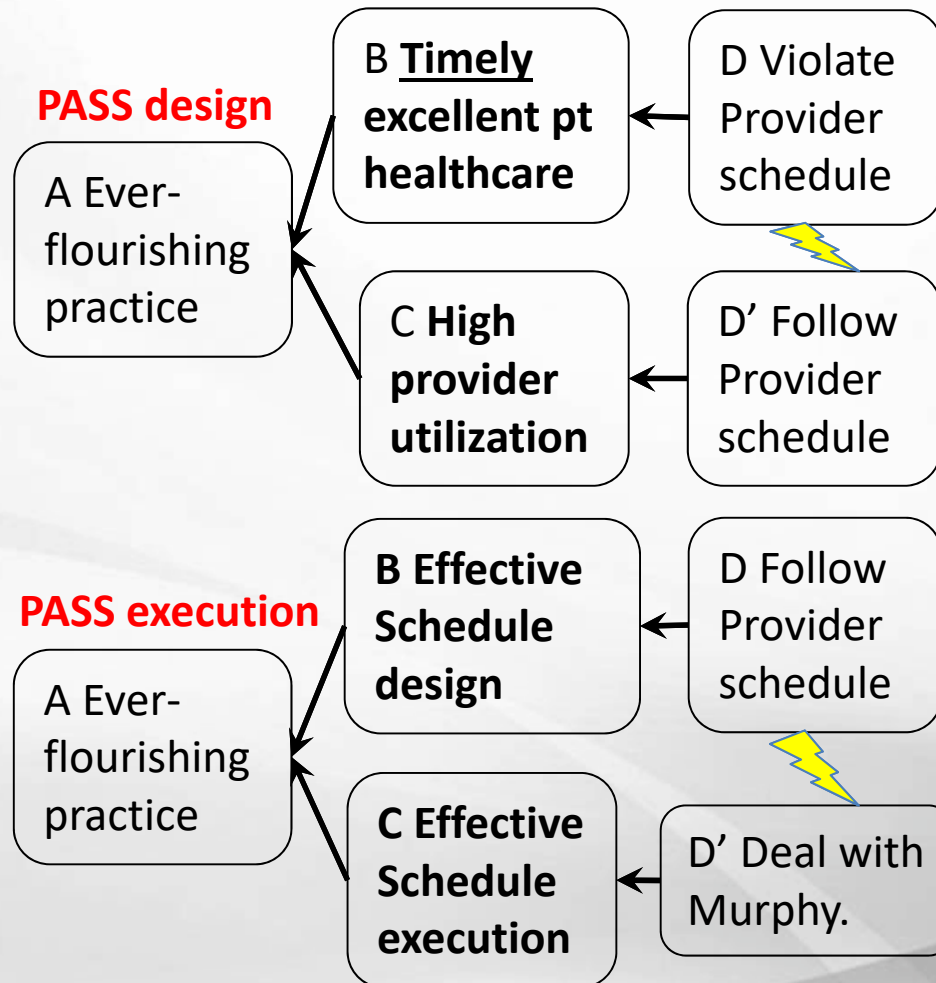
**2011  
Schedule  
Execution**

WSPs



# Two core problems in patient scheduling

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# Review: Traditional vs. TOC terminology

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1. Problems versus (vs.) UDEs and core problem
2. Classification vs. inherent classification
3. Simplification vs. inherent simplicity
4. Link of chain vs. healthcare supply chain network
5. Provider schedule vs. provider appointment scheduling system (PASS)
6. Schedule design (UDE) vs. PASS (design & execution) ECs
7. Chaos is composed of high levels of:
  - A. Complexity
  - B. Uncertainty
  - C. Local versus global optima



# OUTLINE OF PRESENTATION

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- Wicked problem examples & definitions
- 8 Principles, concepts & tools (w examples) used to convert an ISP to similar WSPs
- Puzzle analogy
- Wicked problem solution procedure
  - Stage I Moving from ISP to WSPs (7 steps)
  - Stage II Solving the WSP (2 steps)

# What is an ill-structured problem (ISP)?

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**Ill-defined/-structured, wicked, messy problems include:**

- **Healthcare**
- **Government**
- **Education**
- **Recidivism (tendency of a convicted criminal to reoffend)**
- **Others: Immigration, opioid, poverty, justice system, US pharmaceutical supply chain, etc.**

# Definitions related to ill-structured problems

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- **Complex system** – A system made up of a large number of parts that interact in a non-simple way. (Simon 1962)
  - **Chaotic environment** – A system in a state of complete confusion & disorder.
- 
- **Ill-defined problem** – A problem that does not have clear goals, operations or an expected solution. (Reitman 1964)
  - **Ill-structured problem (ISP)** – A problem whose structure lacks definition in some respect. (Simon 1973)

# Definitions related to ill-structured problems

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**Messy problems** – “Managers are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other... Situations in which there are large differences of opinion about the problem or even on the question of whether there is a problem.” (Ackoff 1979)

“A mess is a system of problems. A system is a **whole that cannot be decomposed into independent parts**. From this it can and has been shown that a system always has properties that none of its parts have and that these are its *essential* properties....”  
(Ackoff 1981, 20)

Ackoff, R. L. (1979). "The Future of Operational Research is Past." The Journal of the Operational Research Society 30(2): 93-104.

Ackoff, R. L. (1981). "The art and science of mess management." Interfaces 11(1): 20-26.





# Do both of these quotes apply to this solution?

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The sum of local optima is not equal to the global optimum.

Anonymous

**BUT**

The **Whole** is Greater **than** the **Sum** of its **Parts**.

Aristotle, Greek philosopher

# Characteristics of ill-structured problems applied to healthcare (Churchman 1967)

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**Wicked problem** is difficult/impossible to solve for four reasons:

1. Incomplete or contradictory knowledge,
2. The number of stakeholders' opinions involved,
3. The large economic burden, and
4. The interconnected nature of the problem with other problems.

## **1. Incomplete or contradictory knowledge**

- Look at the varying healthcare statistics on the internet.
- Everyone blames someone else for the problem.

Churchman, C. W. (1967). "Guest editorial: Wicked problems." Management Science **14**(4): B141-B142.



# Characteristics of ill-structured problems applied to healthcare (Churchman 1967)

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## 2. Number of stakeholders & opinions involved

- **Macro:** ACA, Insurance, Medicare, Medicaid, VA, EMTALA, electronic medical records (EMR), etc.
- **Micro:** Practice partners, providers, patients, clinical staff, schedulers, business staff, etc.

## 3. Large economic burden

- US: Healthcare expense \$3.5 trillion annually, 17% of GDP but still over 12% of the population is uninsured.

## 4. Interconnected nature of problems

- Health, poverty, education, VA, private/ public hospitals, etc.
- **The proposed solution often is worse than the symptoms.**



# OR conducted on wicked problems

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“In a Management Science editorial, Churchman (1967 B141–2) discussed a seminar Rittel gave on wicked problems and stated: “one is led to conclude from the discussion that the membership in the class of nonwicked problems is restricted to the arena of play: nursery school, academia and the like”. Further, in discussing the operations researchers’ approach to taming wicked problems Churchman stated: “Sometimes, as in OR, it consists of “carving off” a piece of the problem and finding a rational and feasible solution to this piece. In the latter case, it is up to someone else (presumably a manager) to handle the untamed part... A better way of describing the OR solution might be to say that it tames the growl of the wicked problem: the wicked problem no longer shows its teeth before it bites...”.



Cox III, J. F., & Boyd, L. H. (2018). Using the theory of constraints’ processes of ongoing improvement to address the provider appointment scheduling system design problem. *Health Systems*, 1-35. doi:10.1080/20476965.2018.1471439

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# Goldratt on complexity

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**“The more complicated a situation seems to be, the simpler the solution must be, ...” p. 8.**

**“The admiration with sophistication is totally wrong ... The key for thinking like a scientist is the acceptance that any real life situation, no matter how complex it initially looks, is actually, once understood, embarrassingly simple. Moreover, if the situation is based on human interactions, you probably have enough knowledge to begin with.” p. 9.**

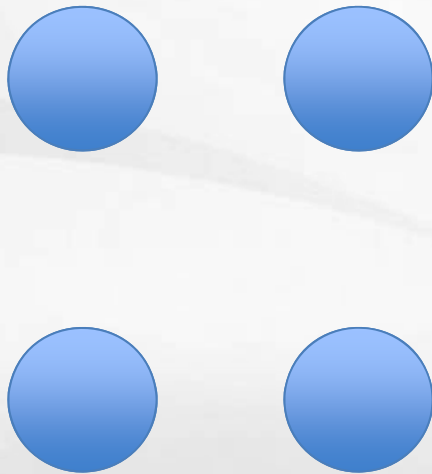


Goldratt, E. M. (2008). *The choice*. Great Barrington, MA: The North River Press Publishing Corporation.

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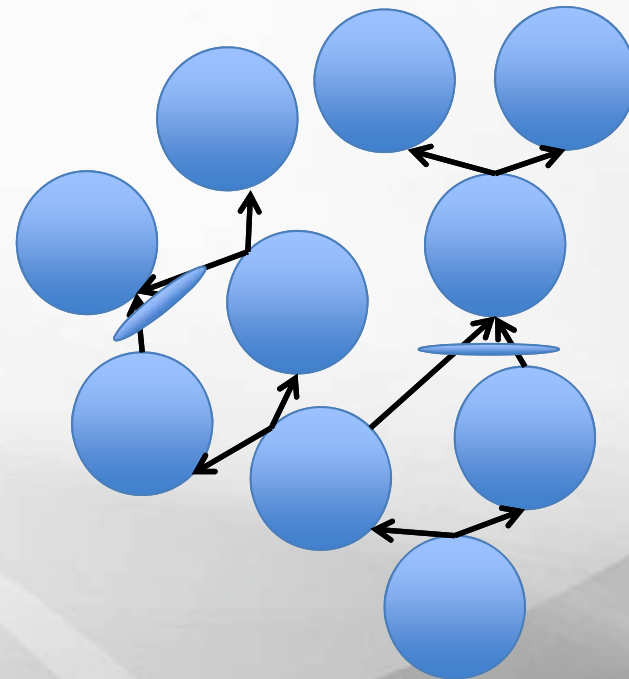
# Simplification Vs. Inherent Simplicity

**OR view**



**System A**

**TOC view**



**System B**

# Problems (UDEs) identified in the literature

**UDE 1 The no-show rate is high.\***

**UDE 2 Many pts are given appts later than they need/desire.\***

**UDE 3 The no-appt-scheduled (NAS) slots are high; greater than 20% particularly in the summer months.\***

**UDE 4 Providers set rules for who they want to see, when, and for how long.\***

**UDE 5 Pt wait times at practice are long.\***

**UDE 6 Waiting-room congestion is high.\***

**UDE 7 A number of unpunctual pts exist: some come early and some come late.\***

**UDE 8 Walk-ins are common.\***

**UDE 9 Occasionally a provider has an emergency pt.**

**UDE 10 Sometimes a provider starts a session late.\***

**UDE 11 Sometimes a provider is interrupted during a consult service time or session; (interactions with support staff, phone calls, writing up notes, comfort breaks, etc.).\***

**UDE 12 Provider consult time is highly variable.\***

**UDE 13 Sometimes pts are called in order of arrival (FCFS) or need instead of by the appt schedule.\***

**UDE 14 Some pts require a second consult (after tests, x-rays, etc.).\***



# Principles, concepts & tools used to address ISP

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1. Principle of bounded rationality-satisficer (Simon 1979, 1991)
2. Inherent classification (IC) (Goldratt 2010)
3. Inherent simplicity (IS) (Goldratt 2005)
4. Principle of hierarchal decomposition PHD (Simon 1962)
5. Principle of time-based dependency (PTD) analysis  
(Knight 2014, 2015)
6. Multi-framing and the EC (Mabin and Davies 2004)
7. Strategic leverage point (SLP) (Cox 2019)
8. TOC, POOGI, TP, etc. (Goldratt numerous references)

# 1. Simon's principle of bounded rationality

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**Simon (1979, 1991) views decision makers as satisficers instead of optimizers; that is, given bounded rationality (imperfect information, uncertainty, complexity, and time constraints on making the decision), the decision maker selects what is perceived to be a good enough alternative at each moment in time.**

Simon, H. A. (1979). "Rational decision making in business organizations." American Economic Review 69(4): 493-513.

Simon, H. A. (1991). "Bounded Rationality and Organizational Learning." Organization Science 2(1): 125-134.



## 2. (Inherent) classifications in science (Goldratt 1988)

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**Three stages of science: classification, correlation, cause-effect.**

**Heavenly bodies:** stars, planets, meteors, comets, etc.

Purpose: Identify similar celestial bodies.

**Periodic Table in Chemistry (Dmitri Mendeleev 1869)**

Column (group)- Elements with similar chemical properties by atomic weights.

Row (period)- Elements with same number of atomic orbitals.

Purpose: Predict missing elements, reactions, properties

**Tree of Life taxonomy in Biology (Darwin 1859)**

Species are linked hierarchically in a tree structure, moving from the roots representing evolutionary life to many divergent branches representing individual species.

Purpose: Understand evolution of species.



Goldratt, E. M. (1988). "Apologia or in the move towards the third stage." The Theory of Constraints Journal 1(2): 23-38.

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## 2. Inherent classification definition (Goldratt 2010)

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“The most intuitive structure to a body of knowledge is a classification. But, as I already explained in the last edition of The Goal (2<sup>nd</sup> revised edition, Chapter 38, 1992, my addition), classification is really meaningful only if it is the **inherent classification** – a classification that stems from the basic element of cause-effect. No problem; the mere fact that there is a **guiding principle** indicates that the inherent classification is at our grasp (probably already exists as one of the subjects)...Therefore, a good frame will exist if the guiding principle is used to logically develop the sequence in which the classification emerges. And to explain the subjects at their proper place, the place provided by the classification.”

Goldratt, E. M. 2010. Communication concerning organizing new TOC developments for his 2-day presentation at the TOCICO International Conference. Dated 17 June 2010.

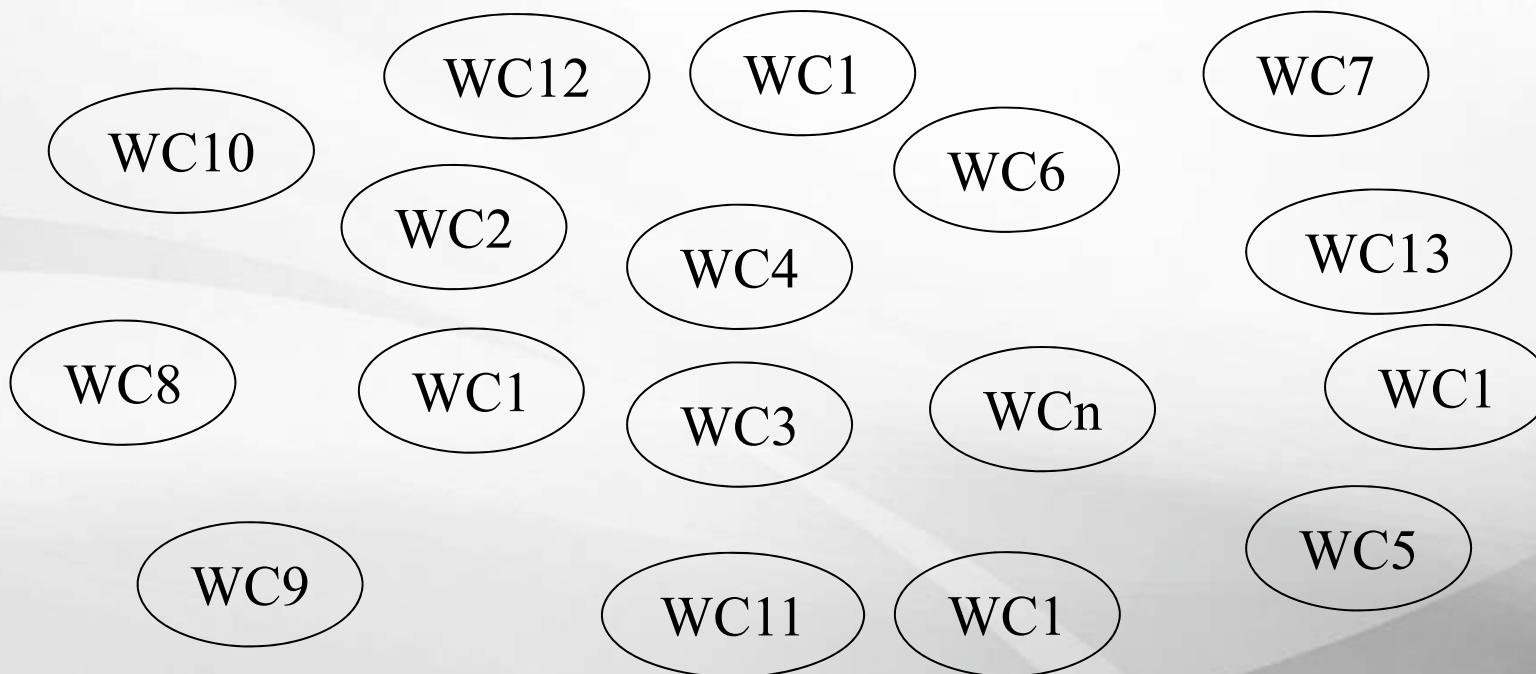


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## 2. Inherent classification: Production/ Opns Mgt

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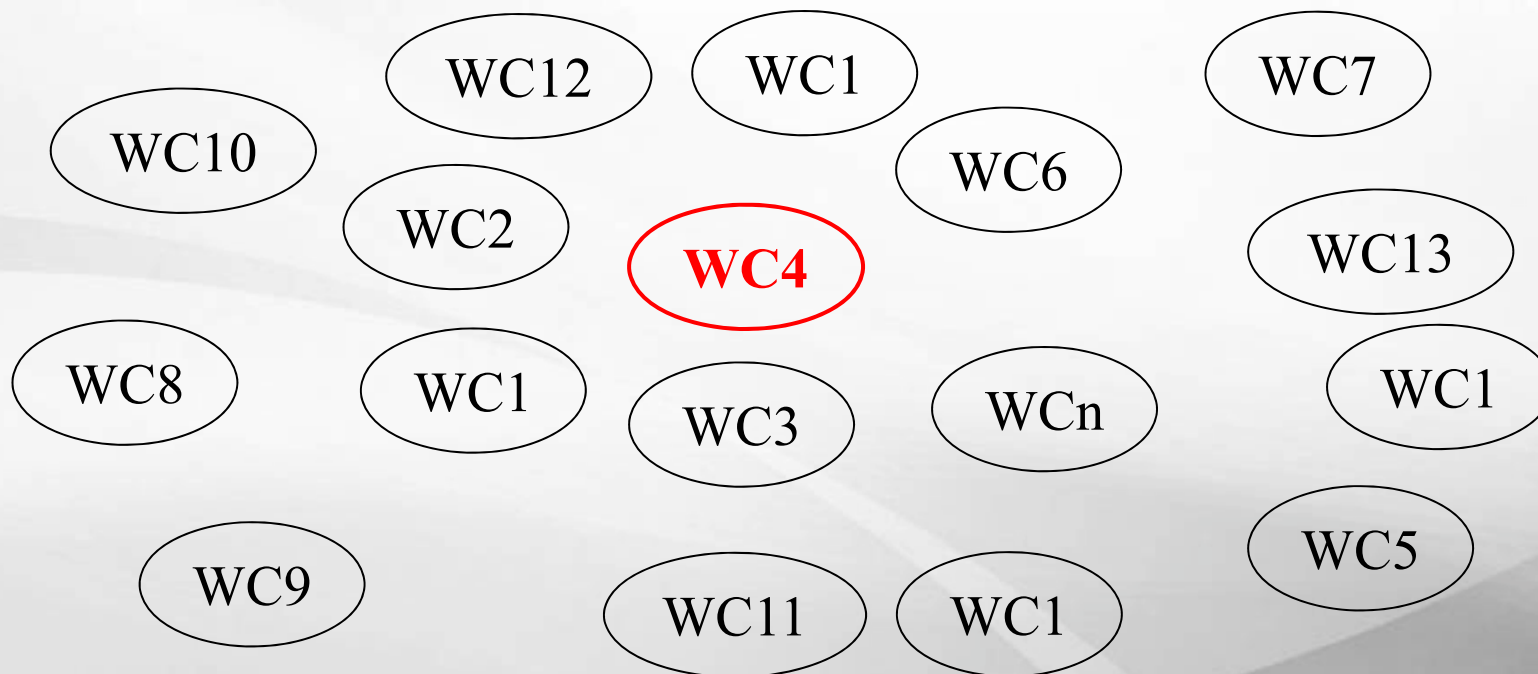
**Question: How does one inherently classify resources to “maximize” production?**



## 2. Inherent classification: Production/ Opns Mgt

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**Purpose: The IC to maximize production is  
CONSTRAINTS & NON-CONSTRAINTS**



## 2. Inherent classification: Production/ Opns Mgt

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**Question: How does one inherently classify resources to schedule production?**

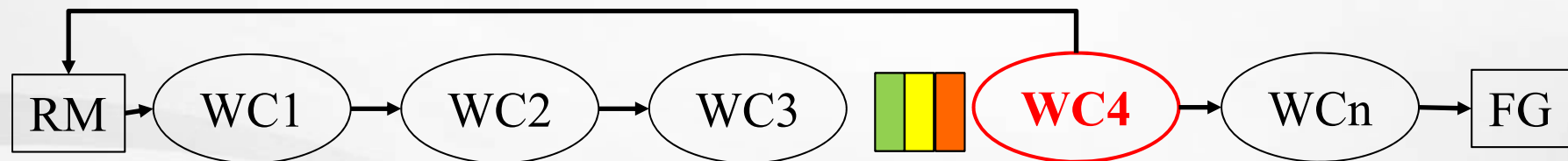


## 2. Inherent classification: Production/ Opns Mgt

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**Purpose: The IC to schedule production is DBR and SDBR.**

DBR



SDBR



## 2. Inherent classification: Production/ Opns Mgt

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**Question: How does one inherently classify manufacturing plants to plan and control?**



## 2. Inherent classification: Production/ Opns Mgt

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**Purpose: The IC of manufacturing plants to plan and control is IVAT.**

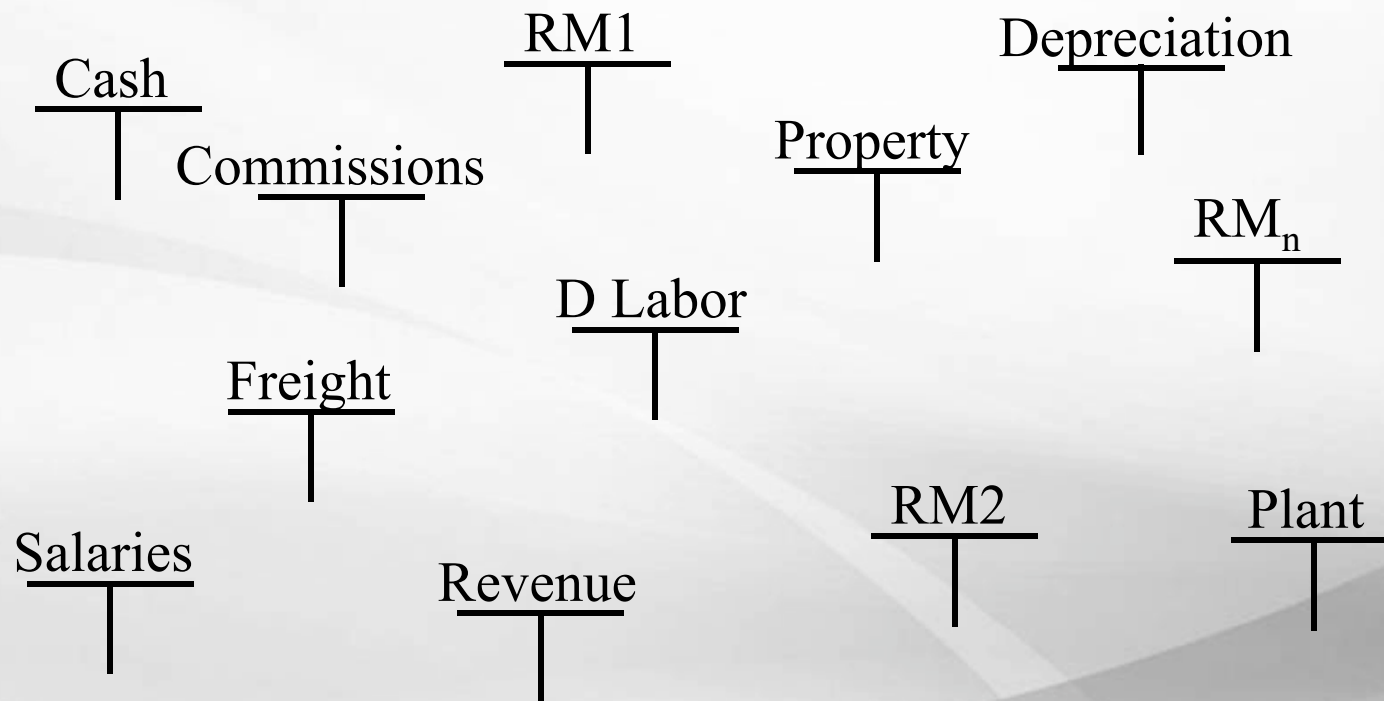
**I V A T**



## 2. Inherent classification: Managerial Accounting

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**Question: How does one inherently classify the chart of accounts to make effective decisions?**



## 2. Inherent classification: Managerial Accounting

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**Purpose: The IC of the chart of accounts to make decisions is throughput accounting.**

**Throughput**

**T**

$\triangle T$

**Inventory/investment**

**I**

$\triangle I$

**Operating Expense**

**OE**

$\triangle OE$

## 2. Inherent Classification: Problem ID/solution

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**Question: How does one logically identify, analyze /solve a chronic problem?**

**Purpose: The IC of questions is the CQS.**

**Question: How does one determine when to act?**

**Purpose: The IC for taking actions is BM.**

**3 regions: green-do nothing, yellow-plan, red-act.**

# 3. Simplification vs. inherent simplicity

(Goldratt 2005)

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**“We use this method (inherent simplicity) in the hard sciences ... The inherent simplicity exists in reality... The point is: If you do not assume a priori that the simplicity exists you will never have the stamina to go about finding it because it is not a triviality at all. This is what we are doing in theory of constraints all the time. The systems are enormously complex. Wait a minute there is inherent simplicity... the thinking processes are the tools that helps us find the inherent simplicity... two different areas exist: one is those areas where we have already found the inherent simplicity and we use it; and the second is those areas where we haven't found it. The first step is to find the inherent simplicity....”**

Goldratt, E. M. (2005). Success through simplicity. TOCICO International Conference: 3rd Annual Worldwide Gathering of TOC Professionals, Barcelona, Spain, TOCICO.





# ISP or WSP?????

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**In my opinion, Goldratt used these Inherent Classification and Inherent Simplicity concepts to develop many of his TOC solutions. He verbalized the process in The Goal (1992).**

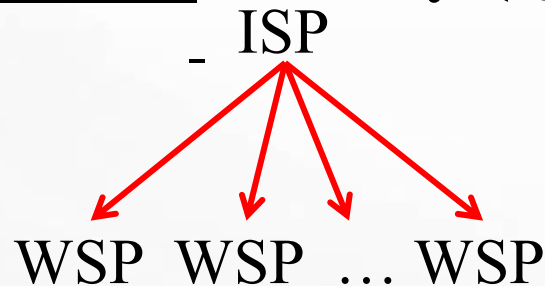
**Prior to Goldratt's work these problem environments probably would have been considered ISPs.**



## 4. Simon's principle of hierarchal decomposition PHD

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Simon (1962) described the structure of complex systems and how one might decompose a complex hierarchal system into simpler similar structures for study. (Quantitative analysis)



Cox opinion: My addition to the above: 1. into simpler similar **(or dissimilar)** structures. 2. Simon's PHD applies to qualitative analysis also. 3. System improvement is achieved at the operations level. 4. Solving the ISP is only possible if the chaos is removed in the lower level operations environment.



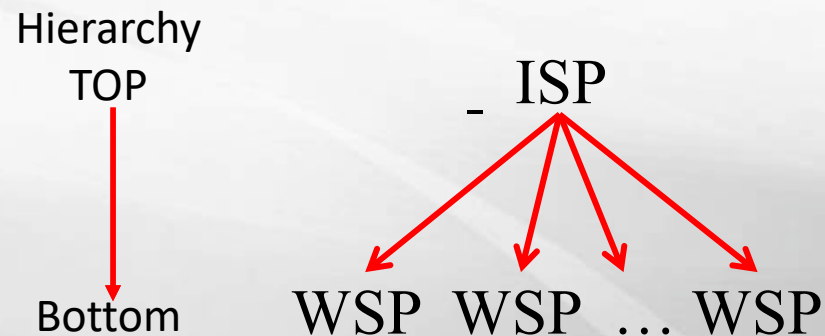
Source: Simon, H. A., 1962, The Architecture of Complexity. Proceedings of the American Philosophical Society, Vol. 106, No. 6. (Dec. 12, 1962), pp.467-482.

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## 4. Hierarchic system: Definition

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***hierarchic system*** -- a system that is composed of interrelated subsystems, each of the latter being, in turn, hierarchic in structure until we reach some lowest level of elementary subsystem.





## 4. PHD EXAMPLE: Utah state government

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**21 agencies → 295 depts. → 22,000 employees**

**Agriculture & Food (9 units)**

**Community & Culture (23 units)**

**Education (18 units)**

**General Services (7 units)**

**Human Services (29 units)**

**Labor (13 units)**

**Library & History (6 units)**

**Public Safety & Corrections (29 units)**

**Records & Archives (2 units)**

**Taxes (9 units)**

**Workforce Services (23 units)**

**Business & Commerce (23 units)**

**Economic Development (13 units)**

**Environmental & Natural Res. (27 units)**

**Health (23 units)**

**Information Technology (5 units)**

**Legal (13 units)**

**Military (1 unit)**

**Purchasing & Finance (6 units)**

**State Government Jobs (5 units)**

**Transportation (10 units)**

<https://www.utah.gov/government/agencylist.html>



# 4. PHD: what is the IC of Utah gov.?

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<b><u>8 Work Environments</u></b>	<b><u>Number</u></b>
• <b>Distribution/ Inventory</b>	<b>3</b>
• <b>Marketing/ Outreach</b>	<b>7</b>
• <b>People</b>	<b>9</b>
• <b>Processing</b>	<b>35</b>
• <b>Project</b>	<b>24</b>
• <b>Regulatory</b>	<b>26</b>
• <b><u>Resource Management</u></b>	<b><u>10</u></b>
<b>Total Major Systems</b>	<b>114</b>

Cox, K. (2014). Better, faster, cheaper state government. TOCICO International Conference: 12th Annual Worldwide Gathering of TOC Professionals, Washington, DC, Theory of Constraints International Certification Organization.



## 5. Knight's Principle of Time-based Dependency (PTD)

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**Knight's approach to planning & controlling complex systems is embarrassingly simple!**

**In a complex system such as healthcare where thousands of pt flows exist in situations of high uncertainty (long-tailed distributions), the provider cannot determine the pt flow until the pt is treated at the current link.**

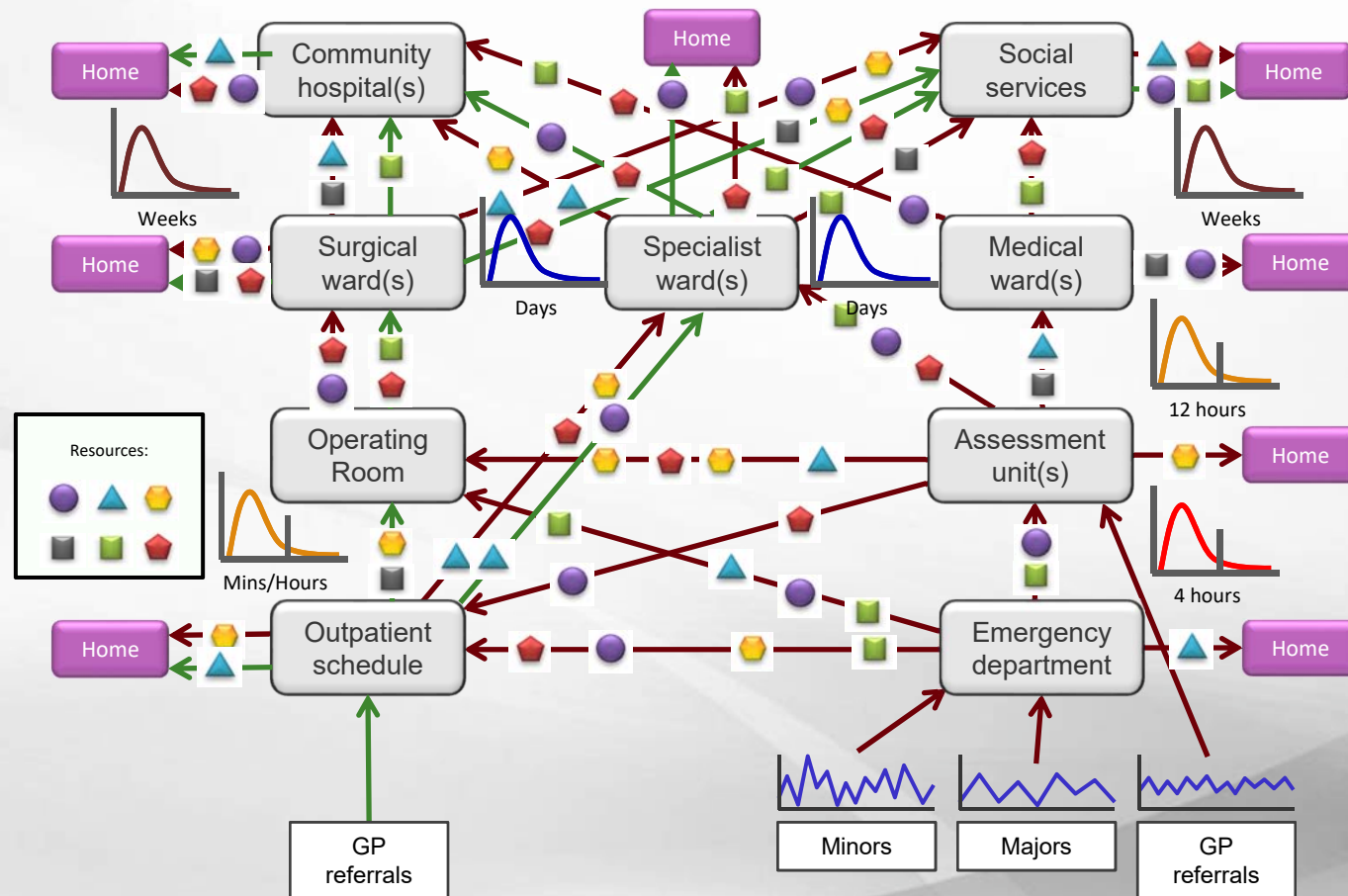


Knight, A. (2014a). Keynote address: Improving global healthcare with the theory of constraints. TOCICO International Conference: 12th Annual Worldwide Gathering of TOC Professionals, Washington, DC, Theory of Constraints International Certification Organization.

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# 5. PTD: Apparent complexity of the acute environment

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Knight, A. (2014a). Keynote address: Improving global healthcare with the theory of constraints. TOCICO International Conference: 12th Annual Worldwide Gathering of TOC Professionals, Washington, DC, Theory of Constraints International Certification Organization.

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## 6. Frame (of reference) & framing

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**A frame (perception) is a complex set of assumptions, beliefs, values & attitudes used to create meaning. A frame usually biases our understanding & judgment.**

**Tversky and Kahneman (1981) define a **decision frame** as ‘the decision-maker’s conception of the act, outcomes and contingencies associated with a particular choice.’**

[http://changingminds.org/explanations/models/frame\\_of\\_reference.htm](http://changingminds.org/explanations/models/frame_of_reference.htm)



Tversky, A. and Kahneman, D. (1981). The framing of decisions and psychology of choice. *Science*, 211, 453-458.

## 6. Multi-framing & the EC Mabin & Davies (2004)

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In addition to providing an example of using the EC to show the frame of individuals, **Mabin and Davies (2004, 8)** list “the benefits of multi-framing as “building frame awareness, overcoming frame blindness, & understanding the development of multiple perspectives, including those of different constituents and stakeholders, which contribute to more robust and acceptable choices.”

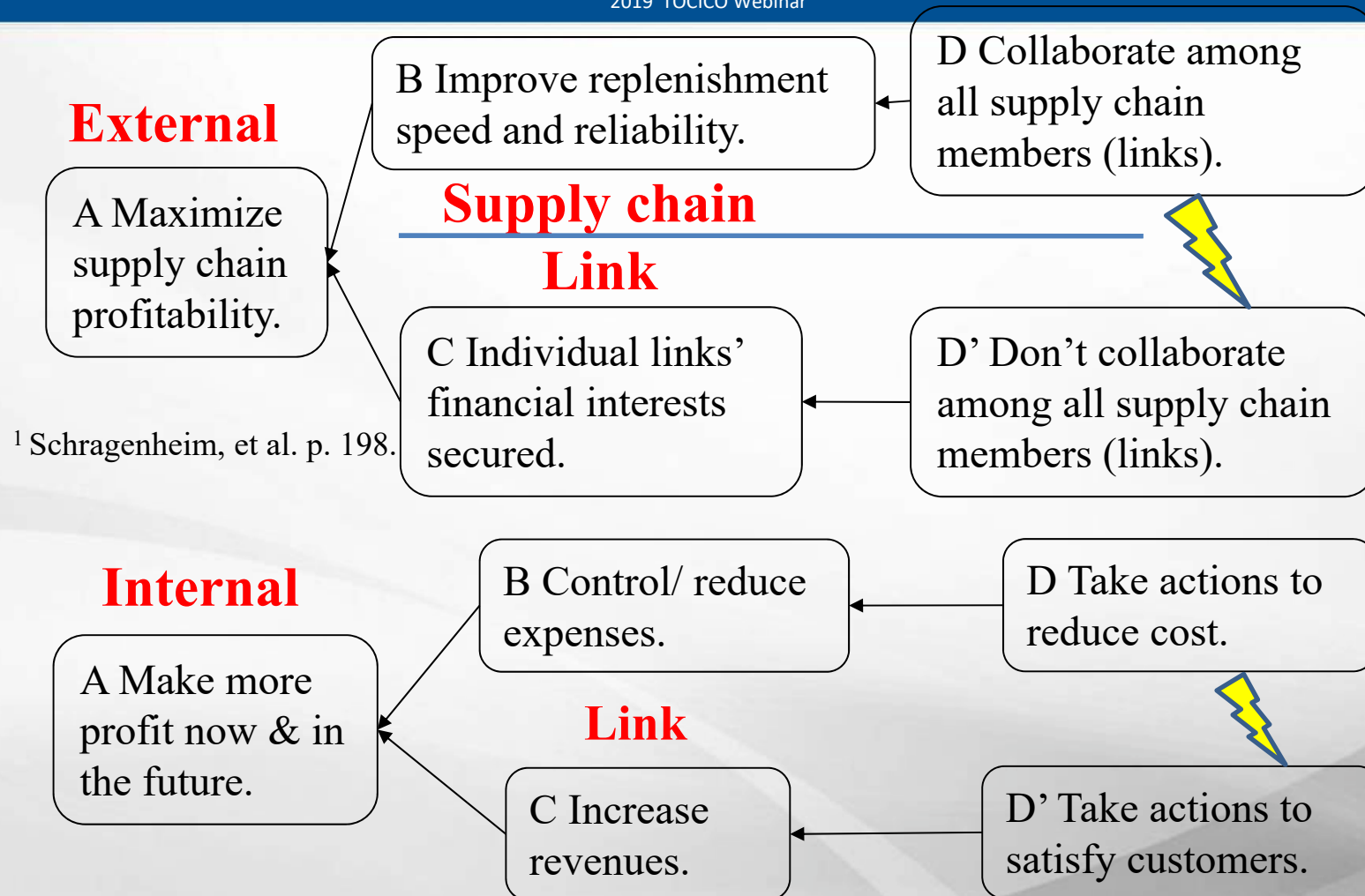
Mabin, V. J. and J. Davies (2004). A case of ethical dilemma: A multi-framing approach. International Business Trends: Contemporary Readings. S. Fullerton and D. L. Moore. Ypsilanti, MI, Academy of Business Administration: Ypsilanti, MI: 8-20





## 6. External & internal<sup>1</sup> frames: Supply chain<sup>2</sup> & link ECs

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<sup>1</sup> Schragenheim, et al. p. 198.

<sup>1</sup> Barnard, A. (2013). Creating breakthrough solutions using the change matrix cloud (CMC). TOCICO Webinar Series. TOCICO, Theory of Constraints International Certification Organization.

<sup>2</sup> Schragenheim, E., H. W. Dettmer and J. W. Patterson. (2009) Supply chain management at warp speed. Boca Raton, Fl. CRC Press.



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## **7. Strategic leverage point (Cox 2019)**

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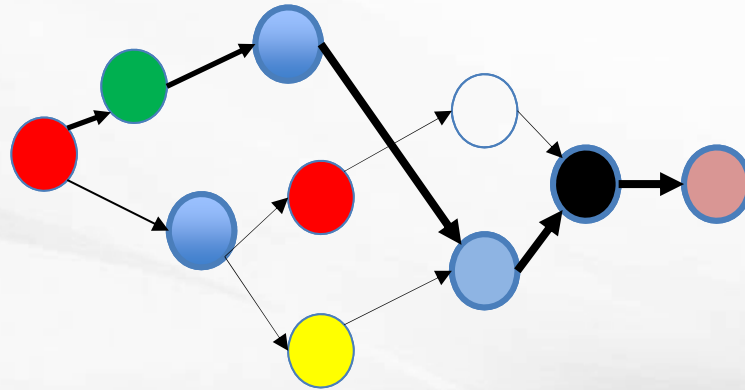
**leverage point (TOCICO Dict. 2012 p 102) — “A point, either physical or logical, where a specific action would provide significant system improvement.” The constraint (critical chain) or core problem (task buffers) are leverage points.**

**A strategic leverage point applies to a more complex system(s) such as a multi-project environment. The staggering resource is the “strategic” leverage point. It provides the capability to plan & release projects to decrease lead time & increase project throughput.**

## 7. Leverage point: Project management

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**CC represents the project constraint and the leverage point for the project.**

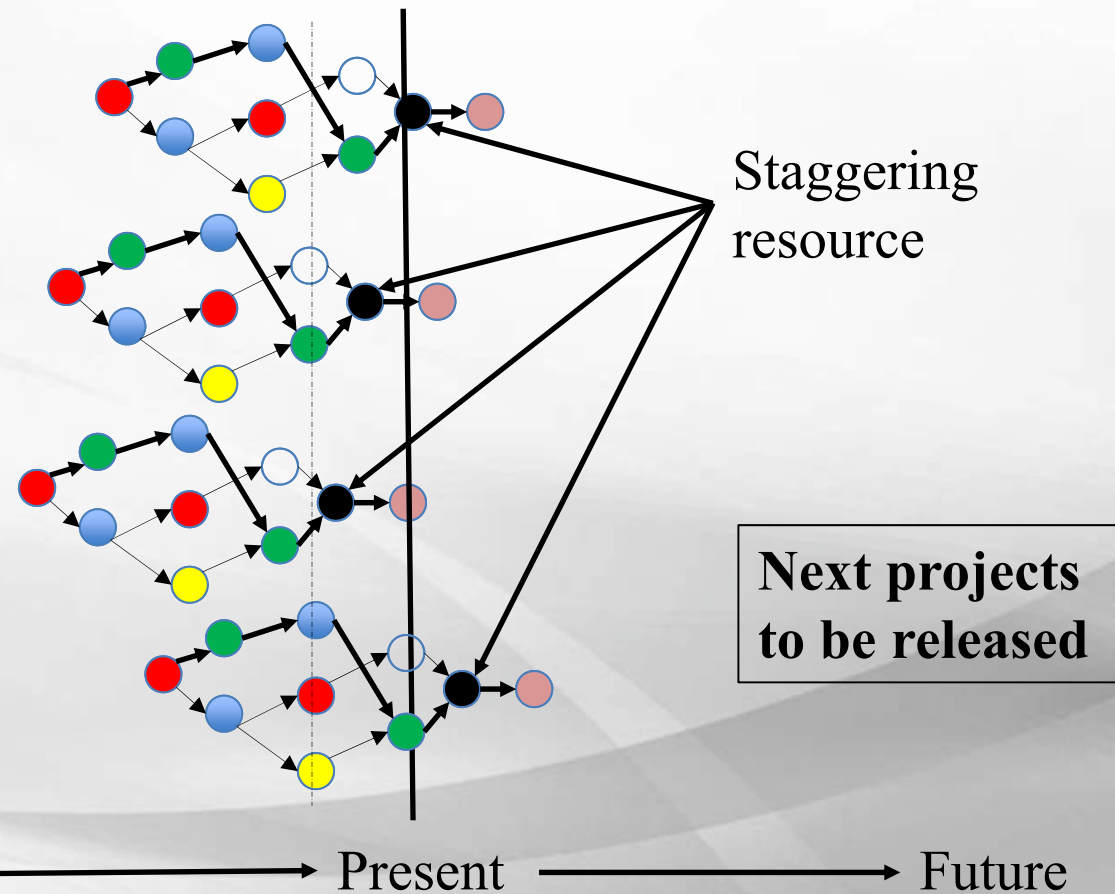


Past → Present → Future

## 7. Strategic leverage point: Multi-project mgnt

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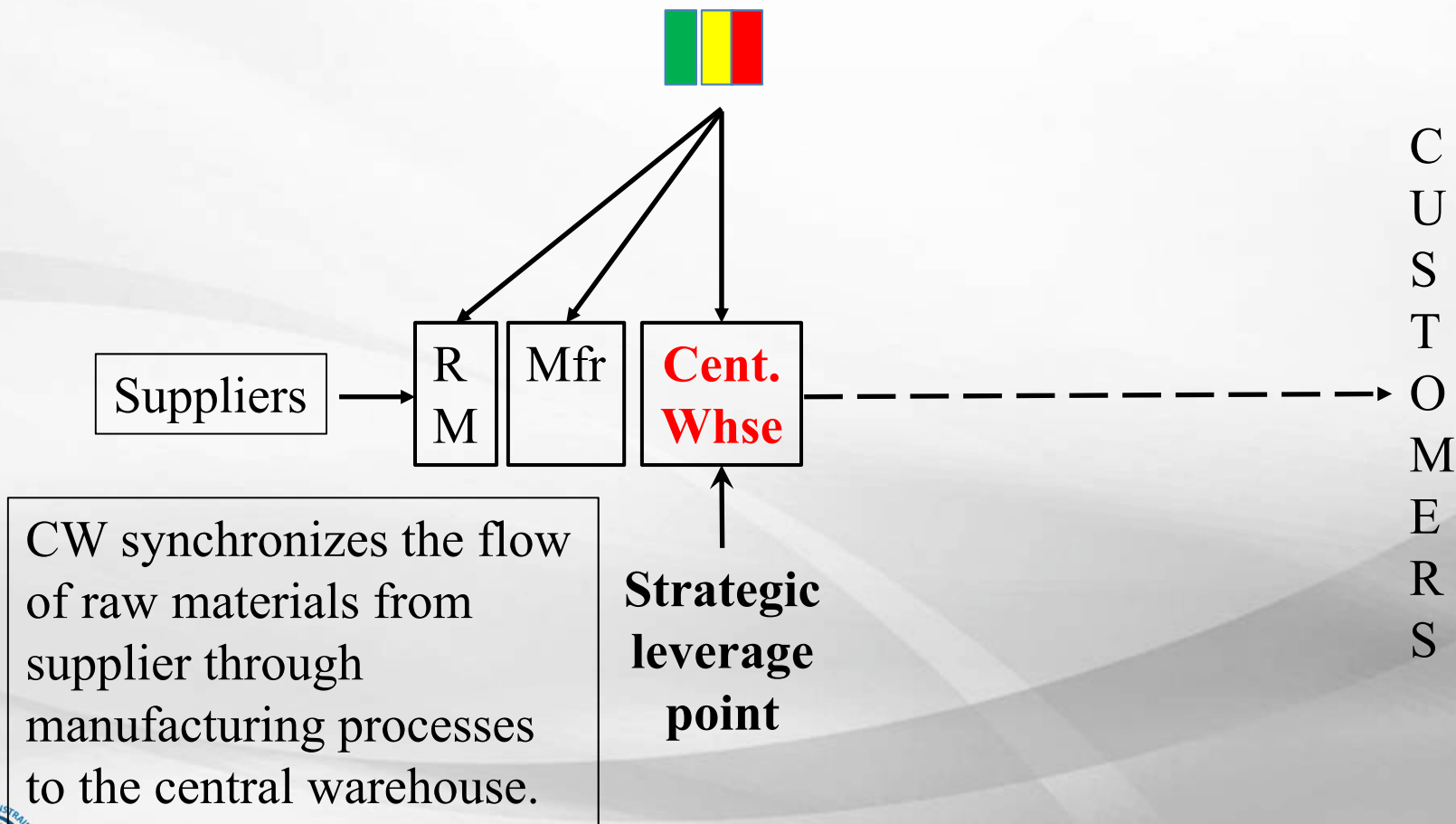
**The strategic leverage point is staggering resource in a multi-project environment. Assume black resource is the integration resource.**



# Leverage point: Central warehouse in manufacturing

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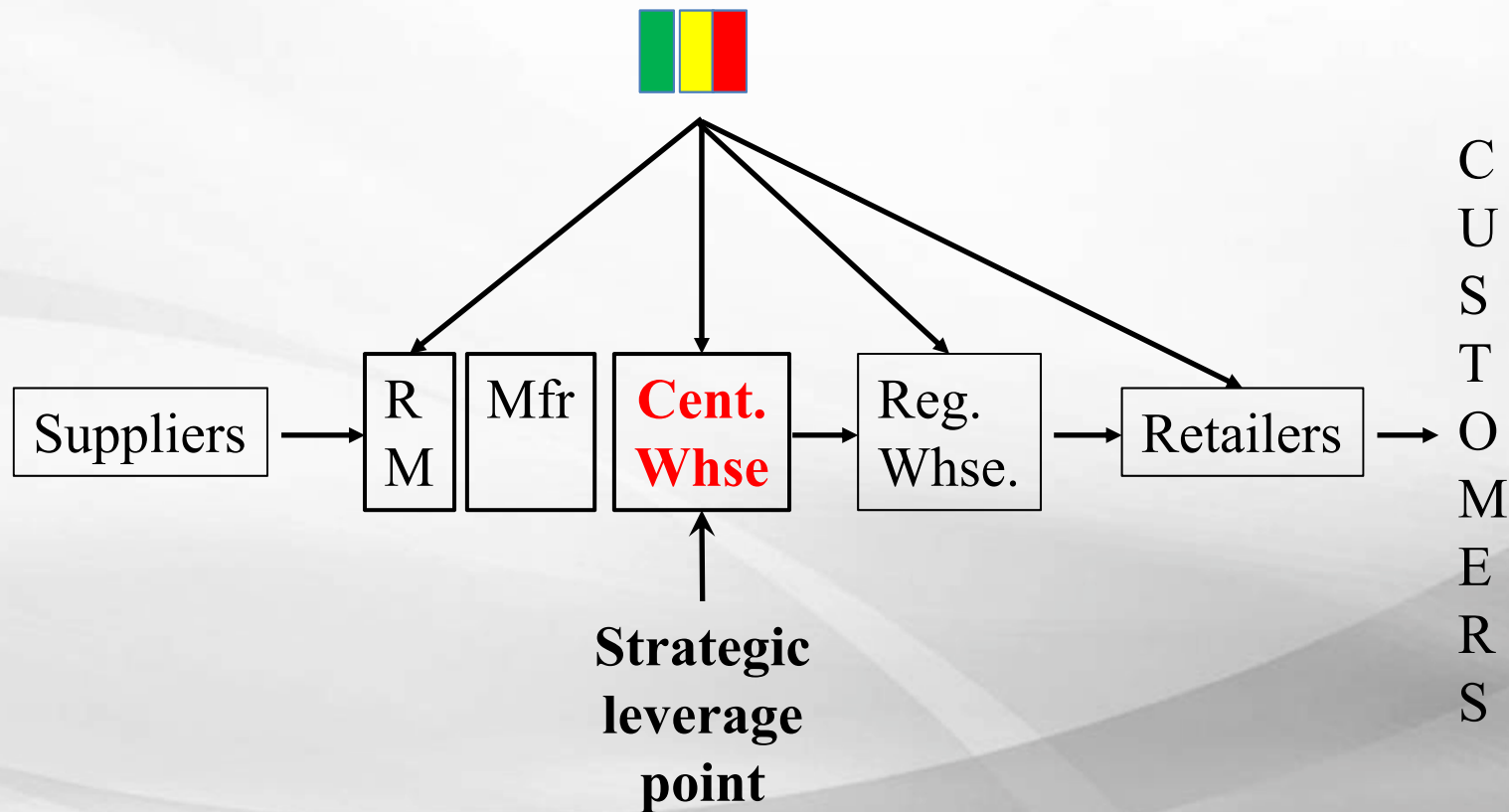
## Unit of analysis is manufacturing



# 7. Strategic leverage point: Supply chain

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Unit of analysis is supply chain



## 8. TOC, POOGI, TP, etc. Why is solving the healthcare & other ISPs so difficult?

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The worst of healthcare environments suffers from chaos.

I define chaos as:

**Chaos = complexity + uncertainty + local optima**

**Where:**

**Complexity** (Goldratt) – having a large number of degrees of freedom (treat symptoms instead of core problems).

**Uncertainty** – knowing events will happen but not when they will happen.

**Local optima** – everyone is being efficient at one's own tasks but not effective as a system.

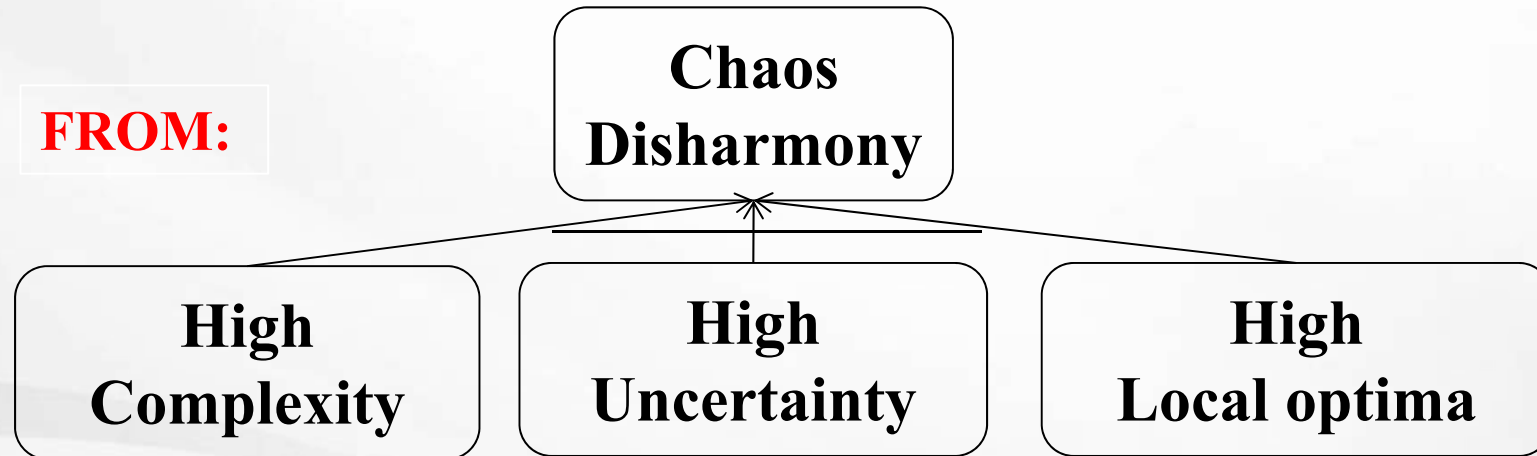


## 8. TOC, POOGI, TP, etc.

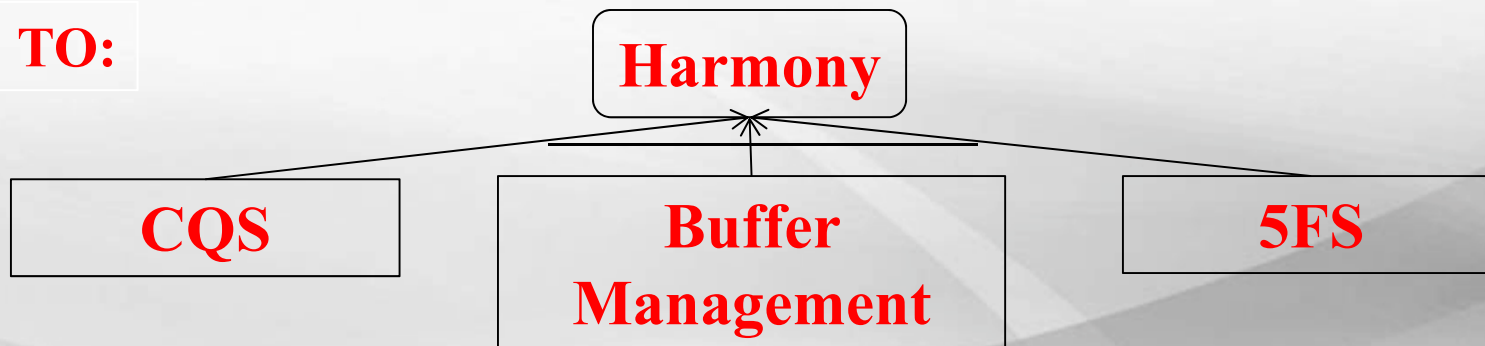
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**To address chaos: Implement the three POOGI!**

**FROM:**



**TO:**







**Let's examine a few examples of these concepts before moving to the strawman solution process for wicked problems.**

# **PUZZLE ANOLOGY Illustrates concepts of Satisficing, Inherent Classification & Simplicity, & Principles of Hierarchal Decomposition & Time-based Dependencies.**

**500  
pieces**



**Objective: Put the puzzle together. How?**





eighty-eight



blue metalmark



buckeye



california dogface



juniper hairstreak



question mark



pavon



red-disked alpine



sagebrush checkerspot



zebra  
swallowtail



kamehameha



mylitta greenwing



sickle winged skipper



monarch



sonoran blue



sara orange tip



wood nymph



golden headed  
sootywing



ocher ringlets



pink-edged sulphur



Actual Size

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of © Mudpuppy

# Inherent classification: How should I sort the pieces to put the puzzle together?

**Hierarchal  
Decomposition**  
System pieces

**Puzzle pieces**

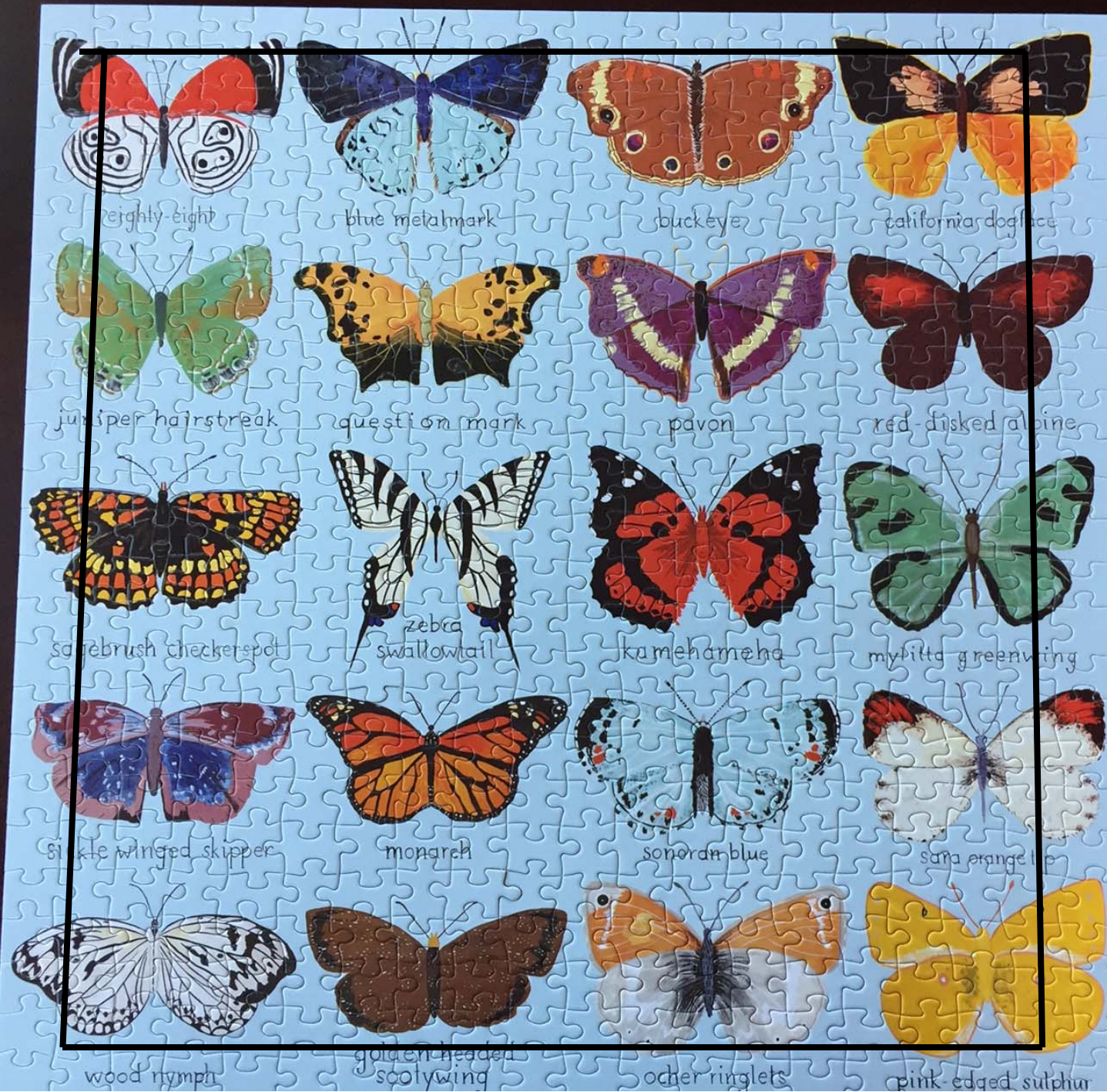
**Exterior**

**Interior**

**Logical units  
of analysis**







# Inherent classification: How should I sort the pieces to put the puzzle together?

**Hierarchal  
Decomposition  
System pieces**

## Puzzle pieces

**Exterior**

- 4 corners
- Top
- Bottom
- Left
- Right sides

**Interior**

Butterflies

20 different  
butterflies

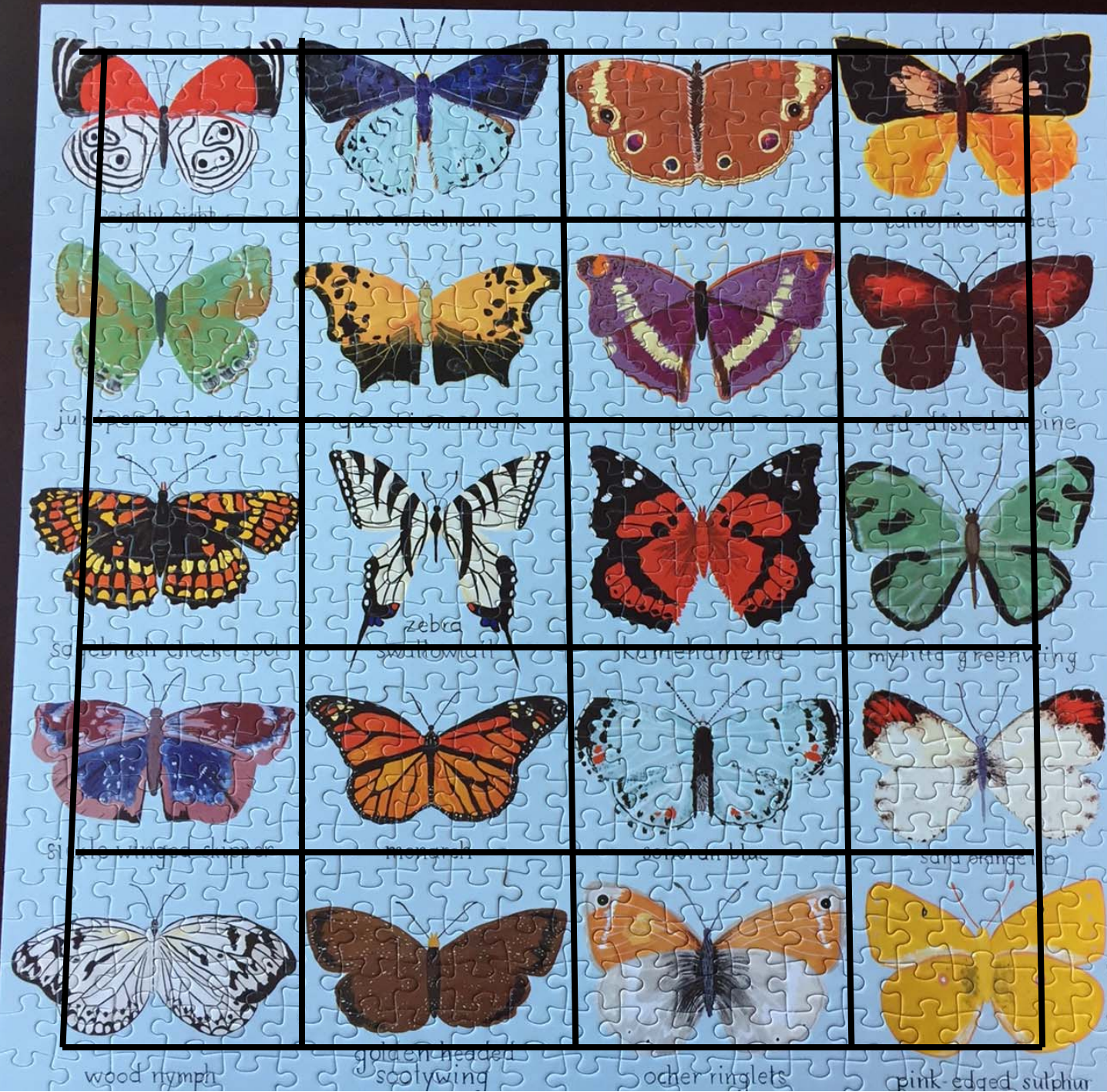
Butterfly position  
in puzzle

Other parts

**Logic units  
of analysis**









# Inherent classification: How should I sort the pieces to put the puzzle together?

**Hierarchal  
Decomposition  
System pieces**

## Puzzle pieces

### Exterior

- 4 corners
- Top
- Bottom
- Left
- Right sides

### Interior

Butterflies

20 different  
butterflies

Butterfly position  
in puzzle

Other parts

Blue w.  
writing

Blue

**Logical unit  
of analysis**



eighty-eight



blue metalmark



buckeye



california dogface



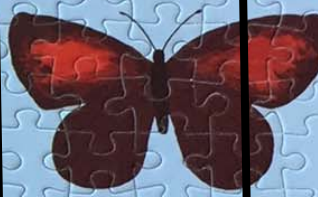
juniper hairstreak



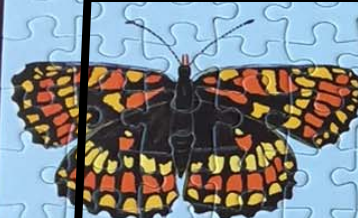
question mark



pavon



red-disked alpine



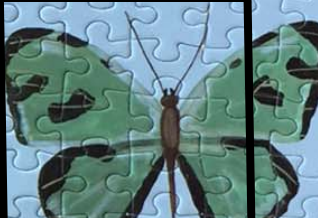
sagebrush checkerspot



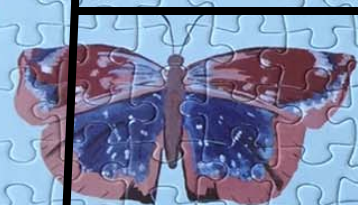
swallowtail



kamehameha



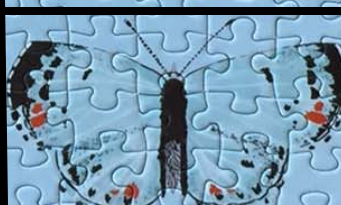
mylitta greenwing



single-winged skipper



monarch



sonoran blue



santa orange



wood nymph



golden-headed  
scolywing



ocher ringlets



pink-edged sulphur



© Mudpuppy





**Put the puzzle together. Using the concepts of inherent simplicity & classification, what unit of analysis should be used in the Principles of Hierarchal Decomposition & Time-based Dependencies?**

**System**



**Satisficing**

**Inherent Classification: What is the classification that achieves the purpose?**  
**Inherent Simplicity: How do I sort the pieces to put the puzzle together?**

**Principle of Hierarchal Decomposition: How do I decompose the parts to put the puzzle together?**

**Logical unit of analysis**



**Principle of Time-based Dependencies**

**How do I determine the sequence?**



# PTD IS example

© Mudpuppy





# Using the PTD, how does one execute the plan to put the puzzle together?

**There are thousands of paths to putting the puzzle together. Inherent Simplicity (IS) What are the causal relationships of the parts to the whole (system)?**

## **EXECUTION**

- 1. Put border together IS**
- 2. Put 20 butterflies separately IS**
- 3. Attach butterflies adjacent to border to the border IS**
- 4. Attach butterflies moving from exterior to interior IS**
- 5. Attach blue with writing to appropriate butterfly IS**
- 6. Put remaining blue pieces in place IS**

**Result: The puzzle is solved!**



eighty-eight



blue metalmark



buckeye



california dogface



juniper hairstreak



question mark



pavon



red-disked alpine



sagebrush checkerspot



zebra swallowtail



kamehameha



mylitta greenwing



sickle-winged skipper



monarch



sonoran blue



sana angel lip



wood nymph



golden-headed scolywing



ocher ringlets



pink-edged sulphur





# WICKED PROBLEM: US healthcare example

2019 TOCICO Webinar

**Stage I: Moving from ISP to WSPs.**

**Stage II: Solving the WSPs.**

# Stage I: ISP to WSPs solution process

2019 TOCICO Webinar

- 0. What is the core problem of the ISP?**
- 1. List the various stakeholders in the ISP environment.**
- 2. Apply the PHD using IC and IS to decompose the ISP into smaller similar (& dissimilar) well-structured problems (WSPs).**
- 3. Apply PTD using IC and IS to sequence the orgs. in a logical (general) process flow starting with first link(s).**

# Stage I: ISP to WSPs solution

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4. **Frame the hierarchal conflicts from upper level to the logical unit of analysis.**
5. **Determine the strategic leverage point to schedule (and execute) the system flow.**
6. **Buffer each link from other links & use BM to synchronize links & reduce buffers (wait times / stocks) between links.**
7. **Subordinate to all stakeholders' necessary conditions.**



# Stage II: ISP to WSPs solution process cont

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- 1. Use / modify existing templates (cases) for appropriate links.**
- 2. Develop templates for missing links: design the planning & execution system for operations based on the strategic constraint & control points.**
  - A. Use the constraint of the current link as the leverage point to plan & control flow from proceeding link, through the link, and to succeeding links.**
  - B. Use buffers & BM between links to synchronize flow across links & reduce wait times /stocks between links.**
  - C. Frame each stakeholder with internal & external ECs to determine how to gain their buy-in.**
  - D. Move staff from engines of disharmony to engines of harmony in developing their new job descriptions.**

# Solution Criteria (Knight, 2014)

1. Satisficing
2. Systems perspective
3. Address the core problem
4. Identify emerging & underlying problems
5. Simple
6. Flexible and responsive to changes
7. Effective as its execution
8. Proactive



Knight, A. (2014, June 8-11). *Keynote address: Improving global healthcare with the Theory of Constraints*. Paper presented at the TOCICO International Conference: 12th Annual Worldwide Gathering of TOC Professionals, Washington, DC.

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# 10,000 foot view then I will paint in some details

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# Stage I: ISP to WSPs solution process

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**0. What is the core problem of the ISP?**

**Core problem is not enough resources to treat all pts.**

**1. List the various stakeholders in the ISP environment.**

**See stakeholder slide.**

**2. Apply the PHD using IC and IS to decompose the ISP into smaller similar (and dissimilar) WSPs.**

**Decompose national environment (Medicare, Medicaid, VA, EMTALA, etc.) to the logical unit of analysis (LUA): hospitals, practices, operating theaters, nursing homes, etc.**

**BLACK = GENERIC PROCESS**

**RED = HC PROCESS.**





# Stage I: ISP to WSPs solution process cont

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**3. Apply PTD using IC and IS to sequence the orgs. in a logical (general) process flow starting with first link(s).**

**The PCPP and ED (AU) are the major first links in the healthcare network, treat pts then refer pt to the next link.**

**4. Frame the hierarchal conflicts from upper level to the logical unit of analysis.**

**Frame the national, state, county, community, etc. conflicts with local unit of analysis. What restrictions are placed on the local units?**



# Stage I: ISP to WSPs solution process cont

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**5. Determine the strategic leverage point to schedule (and execute) the system flow.**

**The PCPP & ED assessment unit are the gateway to the remaining healthcare network and determine the pt's next link. Each link after the first, determines pts. next link.**

**6. Buffer each link from other links & use BM to synchronize links & reduce buffers between links.**

**The buffer is the pt wait times till appt. Proceeding link refers; succeeding link accepts appt based on BM. What are the problems in the pt. flow for major flows.**

**7. Subordinate to all stakeholders' necessary conditions.**

**Links, pts, appts, etc. meet stakeholders' necessary conditions.**



# Stage II: WSP solution process

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1. Use / modify existing templates (cases) for appropriate links.
  - **Tim & Laurie Robinson: Primary care case study.**
  - **Knight: ED, assessment unit, acute, community and mental health hospitals, outpatients operating theatres, care at home/in the community, logistics across the whole health & social care system. See Pride and Joy for a discussion of these solutions.**
  - **Arganguren, Maria & 6 other presentations: Emergency dept.**
  - **Wadhwa and Bacelar MDs: Surgical specialty cases.**
  - **Mabin: Cancer treatment and nursing home decision.**
  - **Groop: Home healthcare using TOC supply chain solution.**
  - **Ronen et al. and Inozu, et al. TOC healthcare texts.**
  - **Cox: Generic template for PASS based on PCPP and literature.**

**Many of these references (and other TOC healthcare references) are available in the TOCICO video conference proceedings; others are books or articles.**



# A simple, effective, comprehensive & generic solution.

2019 TOCICO Webinar

**Alex Knight viewed healthcare similar to a supply chain applied TOC tools to the various links. In his book, Pride and Joy Alex presents TOC solutions for:**

- **Emergency Department**
- **Assessment unit**
- **Acute, Community and Mental Health hospitals**
- **Outpatients**
- **Operating theatres**
- **Care at home/in the community**
- **Logistics across the whole health & social care system.**

Knight, A. (2014b). Pride and joy. Church Farm, Aldbury, Hertz, UK, Linney Group Ltd.

Available on Amazon.



# Stage II: WSP solution process (cont)

2019 TOCICO Webinar

**2. Develop templates for missing links: design the planning & execution system for operations based on the strategic constraint & control points.**

- A. Use the constraint as the leverage point to plan & control flow from proceeding link, through the link, and to succeeding links.**
- B. Use buffers & BM between links to synchronize flow across links & reduce pt. wait times between links.**
- C. Frame each stakeholder with internal & external ECs to determine how to gain their buy-in.**
- D. Move staff from engines of disharmony to engines of harmony in developing their new job descriptions.**

# Detailed healthcare example of converting the ISP of healthcare to WSPs using the solution process

# 0. What is the core problem of the ISP?

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## Global perspective (Knight 2009)

An org. must  
A Run an effective  
healthcare system.

Medics/managers are  
B Required to give the best  
(appropriate) medical treatment  
to those they are now treating.

Medics / managers  
should D Act only upon  
medical considerations.

**Organizations don't have enough  
resources to provide excellent  
healthcare to all patients.**

Medics/managers are  
C Required to treat all pts  
in a more timely manner.

Medics / managers should  
D' Act more and more with-  
in budget considerations.

**DD' assumption: More & better healthcare  
cannot be provided with current resources.**

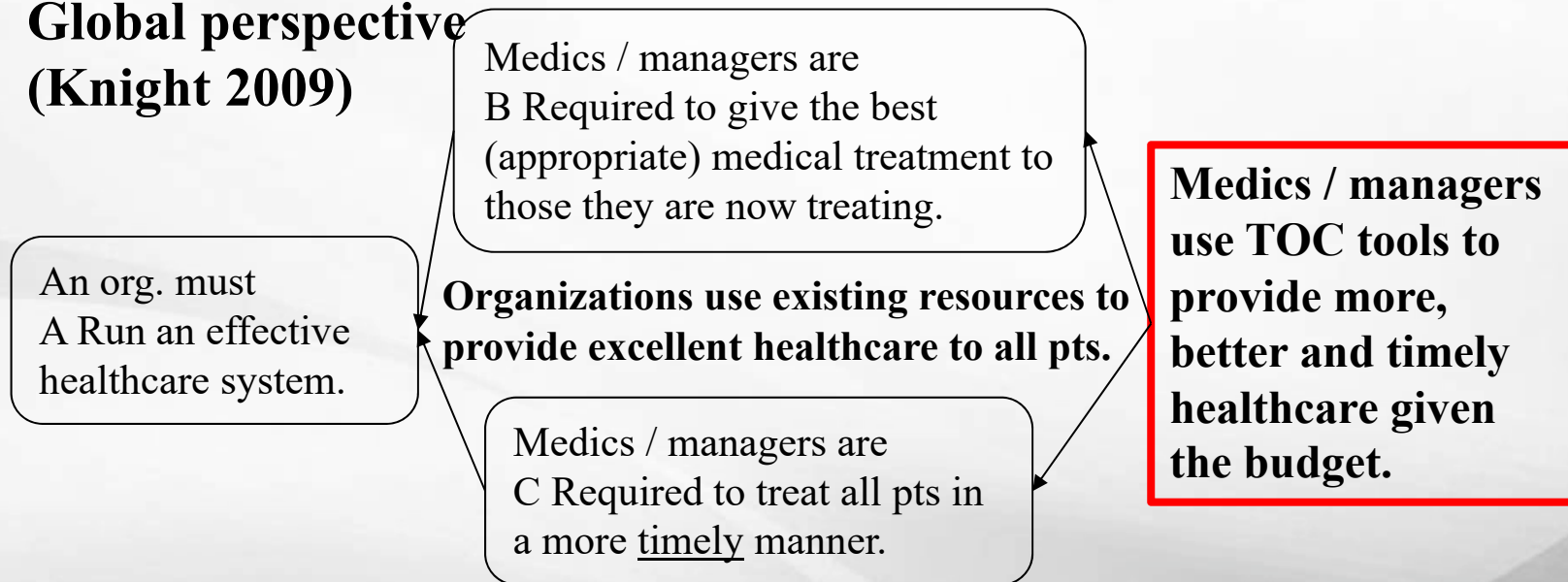
Knight, A. (2009). Theory of constraints: Proven beyond doubt in reality. First European TOCICO Regional Conference, Amsterdam, The Netherlands, Goldratt Marketing Group.





# 0. The ISP solution is simple, comprehensive, effective and generic.

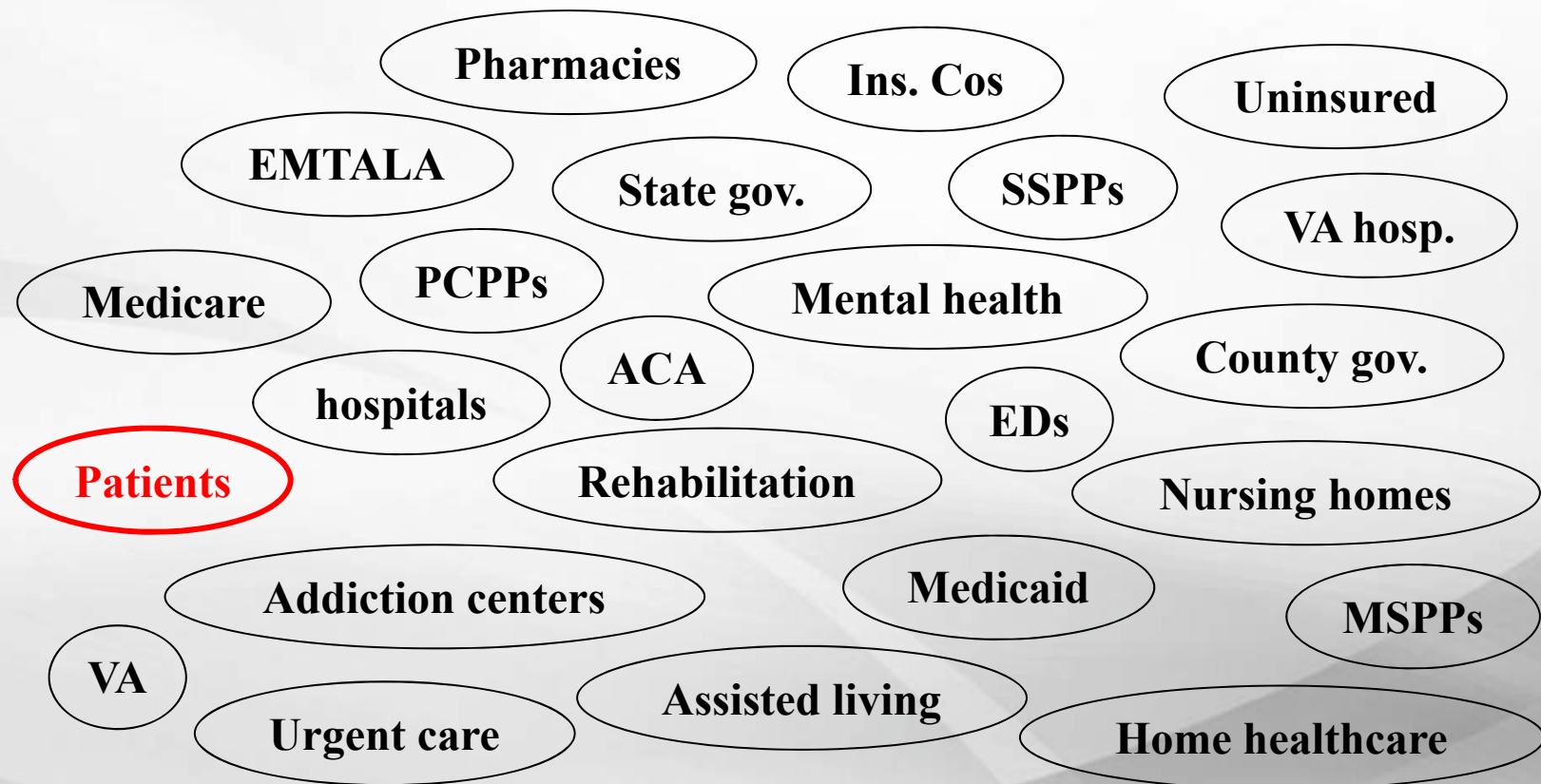
## Global perspective (Knight 2009)



**DD' Injection: Use TOC tools to provide more, better & timely healthcare given the budget.**

Knight, A. (2009). Theory of constraints: Proven beyond doubt in reality. First European TOCICO Regional Conference, Amsterdam, The Netherlands, Goldratt Marketing Group.

# 1. List the various stakeholders in the ISP environment.



## 2. Apply PHD using IC and IS to decompose the ISP (vertical) into smaller similar well-structured problems (WSPs).

**Federal**

ACA, Medicare, Medicaid, VA, EMTALA, Ins. Cos., etc.

**State**

State gov. 50 states

**County**

County gov. 159 counties

**Local**

**Patients**

hospitals

Mental health

EDs

VA hosp.

PCPPs

Rehabilitation

Nursing homes

Addiction centers

Pharmacies

MSPPs

SSPPs

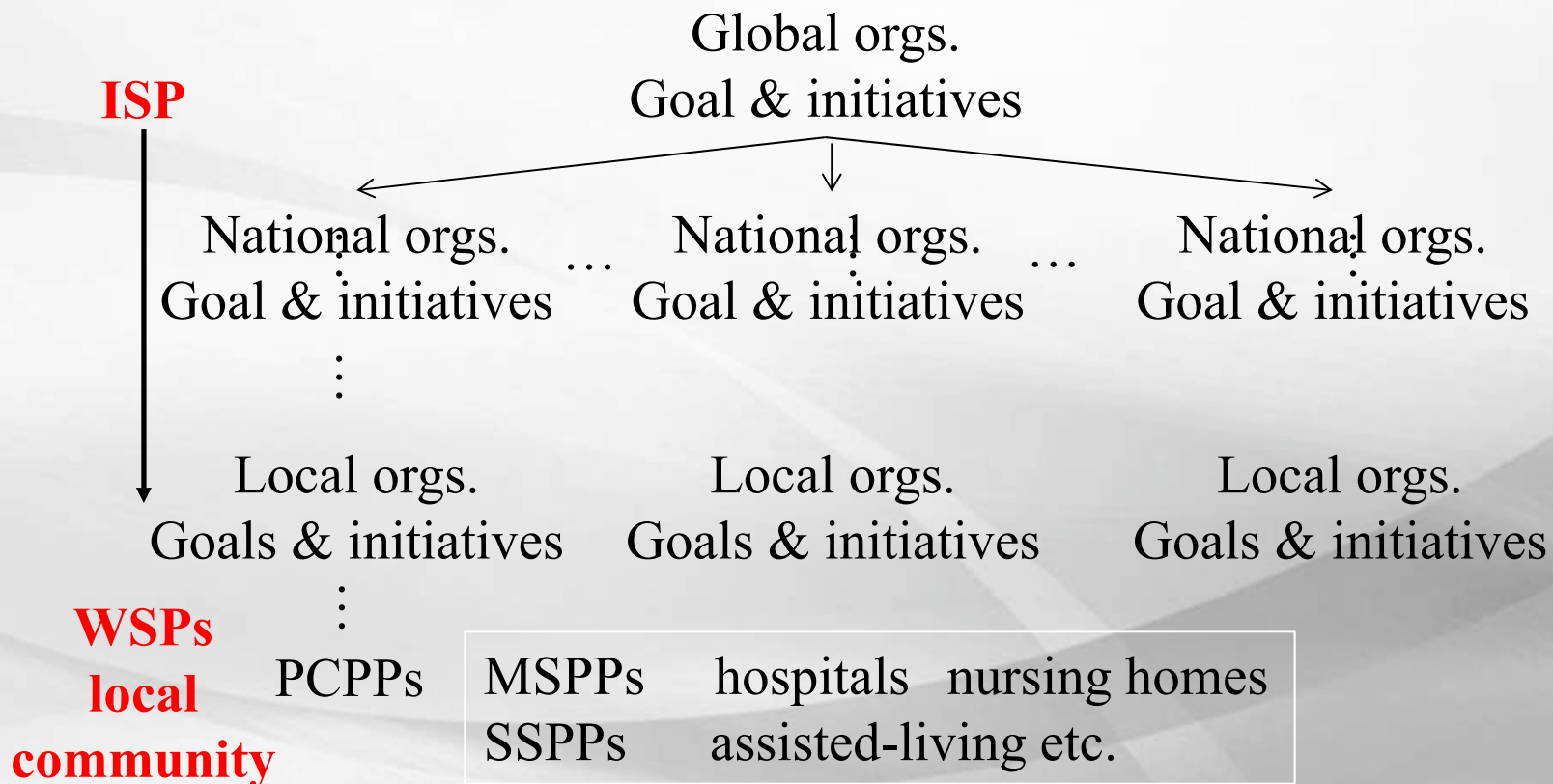
Urgent care

Assisted living

Home healthcare

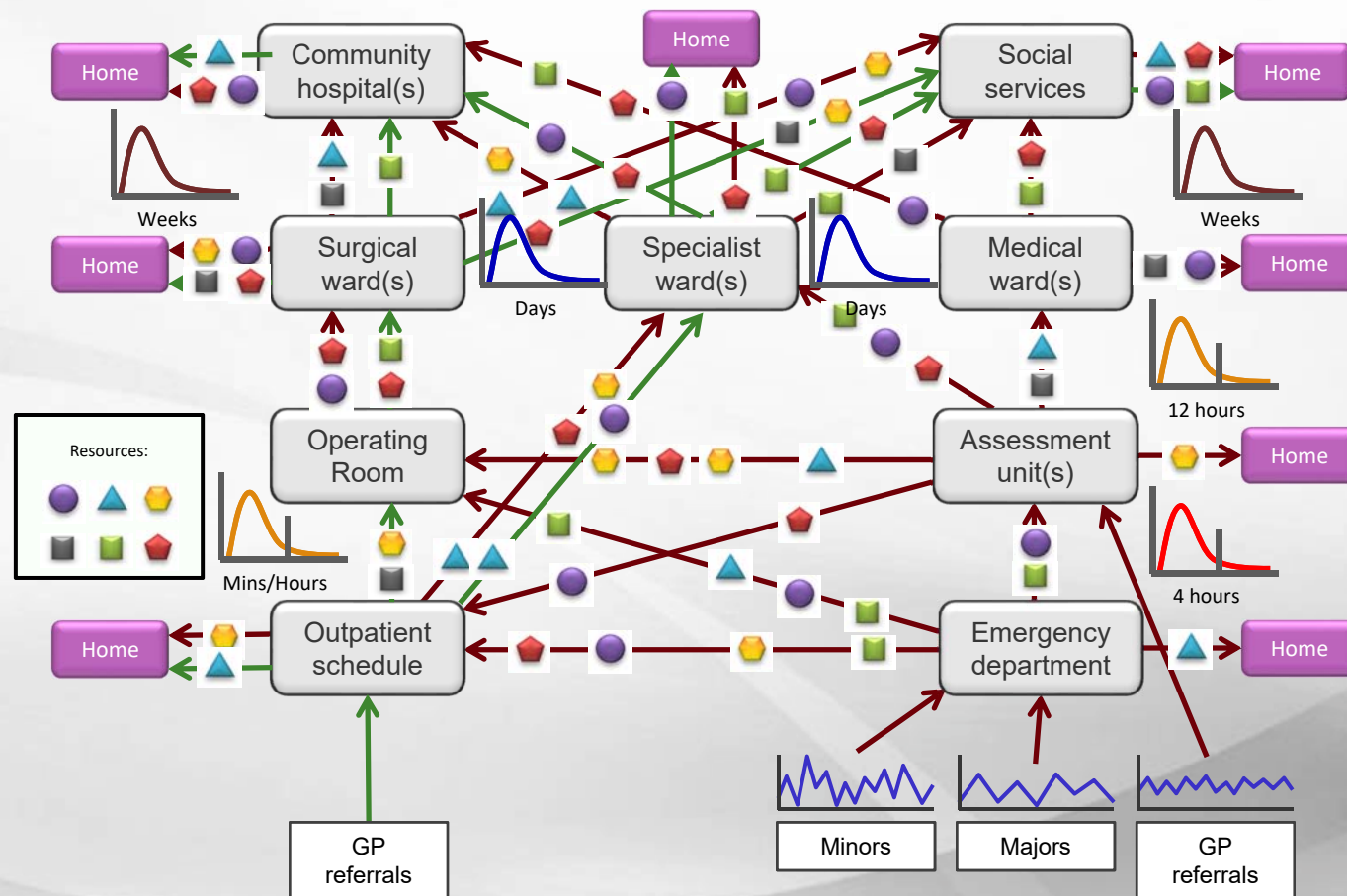
## 2. Apply PHD using IC & IS to decompose the ISP vertically into smaller similar WSPs.

Healthcare units are geographically causally related:  
national to state to county to community.





### 3. Knight's PTD: Apparent complexity of the acute environment eliminated (horizontal sequencing).



Used with permission of © Alex Knight

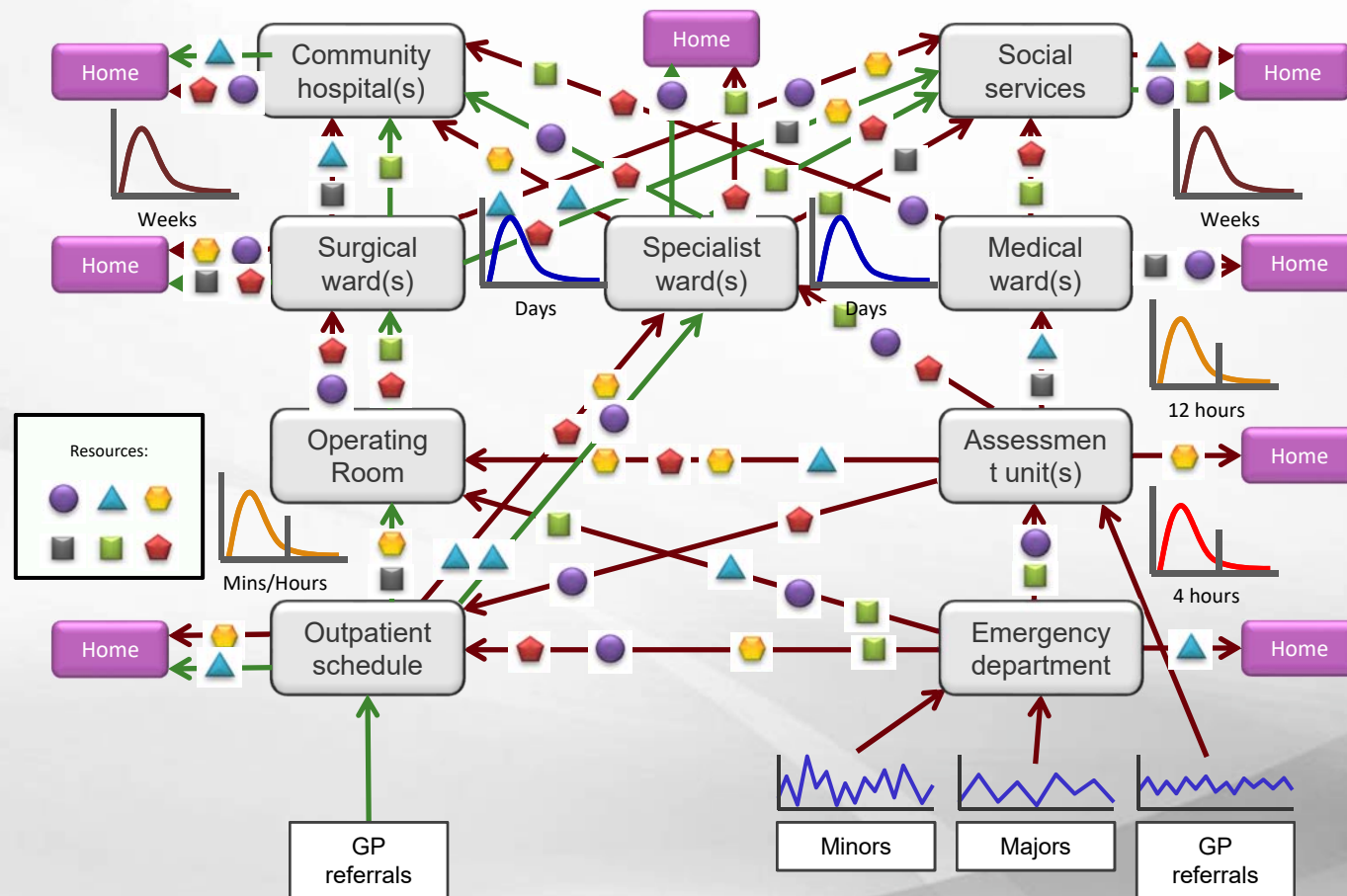


Knight, A. (2014a). Keynote address: Improving global healthcare with the theory of constraints. TOCICO International Conference: 12th Annual Worldwide Gathering of TOC Professionals, Washington, DC, Theory of Constraints International Certification Organization.

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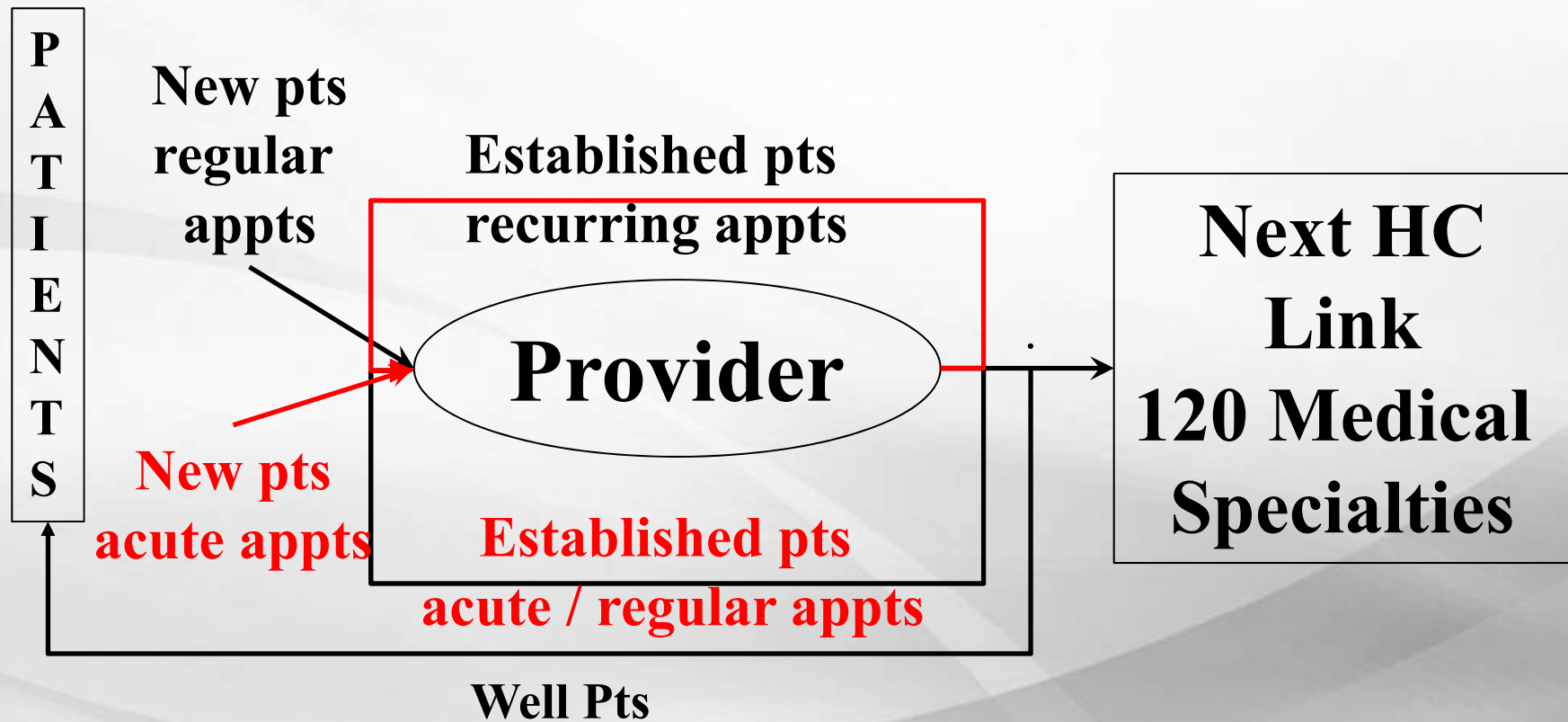
# BM addresses the apparent complexity of the acute environment

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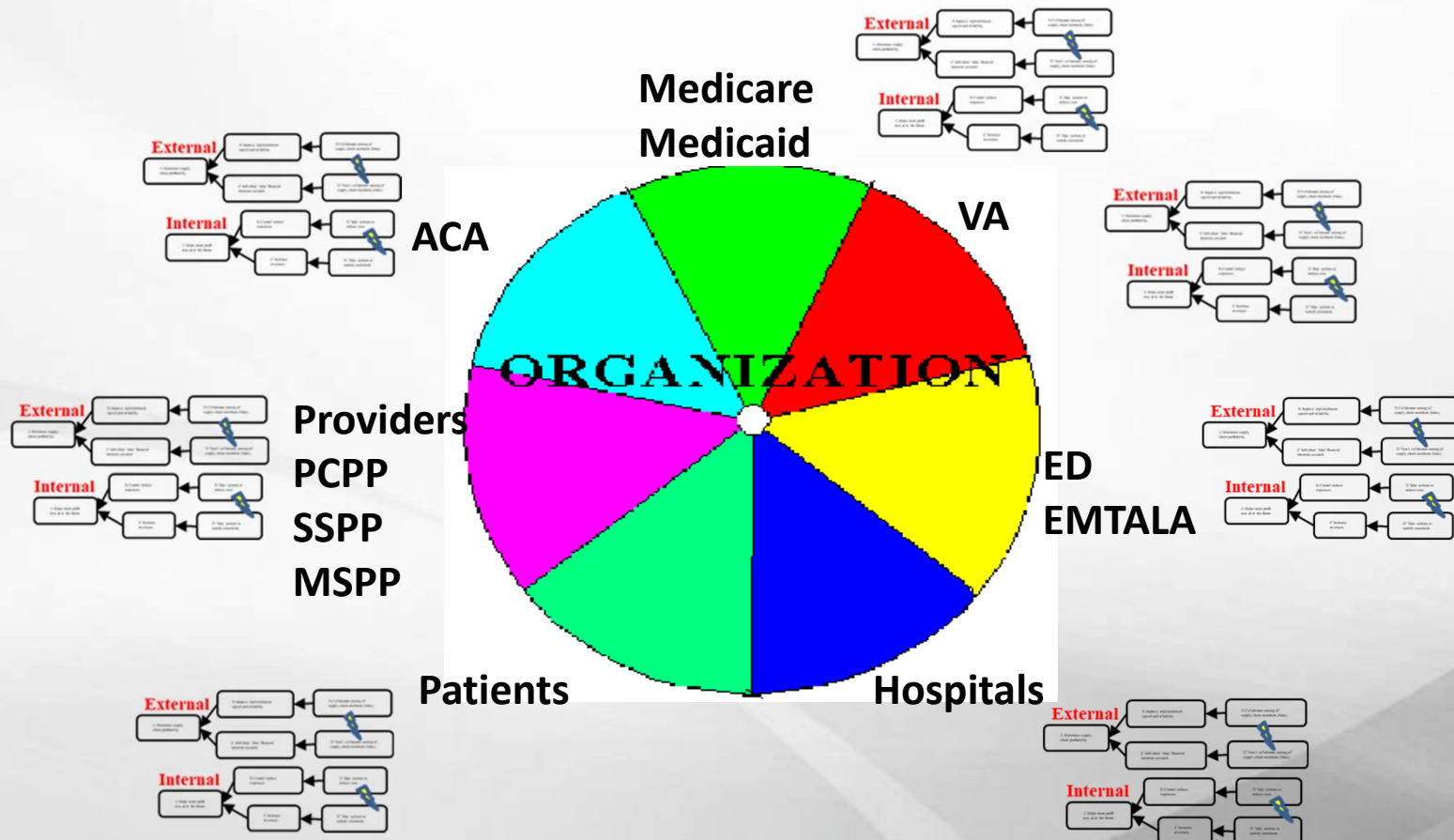


Used with permission of © Alex Knight

### 3. Apply PTD using IC and IS to sequence the orgs. in a logical (general) process flow starting with first link(s).



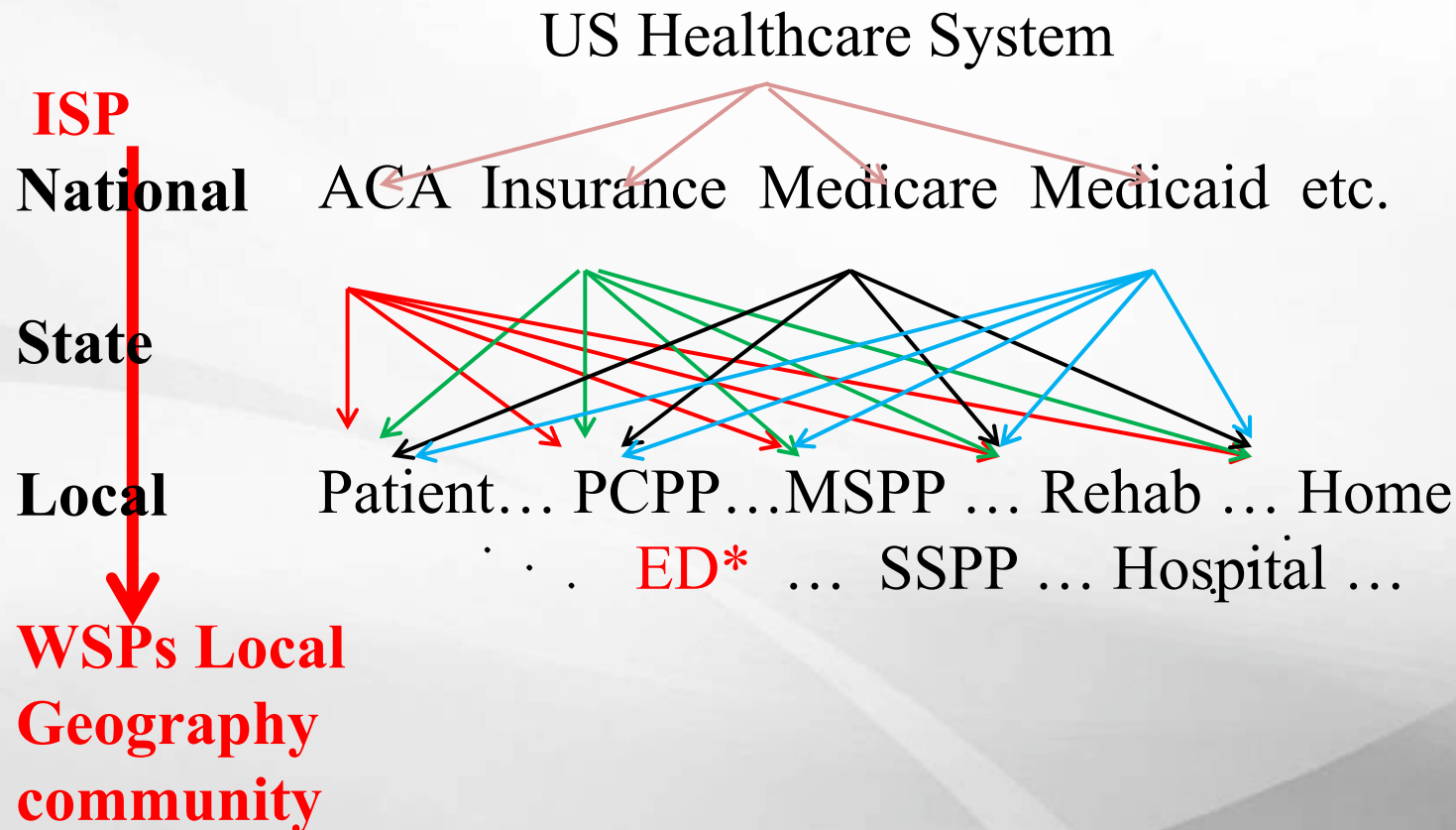
## 4. Frame (internal and external frames) the hierarchal conflicts from upper level to logical unit of analysis.



**Stakeholder frame: Views each problem in isolation from only his perspective. Blames others for problem.**



## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



Stakeholders place various necessary conditions on pts & providers in order to achieve that stakeholder's org. goal.

#### 4. Frame (external and internal ECs) the hierarchal conflicts from upper level to logical unit of analysis.

**Insurance:** Profits are decreasing! Why? Costs increasing!

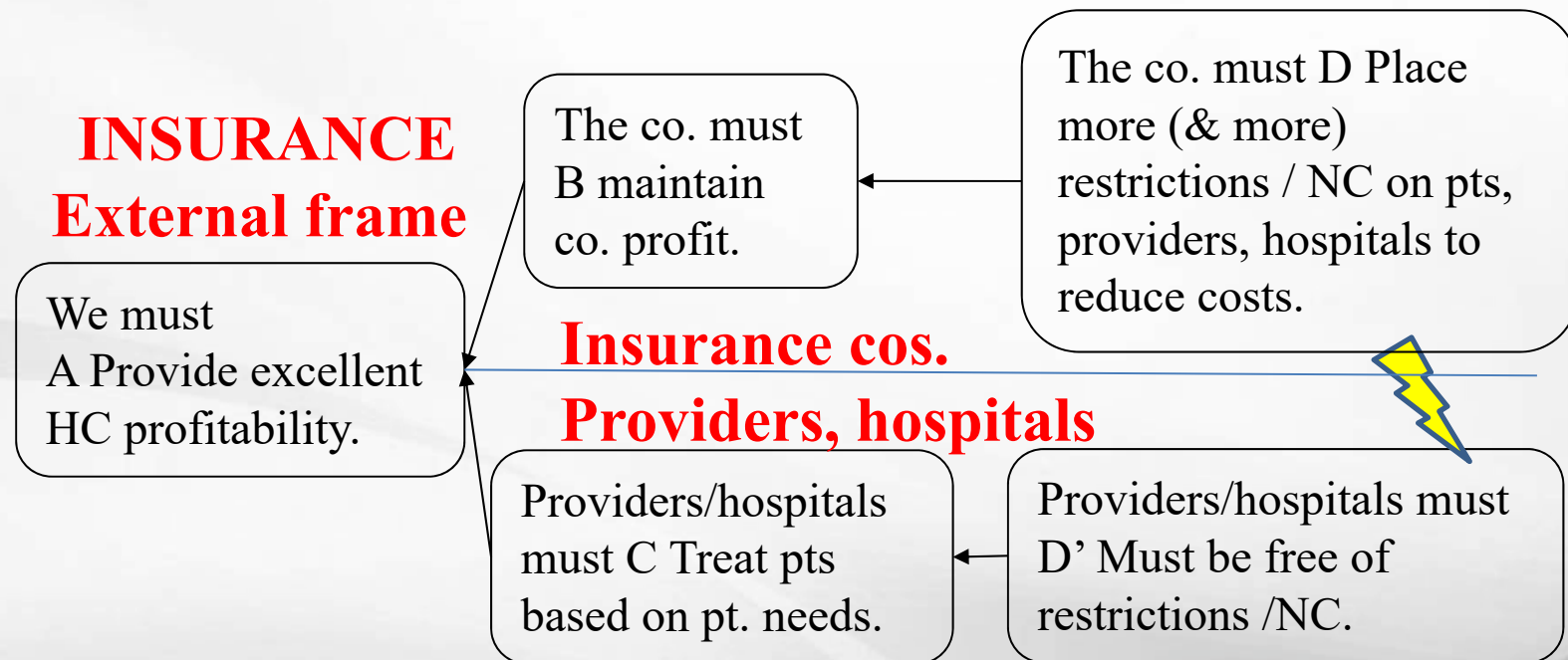
- Actions: Raise customer premiums & deductibles. Add treatment restrictions, admin. paperwork & decrease provider / hospital payments.

**Government:** Costs increasing! Fraud exists.

- Actions: Raise patient premium payments. Add treatment restrictions, admin. paperwork & decrease provider reimbursements. Penalties for non-compliance.

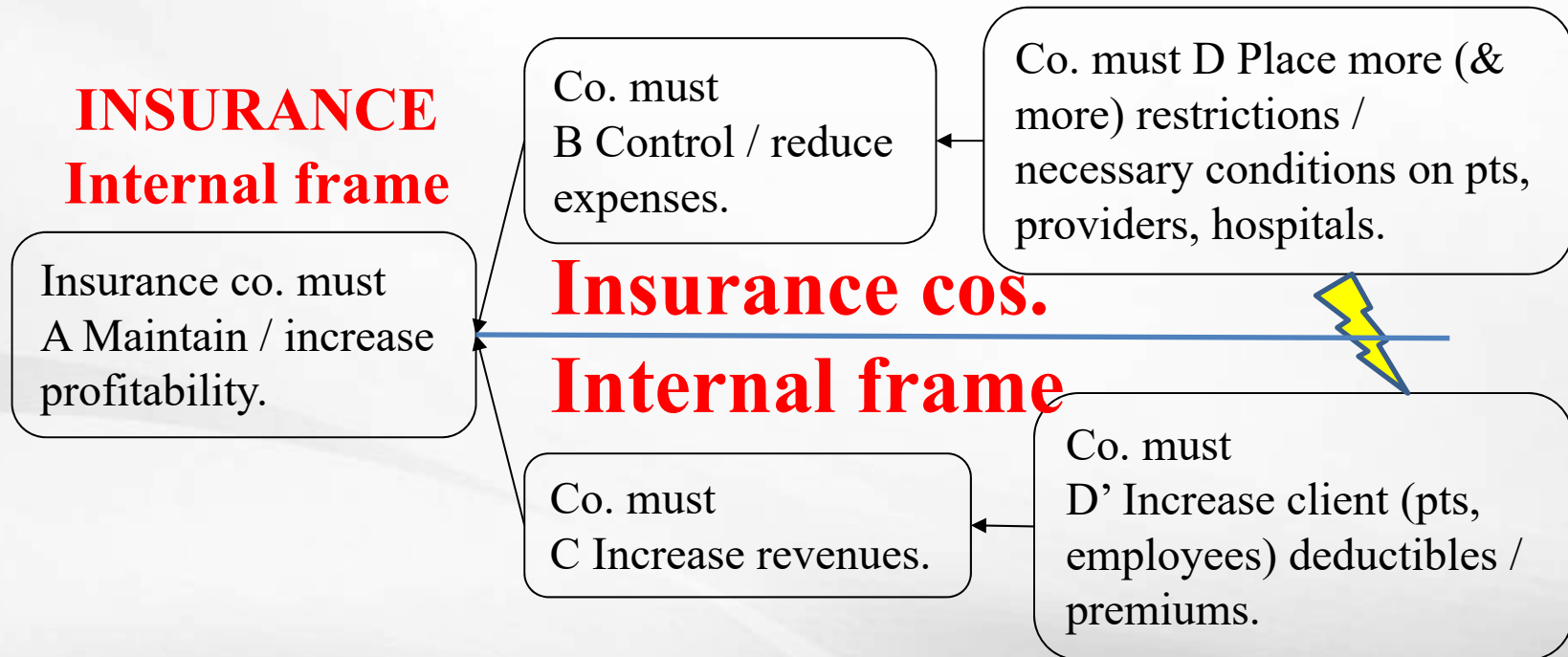
...

## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



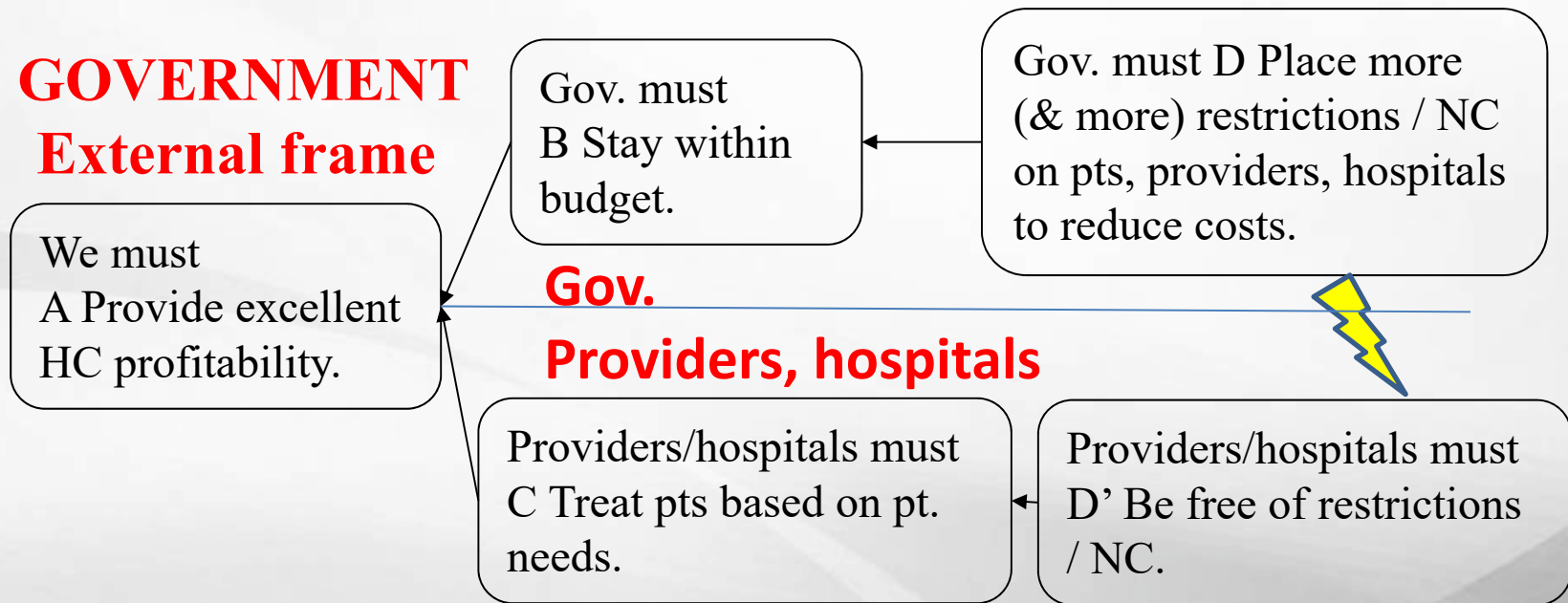
DD' assumption: Insurance cos. do both D & D' to increase profits: place tighter restrictions (on pts, providers, hospitals) wrt treatment, reduce reimbursements (providers, hospitals), increase premiums (on pts, employers).

## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



Results: Insurance cos. do both D & D' to increase profits. place tighter restrictions (on pts, providers, hospitals) wrt treatment, reduce reimbursements (providers, hospitals), increase premiums (on pts, employers).

## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



**DD' assumption:** Gov. does D & D' to stay within budget: place tighter restrictions (on pts, providers, hospitals) wrt treatment, reduce reimbursements (providers, hospitals), increase premiums on pts.

**Result:** Some providers no longer accept Medicare, Medicaid, etc.



## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.<sup>1</sup>

### GOVERNMENT Internal frame

Gov. must  
A Meet its citizens'  
needs efficiently.

Gov. must  
B Stay within a  
diminishing budget.

Gov. must  
D Decrease funding  
to & cut programs.

### **DIMINISHING BUDGET** **GROWING NEEDS**



Gov. must  
C Meet the growing/  
changing needs of its  
citizens.

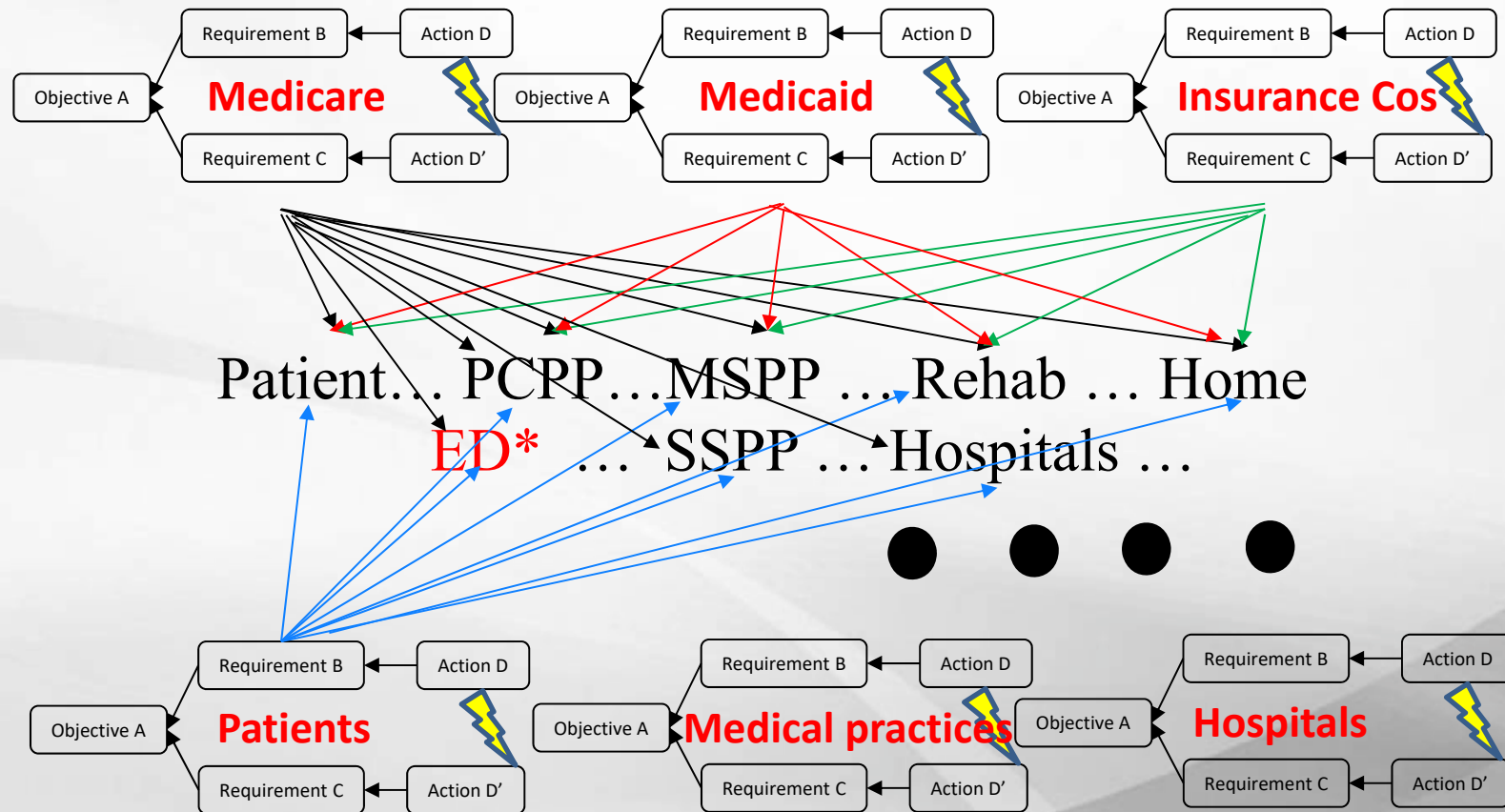
Gov. must  
D' Increase funding  
to existing & new  
programs.

**DD' assumption:** Gov. cannot stay within its diminishing budget while meeting the growing needs of its citizens.

Barnard discusses external and internal EC but does not call them by these names. <sup>1</sup>Barnard, A. (2013). Creating breakthrough solutions using the change matrix cloud (CMC). TOCICO Webinar Series. TOCICO, Theory of Constraints International Certification Organization.

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## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



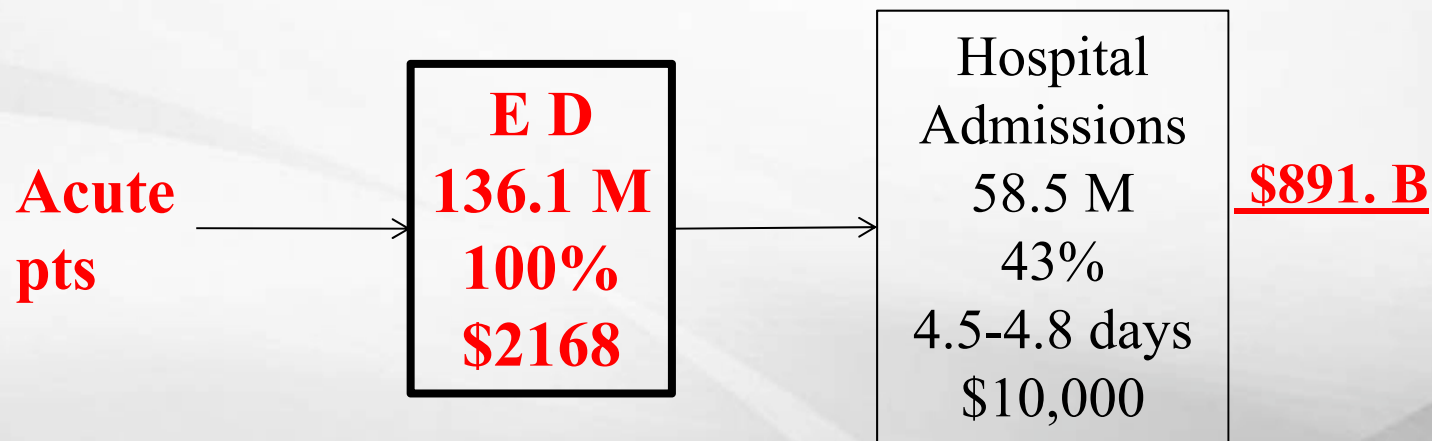
## **4. Frame the hierarchal conflicts from upper level to logical unit of analysis.**

**UDE: Poor people were turned away at the ED because they couldn't pay for treatment.**

**INJ: National level (1986): The Emergency Medical Treatment and Labor Act (EMTALA) is a federal law that requires anyone coming to an ED to be stabilized and treated, regardless of their insurance status or ability to pay. It is enforced but was not funded.**

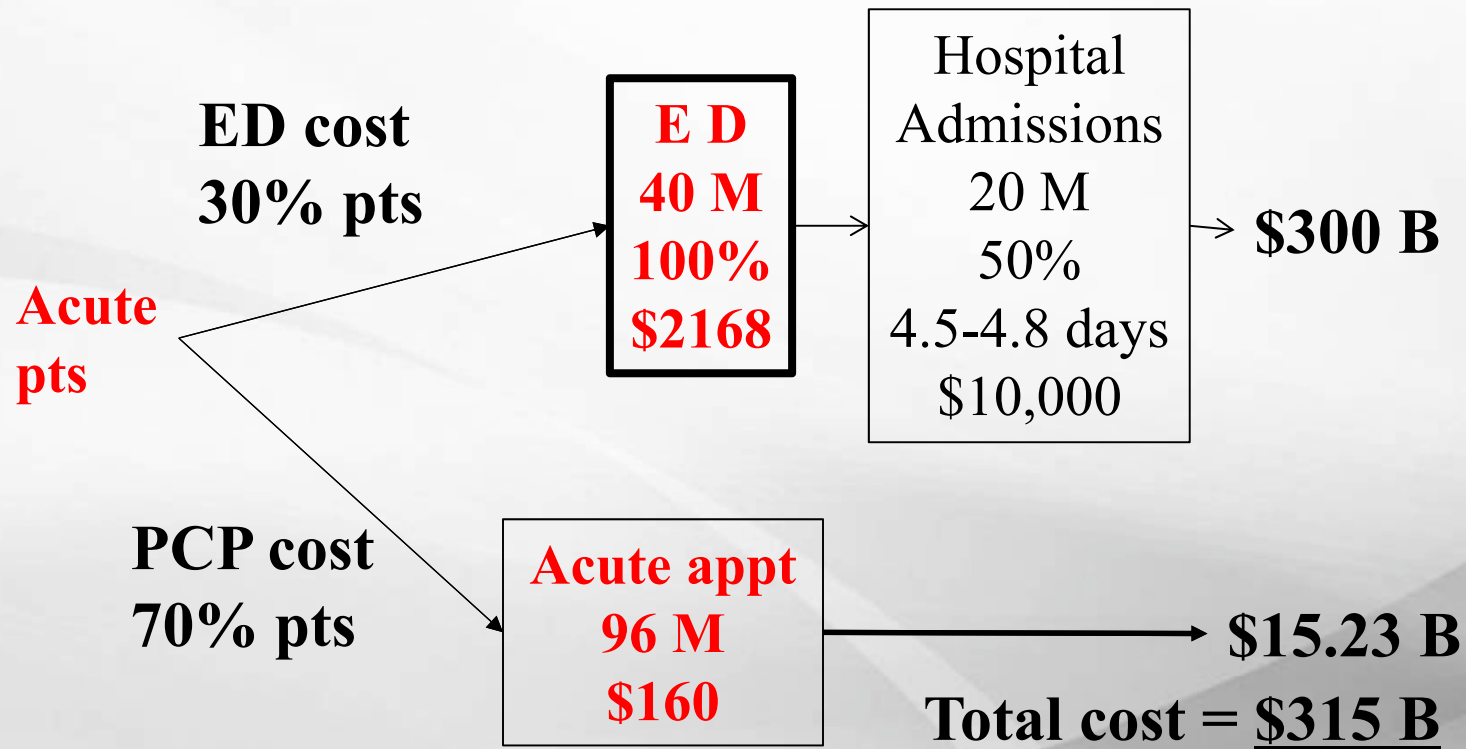
#### 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.

**US annual healthcare cost = \$3.5 trillion!**



**70+% of ED visits are avoidable if the pt had seen a PCP in a timely manner.**

## 4. Frame the hierarchal conflicts from upper level to logical unit of analysis.



Annual savings = \$891 B – 315 B = **\$576 B**



# MACRO-VIEW: US HEALTHCARE

## Q2. WHAT TO CHANGE?

**What is the result of long lead times? The no-show problem!**

**“A recent MGMA study found that even well run practices have a daily average of 12 percent no-shows & last-minute cancellations. Some practices actually experience a whopping 50 percent rate.”**

**Why do patients no show?**

**The appt is not timely; it is next week!!! “I am sick & need to see my doctor now.”**

Cox, Tom. One way to solve the no-show problem. Medical Practice Insider. January 26, 2015  
<http://www.medicalpracticeinsider.com/best-practices/one-way-solve-no-show-problem>



# **MACRO-VIEW: US HEALTHCARE**

## **Q2. WHAT TO CHANGE?**

**Where do these no-show patients go for timely healthcare?**

- **Emergency Department?**
- **Another provider?**
- **Urgent care?**
- **Pharmacy?**
- **Etc.?**

## **5. Determine the strategic leverage point to schedule (and execute) the system flow.**

**The PCPP & ED(AU) are the strategic leverage points (the gateway) to the whole US healthcare system.**

## Q2. What to change?

### Physician Specialty

### Appt. Wait (days)

**Family Practice** – A routine physical.

54

**Cardiology** – A heart check-up.

32

**Dermatology** – A routine skin exam to detect possible carcinomas/ melanomas.

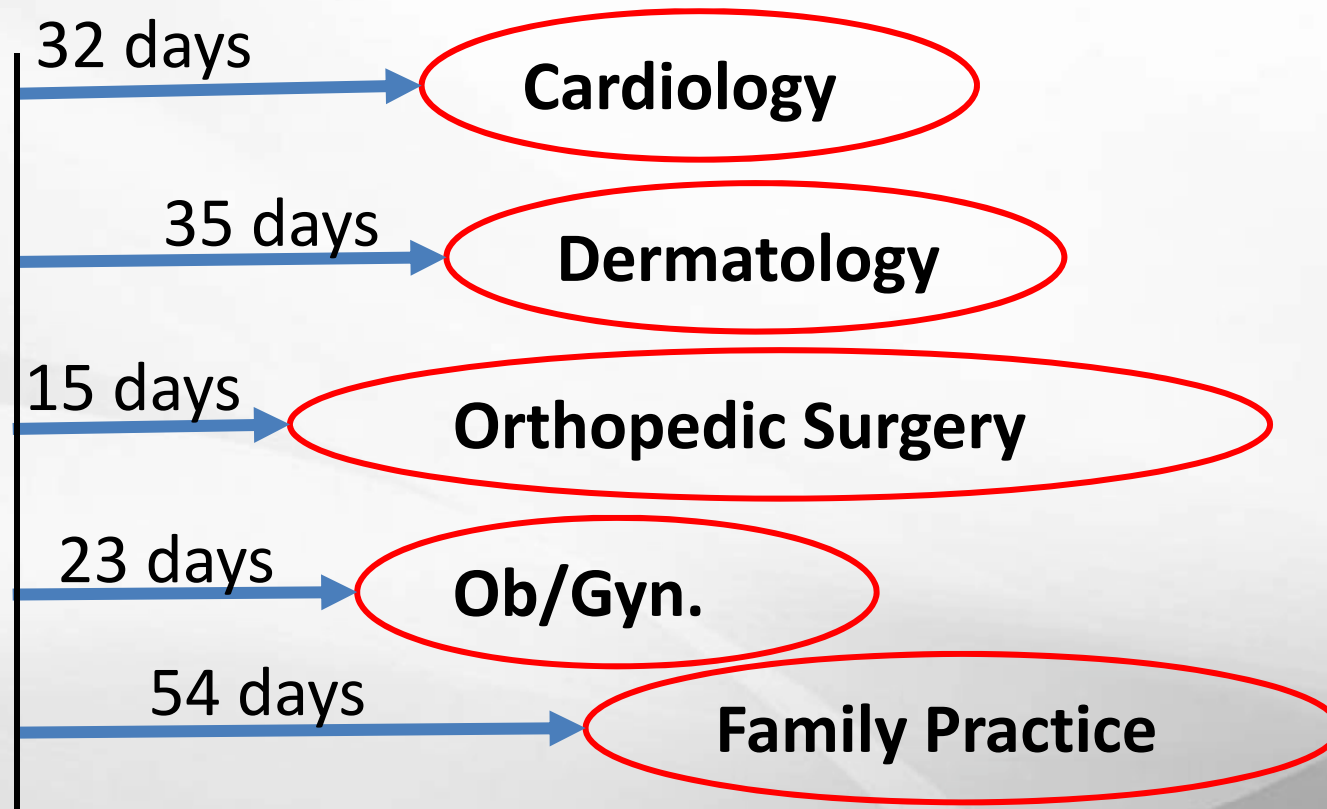
35

**Orthopedic Surgery** – Injury or pain in the knee. 15

**Ob/Gyn.** – A routine “well-woman” gyn. exam. 23

Merritt Hawkins (2017). 2017 Survey of physician appointment wait times. Dallas, TX, Merritt Hawkins.

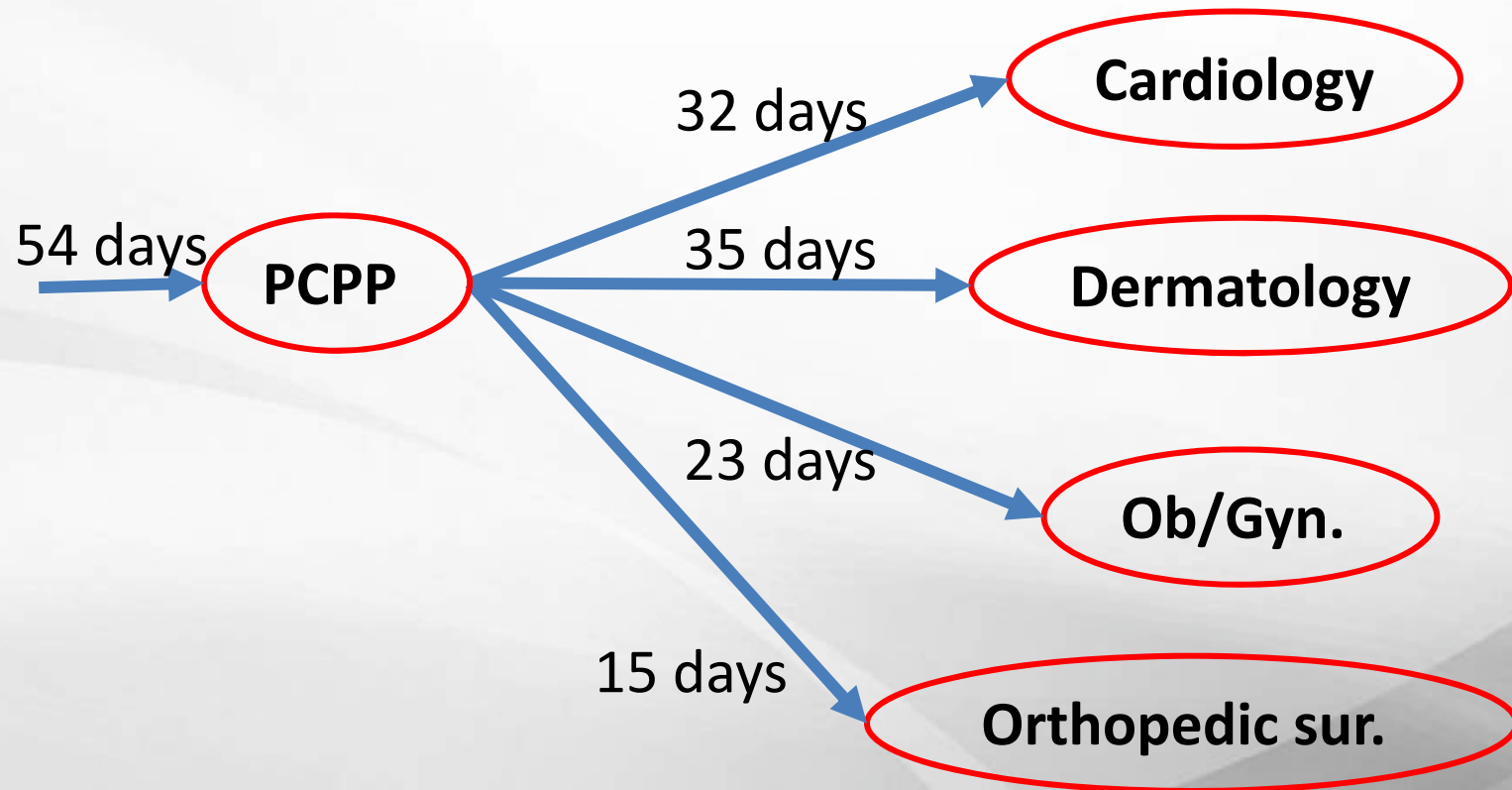
## Q2. What to change?



Merritt Hawkins (2017). 2017 Survey of physician appointment wait times. Dallas, TX, Merritt Hawkins.



## Q2. What to change?



Merritt Hawkins (2017). 2017 Survey of physician appointment wait times. Dallas, TX, Merritt Hawkins.

## Q2. What to change?

### No-show rate for common healthcare specialties

• Primary Care	20%
• Pediatrics	30%
• OB/GYN	18%
• Dermatology	30%
• Ophthalmology	22%
• Dentistry	15%
• Optometry	25%

**PCPP 20% no-show rate is one day of a 5-day week.**

Boyer, Lori. 2018. Which Wins? The National Average No-Show Rate or Yours? Posted on Jun 12, 2018.

<https://www.solutionreach.com/blog/which-wins-the-national-average-no-show-rate-or-yours>



## Q3. What to change to?

# PASS DEFINITION

**The PASS (Provider Appointment Scheduling System) is a buffered provider appointment scheduling template with supporting policies, procedures, rules, measures, strategic buffers and a buffer management system to proactively manage the patient demand and the provider schedule and its execution in the achievement of the practice goal of providing excellent timely patient healthcare at a profit (or within budget).**

Cox III, J. F. and L. H. Boyd (2018). "Using the theory of constraints' processes of ongoing improvement to address the provider appointment scheduling system design problem." Health Systems: 1-35.



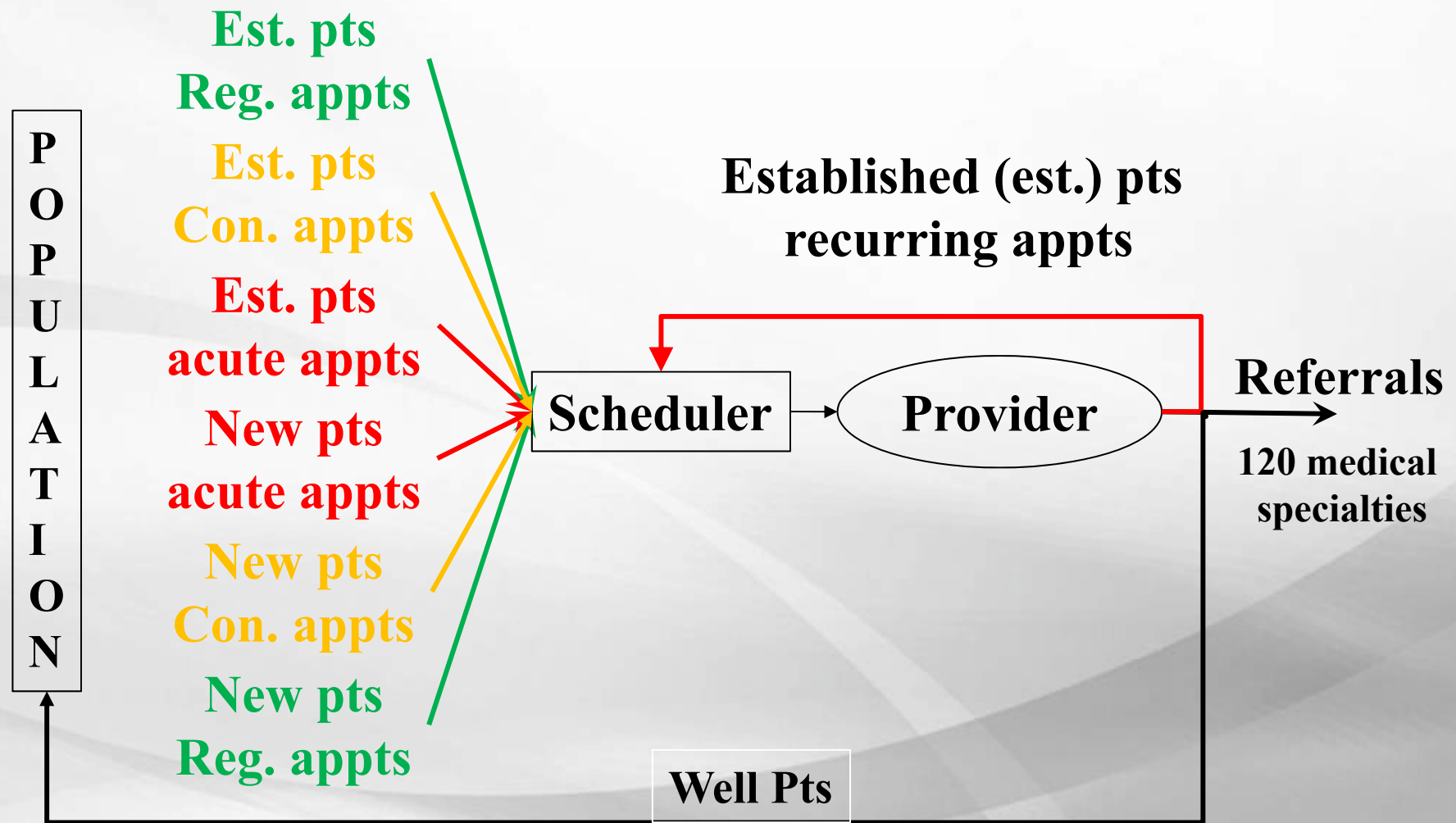
## **Q3. What to change to?**

**ISP converted to similar WSPs.**

**What if:**

- **Pts (particularly acute) are seen in a “timely” manner.**
- **Scheduling chaos is eliminated (proactive managing).**
- **No-show/ late cancellation rates are minimal (2%).**
- **All patients are provided excellent healthcare.**
- **Physician skill levels are highly utilized.**
- **Execution chaos is eliminated (provider does only high skill level tasks, has no interruptions, no multi-tasking, full-kit).**

## 5. The PASS: Define the TOC scheduling system





## 5. TYPES OF PATIENTS / appointments

### 1. Established (Est.) patients

- |                         |                     |
|-------------------------|---------------------|
| A. Routine appt         | Greater 5 days appt |
| B. Recurring appt       | As specified        |
| C. Concerns appt        | 1-5 day appt        |
| D. Acute appt           | Same-day appt       |
| <del>E. Emergency</del> |                     |

### 2. New patients

- |                         |                     |
|-------------------------|---------------------|
| A. Routine appt         | Greater 5 days appt |
| B. Recurring appt       | As specified        |
| C. Concerns appt        | 1-5 day appt        |
| D. Acute appt           | Same-day appt       |
| <del>E. Emergency</del> |                     |

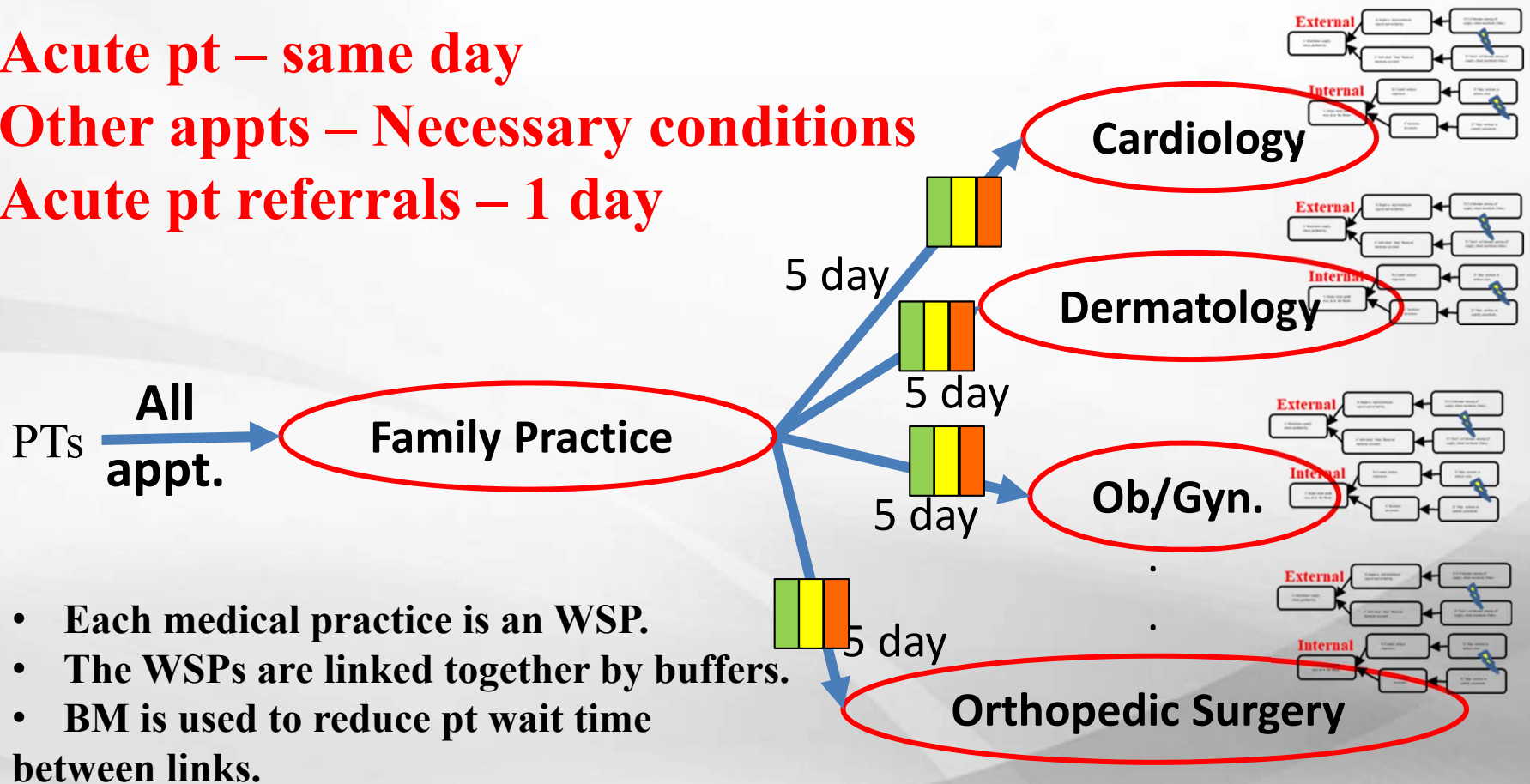
**TRIAGE the patients!**

## 7. Subordinate to all stakeholders' necessary conditions. Q3. What to change to?

Acute pt – same day

Other appts – Necessary conditions

Acute pt referrals – 1 day



**Identify all stakeholders' necessary conditions placed on link.**

# The sum of the local goals is not equal to the whole.

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**Recall Ackoff stated: “A mess is a system of problems. A system is a whole that cannot be decomposed into independent parts.”**

My approach to solving the ISP is to decompose the “mess” (hierarchal system) to its logical unit of analysis: the medical unit. Solve the medical unit as a WSP.

With regard to Ackoff’s statement: I am not solving the problem as independent parts, I connect the WSP units with time buffers between links (time till appt) & continually reduce the time between links. I know that the shorter the time from the need for an appt till the appt time the better the patients’ healthcare will be & the less likely it is the patient will no show. The lower the no-show rate the higher the provider utilization. So by reducing the time buffers between healthcare units the closer we are to achieving the two EC requirements: **B Pts receive excellent timely healthcare. & C Providers are effectively utilized.**



Ackoff, R. L. (1981). "The art and science of mess management." *Interfaces* 11(1): 20-26.

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# Practicing medicine should be the way you dreamed it would be.

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## **Searching for a direction for a solution in Education**

- 1. Reduce multi-tasking.**
- 2. Focus (concentrate) on a limited number of subjects in achieving education requirements for end-of-year exam.**
- 3. Use teaching resources effectively.**



## **Stage I: ISP to WSPs solution process**

- 0. What is the core problem of the ISP?**
- 1. List the various stakeholders in the ISP environment.**
- 2. Apply the PHD using IC and IS to decompose the ISP into smaller similar (& dissimilar) well-structured problems (WSPs).**
- 3. Apply PTD using IC and IS to sequence the orgs. in a logical (general) process flow starting with first link(s).**

## **Stage I: ISP to WSPs solution process cont**

- 4. Frame the hierarchal conflicts from upper level to the logical unit of analysis.**
- 5. Determine the strategic leverage point to schedule (and execute) the system flow.**
- 6. Buffer each link from other links & use BM to synchronize links & reduce buffers (wait times / stocks) between links.**
- 7. Subordinate to all stakeholders' necessary conditions.**

# What are the causes for students to dropout of school?

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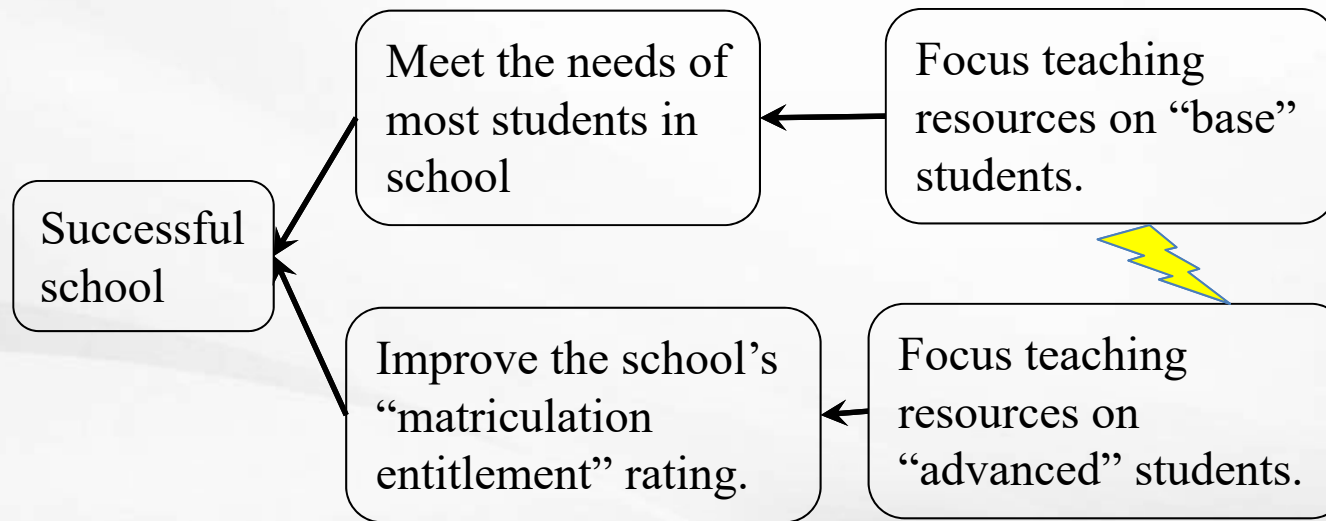
- Pregnancy and Parenthood. Teen pregnancy can pose concerns for **students** trying to complete **high school** academic requirements. ...
- Boredom. **Students** often **drop out** of **high school** and college due to apathy or boredom. ...
- Academic Struggles. ...
- Lack of Parental Support. ...
- Money.

<https://education.seattlepi.com › problems-cause-students-drop-out-school-1...>



# 0. What is the core problem of education (ISP)?

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# 1. List the various stakeholders in the ISP environment.

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**1. Student**

**2. Peers**

**3. Teacher**

**4. Family**

**5. Staff**

**6. Tax payers**

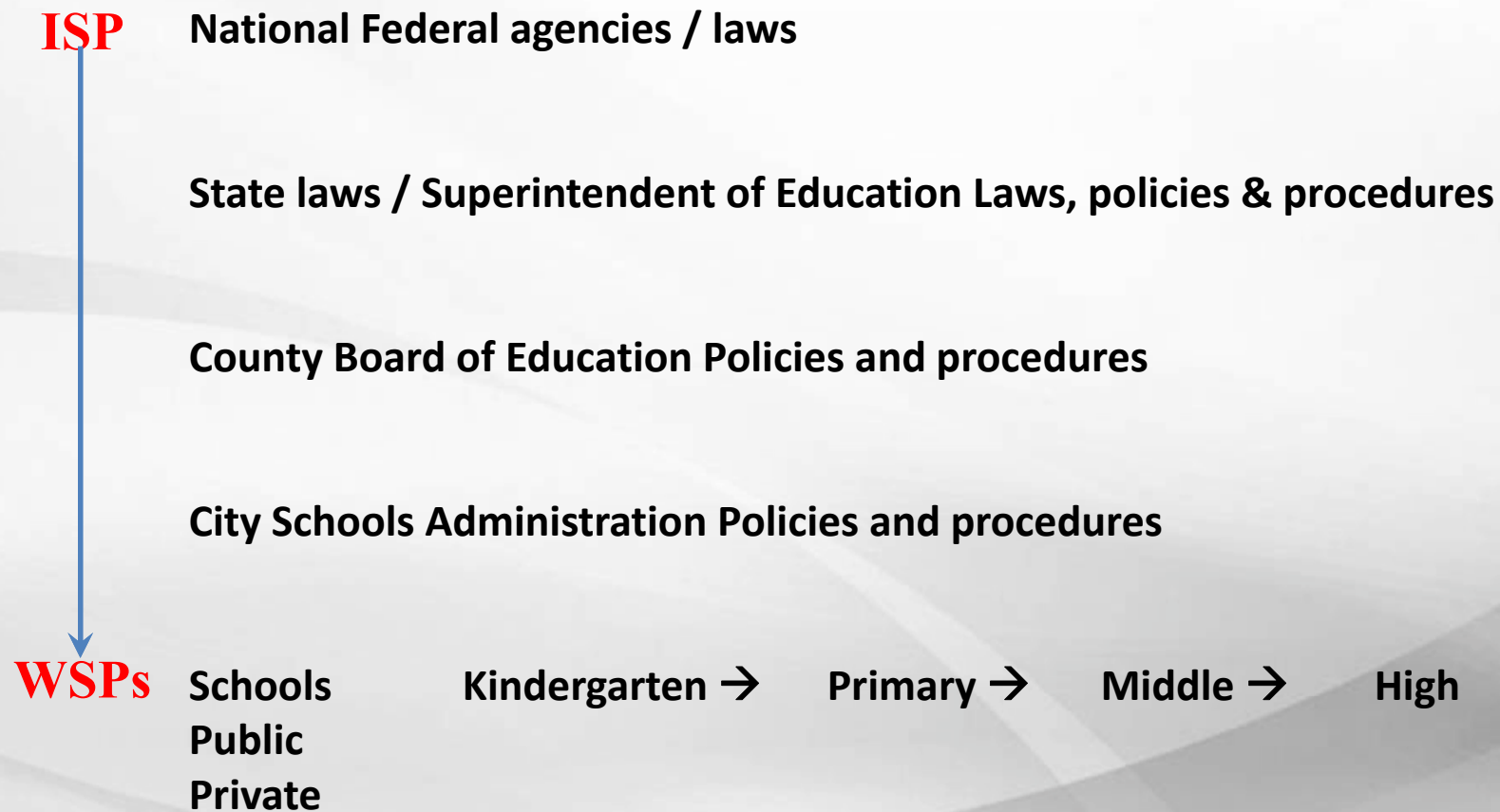
**7. Society**

**8. Governments**

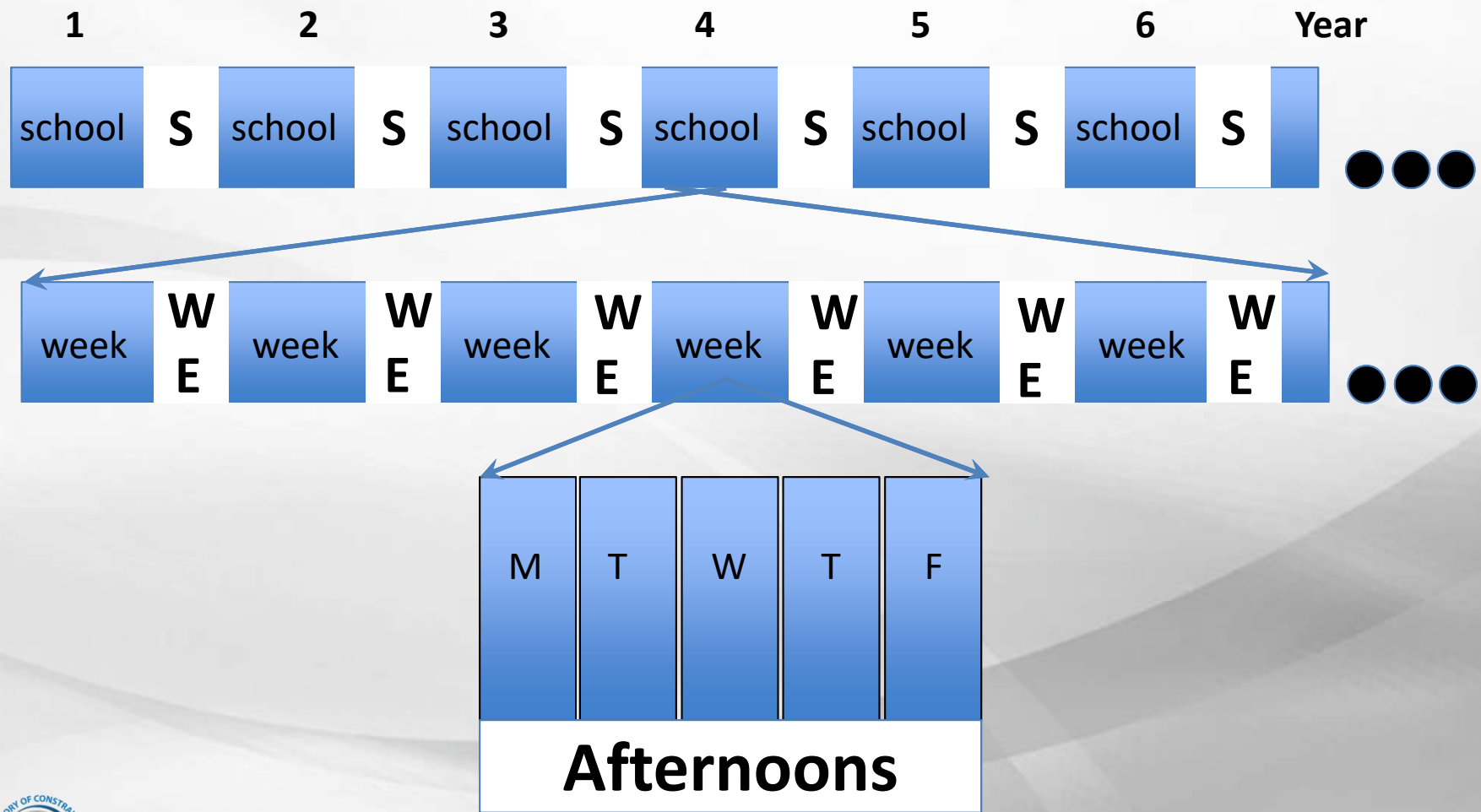




## 2. Apply the PHD using IC and IS to decompose the ISP into smaller similar (& dissimilar) well-structured problems (WSPs).



### 3. Apply PTD using IC and IS to sequence the orgs. in a logical (general) process flow starting with first link(s).



#### 4. Frame (internal and external frames) the hierarchal conflicts from upper level to logical unit of analysis.



## 4. Federal laws regulating education

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**Individuals with Disabilities Education Act (IDEA)**- An education law that requires schools to provide special education and related services to kids with disabilities who need them.

**Section 504 (of the Rehabilitation Act)**- A civil rights law that prohibits discrimination on the basis of disability at schools that receive federal funding.

**Americans with Disabilities Act (ADA)**-A civil rights law that prohibits discrimination on the basis of disability in schools, workplaces and public spaces.

<https://www.understood.org › your-childs-rights › basics-about-childs-rights>



## 4. Conflicts: 130+ rules governing schools in the state of Georgia

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State laws regulate public education in a number of different ways, including curriculum standards and how schools are funded. ... For example, Georgia law allows teachers and administrators to use corporal punishment in public schools, which has become less common throughout the ...

<https://statelaws.findlaw.com › georgia-law › georgia-education-laws>

<https://www.gadoe.org/External-Affairs-and-Policy/State-Board-of-Education/Pages/PEABoardRules.aspx>





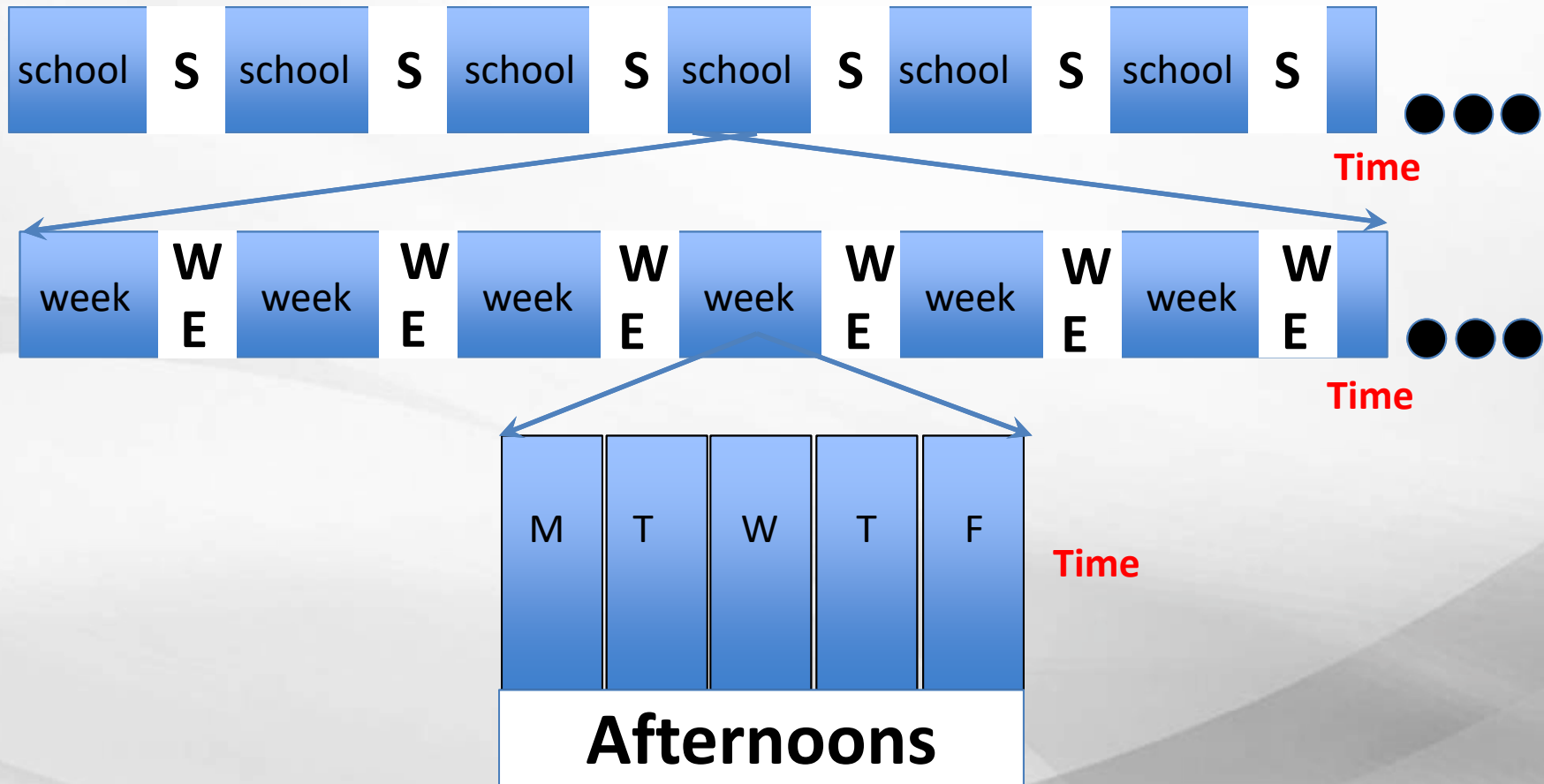
## **5. Determine the strategic leverage point (SLP) to schedule (and execute) the system flow.**



**Hypothesis (based on intuition) = LP is the teacher / class.**

**The SLP is the school.**

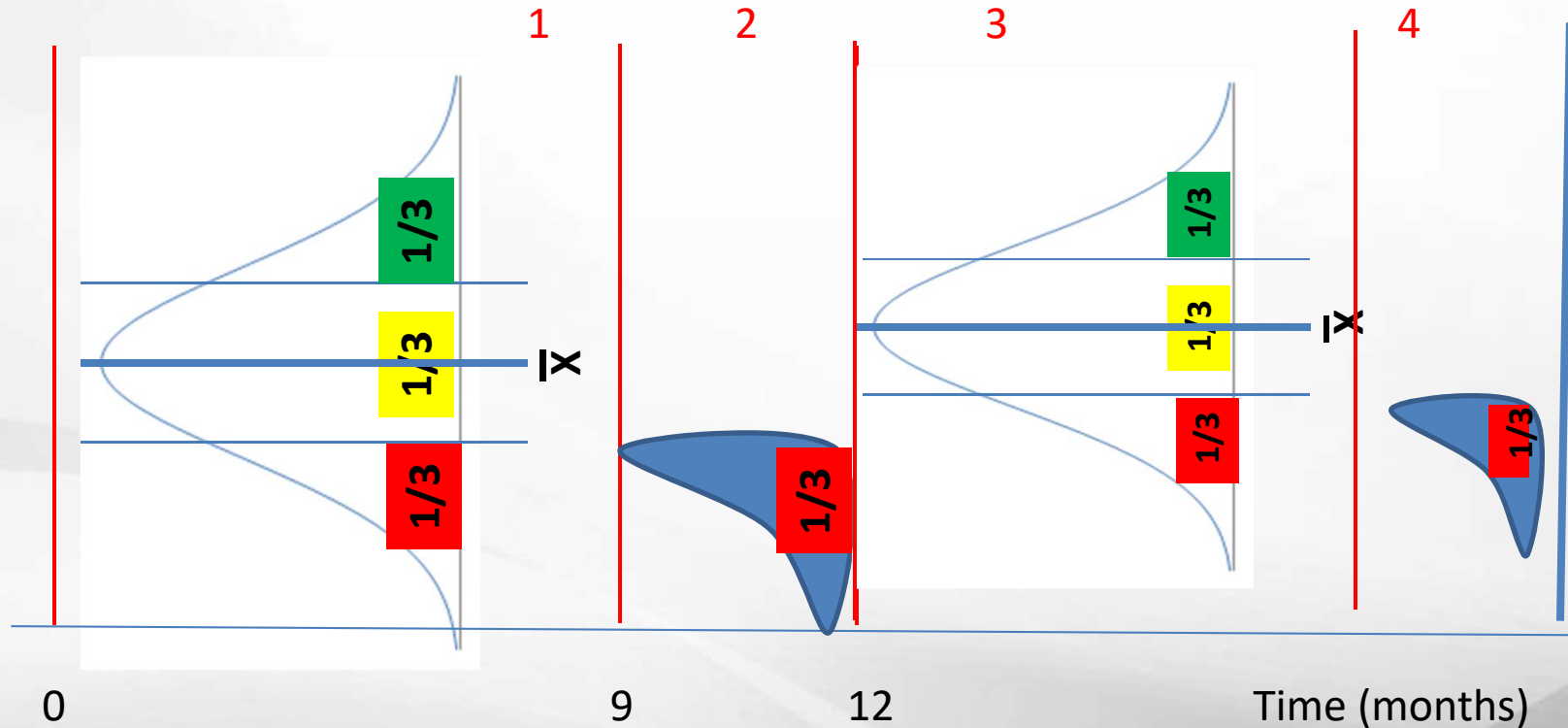
**6. Buffer each link from other links & use BM to synchronize links & reduce buffers between links.**



**The buffers (white segments) are used to bring the at-risk students up to the class average.**

## 6. Buffer each link from other links & use BM to synchronize links & reduce buffers between links.

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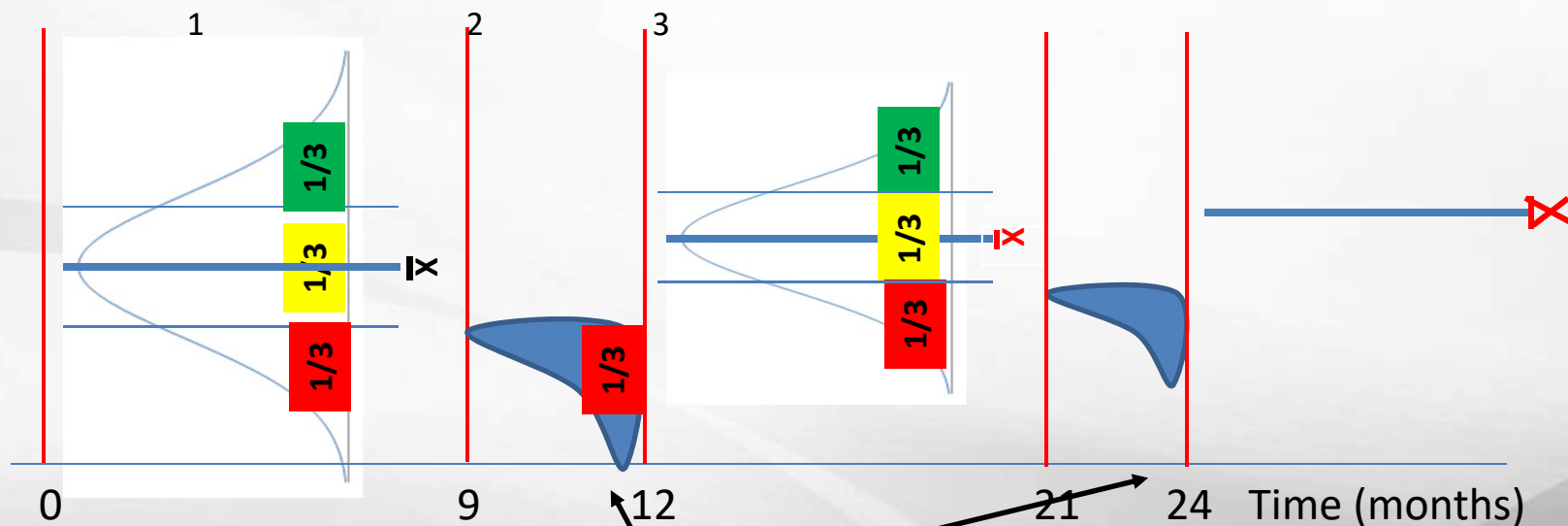


Class average and standard deviation changes over time caused by intervention. Note the class average has increased and the standard deviation of decreased which translates into the teacher being able to teach higher level topics with fewer students doing poorly.

## 6. Buffer each link from other links & use BM to synchronize links & reduce buffers between links.

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Hypothesis: Additional focused daily teaching after school and on weekends of lower 1/3 of students results significant increase of class mean and decrease in standard deviation in testing during the year.



Mandatory intensive focused summer teaching of lower 1/3 of class accomplishes the same results.

# Diagram explanation

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Segment 1 is the first 9-month period of the year, the regular teaching year.

Segment 2 is the 3-month summer period of the year.

Segment 3 is the next 9 month period. Etc.

The normal curve in segment 1 represents the grade distribution of the class based on either end-of-year standardized exams or the end-of-year class average.

Based on the teacher knowledge of working with each student he/she provides an assessment of why the student got her grade (too many absences to keep up; family problems; no help at home; weakness in one specific subject; weakness in all subjects; etc.). The lower  $\frac{1}{3}$  of the class is then required to attend summer school. The summer class is  $\frac{1}{3}$  the normal size and the teacher/tutor focuses only on the specific subject(s) needing attention. With this increased attention on these at-risk students and the focus on the weakest subject matter student's skills should increase significantly. The starting point for the next year's class should have an increased average score and smaller standard deviation.

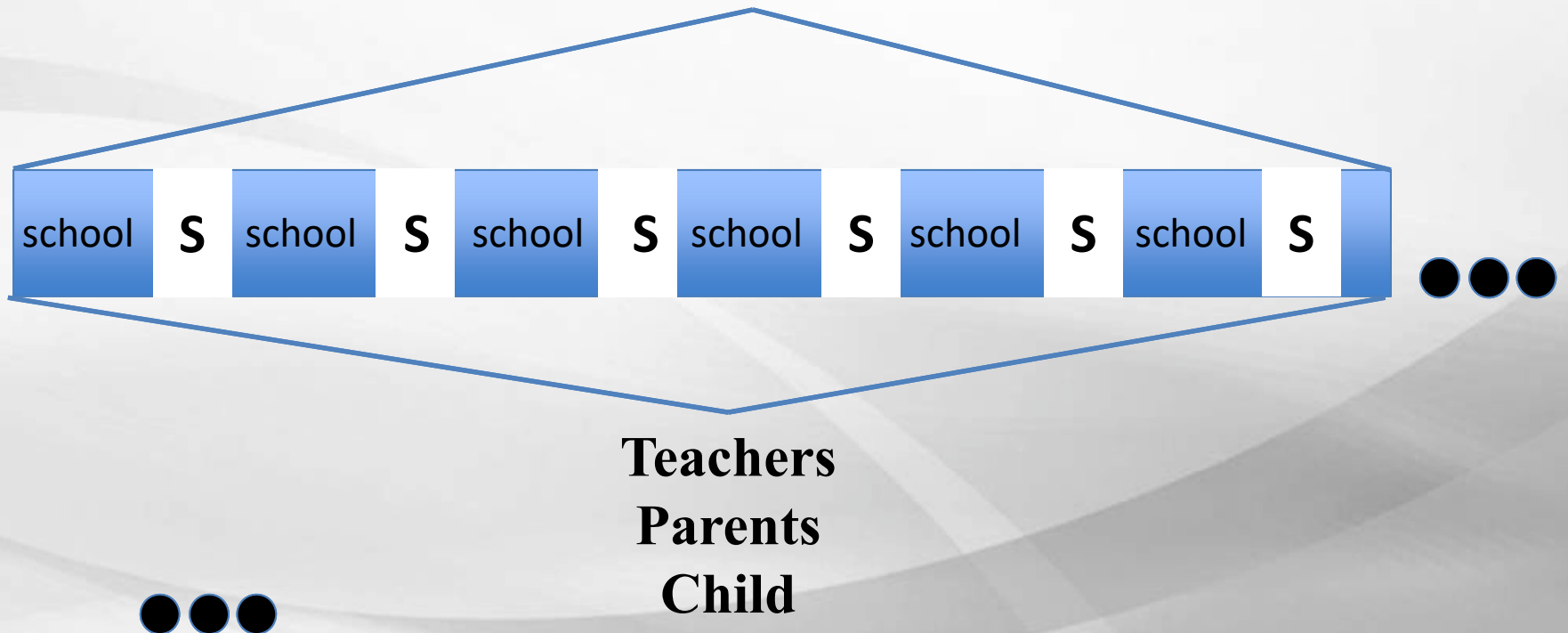
If this approach is taken from kindergarten onward the class average increase each year and the class standard deviation should reduce thus the teacher is able to cover more material as the at-risk student have improved with the focused teaching provided.





## 7. Subordinate to all stakeholders' necessary conditions.

**Federal Regulations  
State Regulations  
County Regulations  
School Regulations**



## **Stage II: ISP to WSPs solution process cont**

- 1. Use / modify existing templates (cases) for appropriate links.**
- 2. Develop templates for missing links: design the planning & execution system for operations based on the strategic constraint & control points.**
  - A. Use the constraint as the leverage point to plan & control flow from proceeding link, through the link, and to succeeding links.**
  - B. Use buffers & BM between links to synchronize flow across links & reduce wait times /stocks between links.**
  - C. Frame each stakeholder with internal & external ECs to determine how to gain their buy-in.**
  - D. Move staff from engines of disharmony to engines of harmony in developing their new job descriptions.**

## Stage II: ISP to WSPs solution process cont

### 1. Use / modify existing templates (cases) for appropriate links.

Goldratt, R., & Weiss, N. (2005). Significant enhancement of academic achievement through application of the theory of constraints (TOC). *Human Systems Management*, 24, 13-19.

See TOC for Education website <http://w.tocforeducation.com/home.html>

#### Applications

- Conflict Resolution/Prevention
- Counseling
- Bullying
- Suicide Prevention
- Leadership
- Peer Mediation
- Parenting
- Alcohol and drug counseling
- Children who have been abused
- Learning and Physical Disabilities
- Dyslexia
- Differentiated Instruction
- Curriculum delivery
- Sports teams
- Juvenile Justice
- Civic Groups
- Dental Health
- Young children who have not yet learned to read and write

# Focusing in education

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Abstract. Changes in the administration of matriculation examinations in Israel (based on the Theory of Constraints), has produced a marked improvement in the high school graduation rate of underprivileged students, without the need for additional manpower or resources and without changing the pedagogical way teachers are asked to teach the relevant knowledge. Because of changes made within the educational system in the early 1990's, the high school diploma has become the prime measure of success also for underprivileged students, within the vocational/technological high school. This article presents a case study of the "Reut" school, where adoption of the Theory of Constraints (TOC) has led to a continuous increase in the number of students eligible for high school diplomas. The article describes the two-phase process of applying the principles of TOC in the administration of matriculation exams. **The first phase employs operational flow principles to align the allocation of academic resources according to the weakest link (constraint); the second phase uses TOC project management principles to streamline resource utilization. The improvement achieved at each phase is described together with an analysis of the results. The article ends with conclusions drawn from an analysis of the processes.**

Goldratt, R., & Weiss, N. (2005). Significant enhancement of academic achievement through application of the theory of constraints (TOC). *Human Systems Management*, 24, 13-19.

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# Recidivism

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But many Americans are unfamiliar with how restrictive U.S. laws are for the formerly incarcerated. Restrictions, corruption and limited educational and drug rehab services help ensure that more than 75% of prisoners [return to the system](#) within five years of release in America.

**Direction of the recidivism problem:**

**See Christina Cheng's Chapter 27 Theory of constraints in prisons.**

<https://www.usatoday.com/story/opinion/policing/reentry/column/2017/12/29/reentry-incarceration-corruption-prison-barriers-recidivism-policing-usa/979903001/>

Cheng, C. (2010). Chapter 27 Theory of constraints in prisons. In J. F. Cox III & J. G. Schleier Jr. (Eds.), *Theory of Constraints Handbook* (pp. 813-841). New York, NY: McGraw-Hill Publisher.

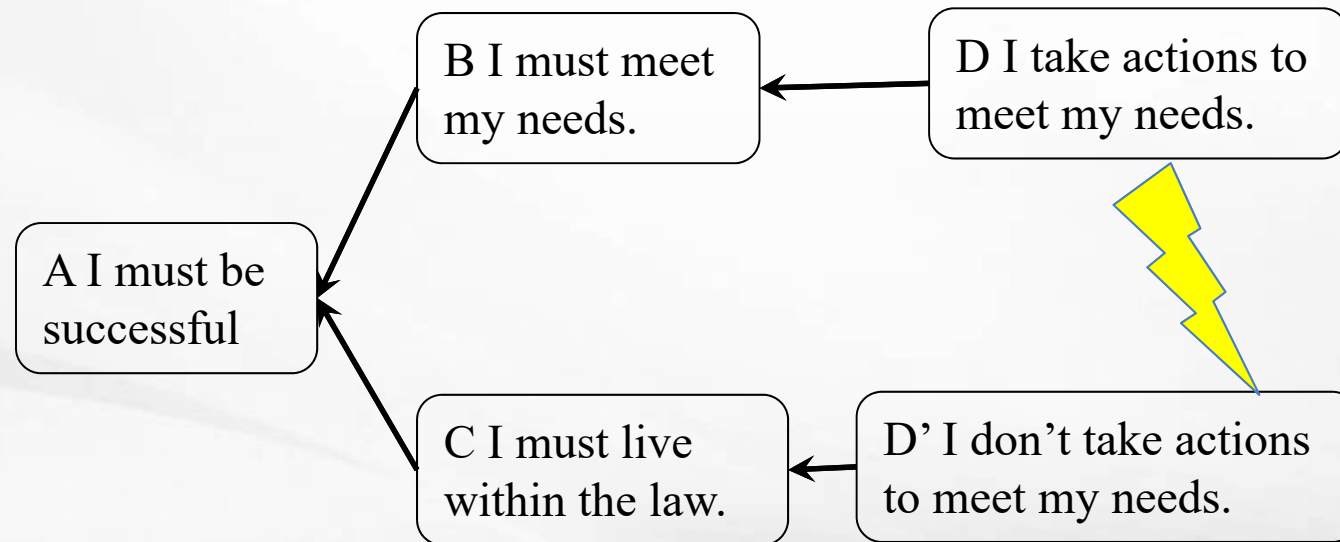


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# EC of hypothesized core problem

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# Causes of crime

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## Crime-prone individuals

- ~~Biological factors~~
- Family factors
- School performance and intelligence\*
- Truancy\*
- The influence of delinquent peers
- Poverty and unemployment
- Substance abuse
- Public tolerance of crime
  
- Solution must be “... the need for a wide range of strategies in preventing it.”



Weatherburn, D. (2001, February). What causes crime? *Crime and Justice Bulletin*, 54, 1-12.

## CAUSES OF MURDER AND OTHER CRIMES

J. Warner Wallace writes (in discussing the mass shootings in Santa Fe, Texas):  
“... I, however, know *precisely* why this latest killer did what he did. And I also know what will motivate the *next* killer to act in a similar way.

Many years ago, [as I began investigating high-profile murders in Los Angeles County](#), I carefully chronicled the motives for every homicide that occurred in our region. You might think there are a million reasons why someone would commit a murder, but there are only three possibilities.

At least one of these three motives is the driving force behind every homicide, theft, burglary and robbery. In fact, these three motives lie at the heart of every conceivable crime or misdeed.

Human misbehavior is motivated by: **financial greed, sexual – or relational – lust, and the pursuit of power.**

You might be wondering if there is a fourth category. There isn't. What about jealousy? What about anger? Ask yourself the question: What is causing the jealousy or anger? There are only three answers to this question, and now you know them.”

<https://www.foxnews.com/opinion/why-do-people-become-killers-there-are-only-three-reasons-here-they-are>



THE END.  
THANK YOU.

# Biographical sketch

James F. Cox III, Ph.D., TOCICO certified, CFPIM, CIRM, JONAH's JONAH, Professor Emeritus, was the Robert O. Arnold Professor of Business at the University of Georgia. Prior to an academic career of over 30 years, he held positions in industry and the military. He taught Jonah workshops and numerous TOC workshops and programs.

Dr. Cox's research has centered on TOC for over thirty years. He recently co-edited (with John Schleier) the TOC Handbook. He has written three books on TOC and has authored/coauthored almost 100 refereed articles in top academic and practitioner journals. He was the coeditor of the APICS Dictionary (five editions) and more recently co-editor (with Lynn Boyd, et al.) of the TOCICO Dictionary, 2<sup>nd</sup> Edition.

Dr. Cox an APICS member for over 40 years, held numerous chapter, regional, and national offices including serving on their BODs. He also served on the TOCICO founding Board of Directors and as their first Director of Certification, setting up the initial certification structure and exams. He was again on the TOCICO BODs (2012-2016). In addition to speaking at numerous academic conferences, he has spoken at over 50 APICS and other professional organization chapter meetings, several regional seminars and several international conferences on TOC. He received the APICS Voluntary Service Award and the TOCICO Lifetime Achievement Award and Distinguished Service Award for contributions to the field. [jcox@uga.edu](mailto:jcox@uga.edu)





## ORIGINAL IMPLEMENTATION IN PRIMARY CARE PRACTICE

Cox III, J. F. and T. M. Robinson (2012). The use of TOC in a medical appointment scheduling system for family practice. TOCICO International Conference: 10th Annual Worldwide Gathering of TOC Professionals, Chicago, IL, Theory of Constraints International Certification Organization.

The use of TOC in healthcare is an emerging field. This presentation describes the use of the five focusing steps (5FS), throughput accounting (TA), drum-buffer-rope (DBR), buffer management (BM), the engines of harmony, and the thinking processes (TP) in a family practice organization. Many medical providers use a patient appointment scheduling system based on fixed appointment times to schedule patient flow; the use of TOC in this type of scheduling system is a new and significant area of study. The TOC tools (the TP) and BM were used to improve scheduling, execution, and patient flow by eliminating the major causes of interruptions, thus providing a smoother flow of patients to and from the provider. The attendee benefits from understanding: 1. The application of each TOC tool to the medical practice through various examples in an actual practice. 2. The use of BM to proactively improve appointment scheduling and execution systems. 3. The major causes of poor organizational performance across a medical practice.

## PRACTITIONER: USE OF 5FS IN PROVIDER PRACTICE

Cox III, J. F., et al. (2014). "Applying the "theory of constraints" to solve your practice's most vexing problem." Family Practice Management: 18-22.

The theory of constraints has been used successfully in almost every type of organization and industry. It has even been used in healthcare, although less extensively. In the UK, it helped a hospital move from the bottom 10 to the top 10 among hospitals ranked by emergency room response time after only a few months of implementation. An oral surgeon's practice used the theory of constraints to go from break-even to a \$3.5 million profit. We recently applied TOC to a family medicine clinic with 10.5 providers. The results included an almost 40 percent increase in provider capacity and a 29-percent increase in revenues. The purpose of this paper is to explain the steps we followed.

## PRACTITIONER: USE OF BM IN PROVIDER PRACTICE

Cox III, J. F., et al. (2016). "Unconstraining a doctor's office. TOC's buffer management can help solve core scheduling problems." Industrial Engineer **48**(2 February): 28-33.

TOC is based on the principle of inherent simplicity, that even the most complex system can be planned, scheduled, controlled and improved by identifying and managing one or very few key leverage points in the system to achieve significant system improvement. These leverage points are constraints and can be internal (a resource, a policy, a procedure or a measurement) or external to the system (the market). By changing a few policies and procedures, most organizations can focus, increase profits, and improve healthcare quality and delivery significantly almost immediately without incurring any or much cost. Strategic buffers and buffer management are the key to both schedule design and schedule execution.

## DIFFERENT FRAMES: OUTPATIENT SCHEDULING PROBLEM--1

Cox III, J. F. (2015). An examination of the academic, practitioner, TOC & my perspectives of the provider appointment scheduling system. TOCICO International Conference: 13th Annual Worldwide Gathering of TOC Professionals, Cape Town, South Africa, Theory of Constraints International Certification Organization.

The problem of appointment scheduling in healthcare has been researched by well over a hundred academicians and practitioners for over sixty years without any viable solution being identified. In TOC terminology we call this appointment scheduling problem a “chronic problem”. Why do chronic problems remain unsolved? A clash of the two worlds of research exists: academics versus practitioners. Academicians are primarily measured and rewarded by their research contributions to their fields as recognized by publishing in the top tier academic journals. High powered statistical analyses and mathematical programming techniques are the highly recommended research methodologies: the rigor of the research is of utmost importance. On the other hand, practitioners are interested in how to solve their specific problem; the relevance of the research. Goldratt (TOC Journal) offered a different perspective to research (science) as developing in three stages: classification, correlation and cause and effect. I will compare and contrast these different perspectives to my perspective. In 2012, Cox and Robinson presented a case study that solved many of the appointment scheduling problems of a large family practice clinic. Since that presentation, a literature search of the appointment scheduling area revealed the above divide. This review of the combined literature also reveals at least 14 major “problems” (UDEs). These UDEs are studied from a TOC perspective using the three processes of ongoing improvement (POOGI) and using classification (the first stage of science) to sort through the causal relationships (the third stage of science) in moving from the chaos of the problem environment to the harmony of the TOC solution environment and approach. Hopefully the research process of using the TOC processes of on-going improvement and classification will provide a framework for addressing other chronic problems.



## DIFFERENT FRAMES: OUTPATIENT SCHEDULING PROBLEM—2

Cox III, J. F. and L. H. Boyd (2016). An examination of the academic, practitioner, TOC & our perspectives of the provider appointment scheduling system: Part 2. TOCICO International Conference: 14th Annual Worldwide Gathering of TOC Professionals, Leesburg, VA, Theory of Constraints International Certification Organization.

The problem of appointment scheduling in healthcare has been researched by several hundred academicians and practitioners for over sixty years without any viable solution being identified. There is little overlap in the research by these two groups. Academicians are primarily measured and rewarded by publishing in top tier academic journals, which generally requires theory development, sophisticated statistical analyses, or optimization techniques. In academia, the rigor of the research is of utmost importance. On the other hand, practitioners are interested in how to solve specific problems, so the relevance of the research is the primary concern. In 2012, Cox and Robinson presented a case study that solved many of the appointment scheduling problems of a large family practice clinic. Since that presentation, a literature search of the appointment scheduling area has revealed the above divide between the academic and practitioner approaches to the appointment scheduling problem. This review of the combined literature also revealed 14 major "problems" (UDEs). In a preliminary study presented in South Africa in 2015 these UDEs are analyzed from a TOC perspective using the three processes of ongoing improvement (POOGI): the change question sequence, buffer management, and the five focusing steps. We then use classification (the first stage of science) to sort through the causal relationships (the third stage of science) in moving from the chaos of the problem environment to the harmony of the TOC solution environment and approach. In this research we will review those findings and present some illustrations of the scheduling solutions. We also discuss two possible approaches to bridging the academic – practitioner divide, design science and TOC as theory development, that may help TOC be accepted in top-tier academic journals. We hope the solution-development process of using the POOGI and classification of TOC will provide an approach to addressing other chronic problems and will find acceptance in top academic journals.





# GENERIC OUTPATIENT SCHEDULE DESIGN PROCESS

Cox III, J. F. and L. H. Boyd (2018). "Using the theory of constraints' processes of ongoing improvement to address the provider appointment scheduling system design problem." Health Systems: 1-35.

Health care is in crisis today: costs are rising, demand exceeds supply, quality is questioned and patient wait times are excessive while providers and staff are simultaneously overworked and frustrated. No one has a comprehensive system solution to providing more, cheaper, better, and faster health care, even in primary care practices, the first link in the health care supply chain. Additionally, this link like others frequently experiences the combination of complexity, uncertainty, and local optimisation simultaneously to create a chaotic environment. Health care problems have been called ill-structured (also ?wicked?) and because of their tangled web of stakeholders with different and conflicting objectives defy traditional optimisation research methodologies. Proper design and management of the provider appointment scheduling system (PASS) provides a direction for a win-win health care solution (more, cheaper, better, and faster). Our objective is to provide a generic strawman process for developing a robust PASS for most environments. A theory of constraints thinking processes (TP) analysis was conducted on the academic research using a primary care practice to validate both entity and causality existence. From this integrated analysis, a robust process for designing a PASS resulted. Last, we show that Goldratt's TP provides a logical, rigorous framework for qualitative research and design science.

## GENERIC OUTPATIENT SCHEDULE EXECUTION PROCESS

Cox, J. F. (2019). "Using the theory of constraints' processes of ongoing improvement to address the provider appointment scheduling system execution problem." Health Systems: 1-32. doi=10.1080/20476965.2019.1646105

Many primary care clinics suffer from chaos. In scheduling, providers are continually trying unsuccessfully to balance supply and demand, and in execution, to manage disruptions to provider focus and patient flow. In this research the theory of constraints? (TOC) three processes of ongoing improvement (POOGI) provide a direction for the solution to achieving more, cheaper, better, and faster healthcare. This research is the second of a two-part study examining the appointment scheduling literature, identifying the core problem (using a case study for validation) and providing a generic process for developing effective provider appointment scheduling systems (PASS). In the first part, PASS design was studied and in this second part PASS execution is studied. A strawman process is developed to apply across outpatient medical practices. With this generic process implemented across outpatient scheduling systems cost could be reduced significantly while the quality and timeliness could be increased significantly.