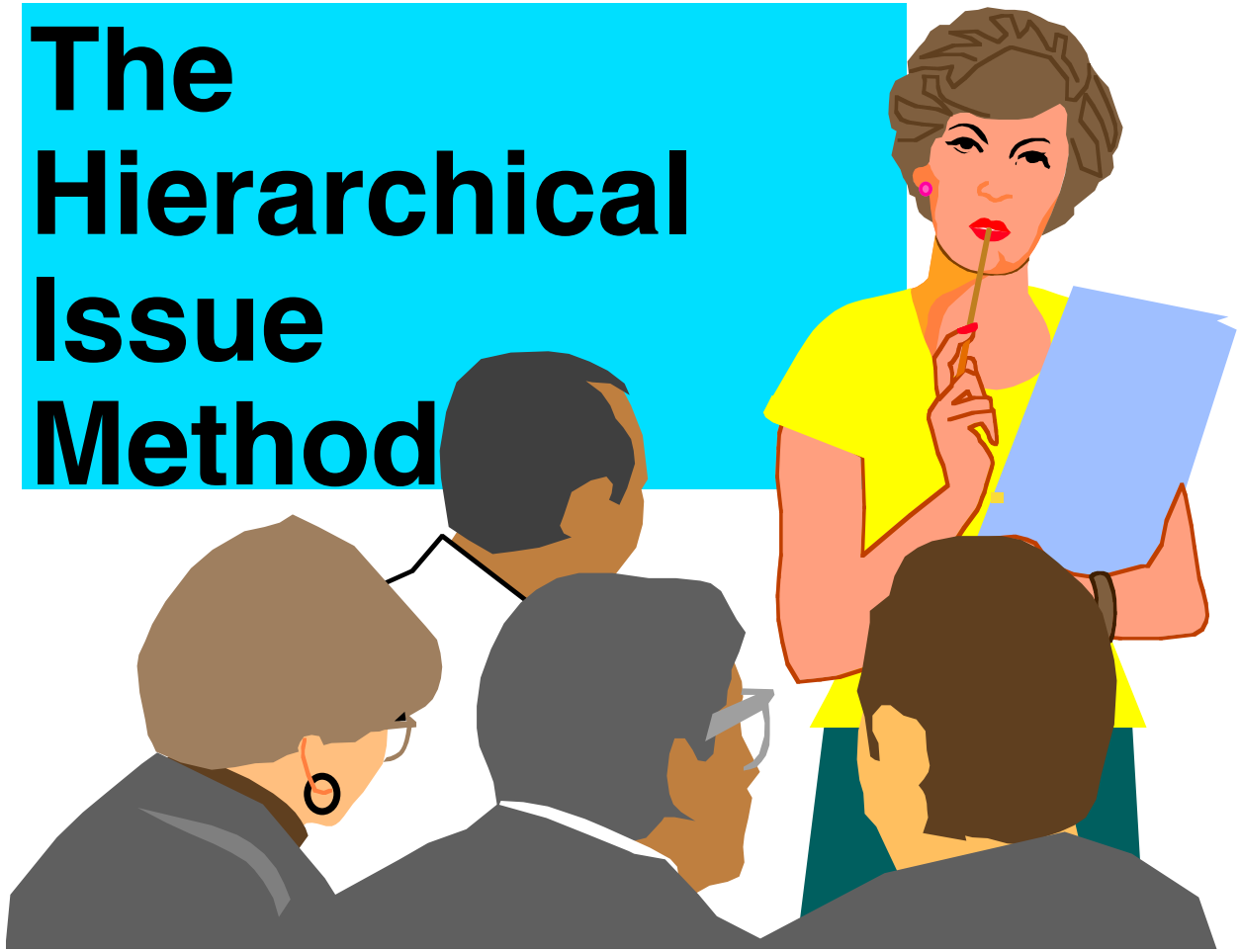
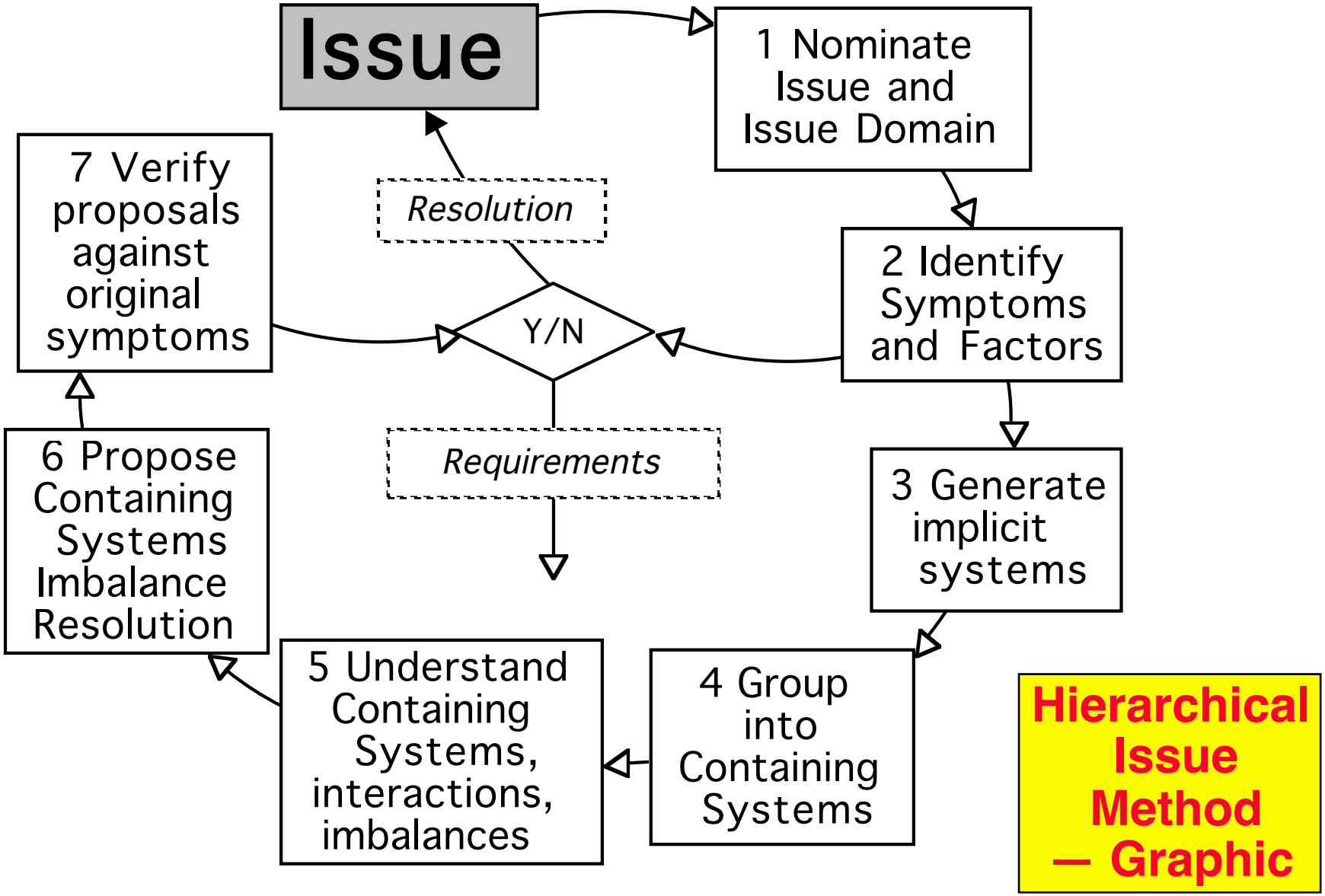
The Hierarchical Issue Method



DERA
Workshop

What is the Hierarchical Issue Method?

- A method for addressing problems or issues, using hierarchies of issue "symptoms"
  - Generates requirements for problem/issue resolution
- Employs techniques, tools and methods to:—
  - Elicit issue "symptoms"
  - Identify possible causes of those symptoms
  - Group possible causes to identify higher level "themes"
    - » Hence "hierarchy"
  - Accommodate complexity, reduce entropy
- Addresses the most complex/abstract/obscure of issues
- A serious, heavyweight alternative to Checkland's SSM
- Eminently suitable for team-based working
- Mathematically provable (sic!)


Issue
1 Nominate Issue and Issue Domain
2 Identify Symptoms and Factors
3 Generate implicit systems
4 Group into Containing Systems
5 Understand Containing Systems, interactions, imbalances
6 Propose Containing Systems Imbalance Resolution
7 Verify proposals against original symptoms
Y/N
Resolution
Requirements
Hierarchical Issue Method — Graphic

The Method

Step	Title	Action/Method/Tool/Technique
1	Nominate Issue and Issue Domain	Select a meaningful description of the Issue with the Client; detail the Issue environment and boundaries. Generally, an Issue is a vague “feeling of unease...”, “concern about...”
2	Identify Issue Symptoms and Factors	Develop set of elemental problems, symptoms of unease or disquiet, plus any evidently strong influences. Sort symptoms from “pet cures”
3A	Understand Interaction Imbalances	Develop a Laundry List of possible causes with the Client—POETIC. Model to understand.
3B	Generate implicit contained systems	From 3A, identify the implicit contained systems in imbalance
4A	Group into Containing Systems	Consolidate the list of implicit contained systems. Group to Identify Containing Systems
4B	Model Idealized Containing Systems	Treat Containing Systems as symptoms. Treat implicit contained systems as causal factors. Model to understand
5	Understand Containing System Interaction Imbalances	Develop interaction imbalances between Containing Systems—describe shortcomings and environment in a Systems Interaction Diagram (SID)
6	Propose Containing Systems Imbalance Resolution	Conceive set of requirements to address shortcomings and imbalances shown in the SID—if possible.
7	Assess requirements impact on all imbalances	Verify 6 against original symptoms.

Example Issues—Different Viewpoints

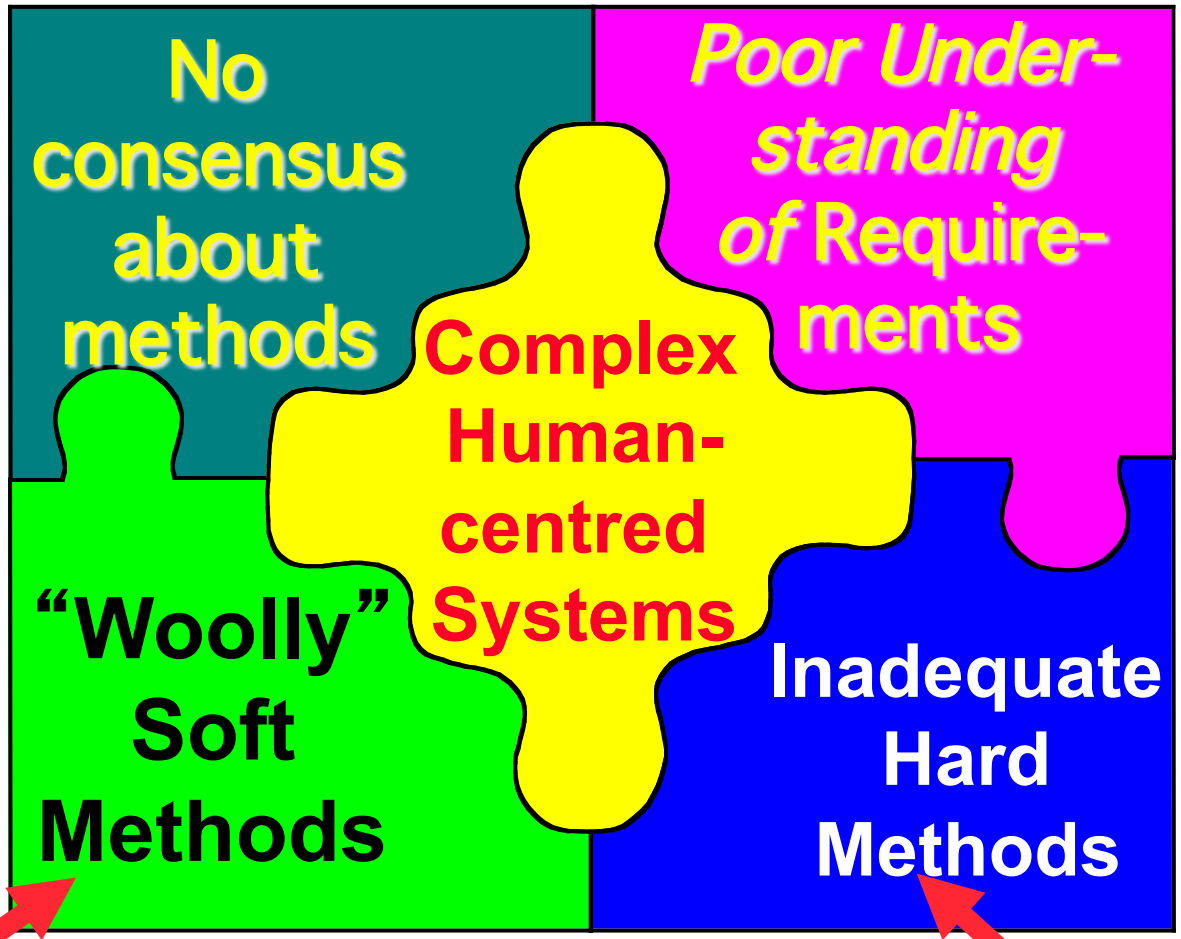
- Concern about organization's morale, but no obvious culprit
- High-level briefing required urgently to rebut detailed criticism of project
- Partnership at risk of breaking up owing to lack of shared vision
- Differing views of causes for lack of performance / effectiveness / efficiency
- Complex equipment presents inconsistent fault symptoms
- Erratic organizational behaviour, but no clear strategy for improvement
- Burgeoning social unrest but no single cause and no evident remedy

- Disagreement on the best way to integrate multi-national forces
- Concern over global warming and future sources of energy at national level

Why a method for addressing Issues is so vital…

- Basis for understanding complexity
- Great unsolved area
  - » current approaches start from presumption of requirement
  - » where does requirement come from?
- Generating requirement needs method and rigour, too
  - » fundamental to being a good customer
- Whatever is supplied against requirement will interact strongly with what exists now
  - » requirement is function of current/future operating environment, other systems, customer's culture
  - » requirements create complementary requirements
  - » requirements come in sets

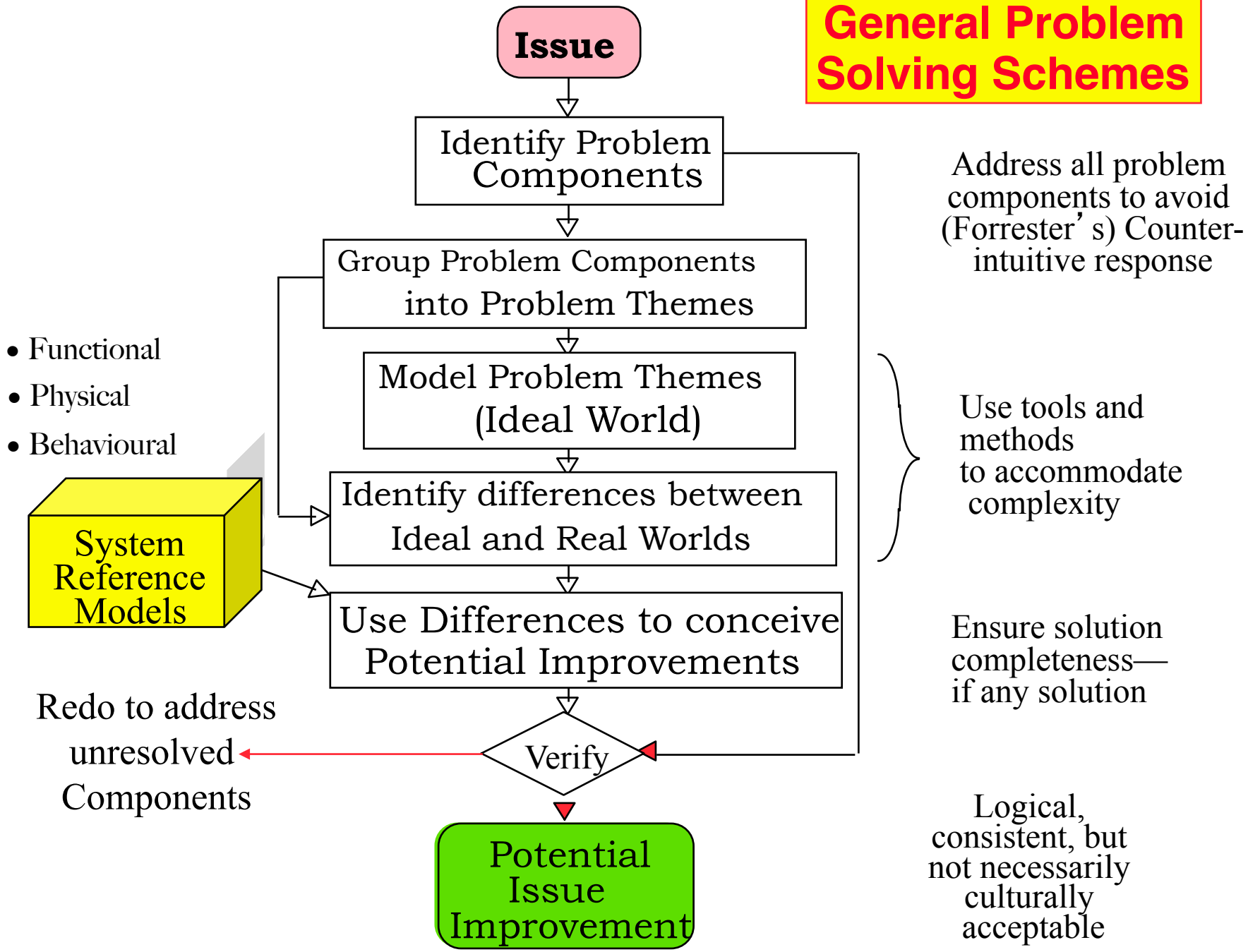
What seems to be the Difficulty?



Some view soft methods as lacking rigour

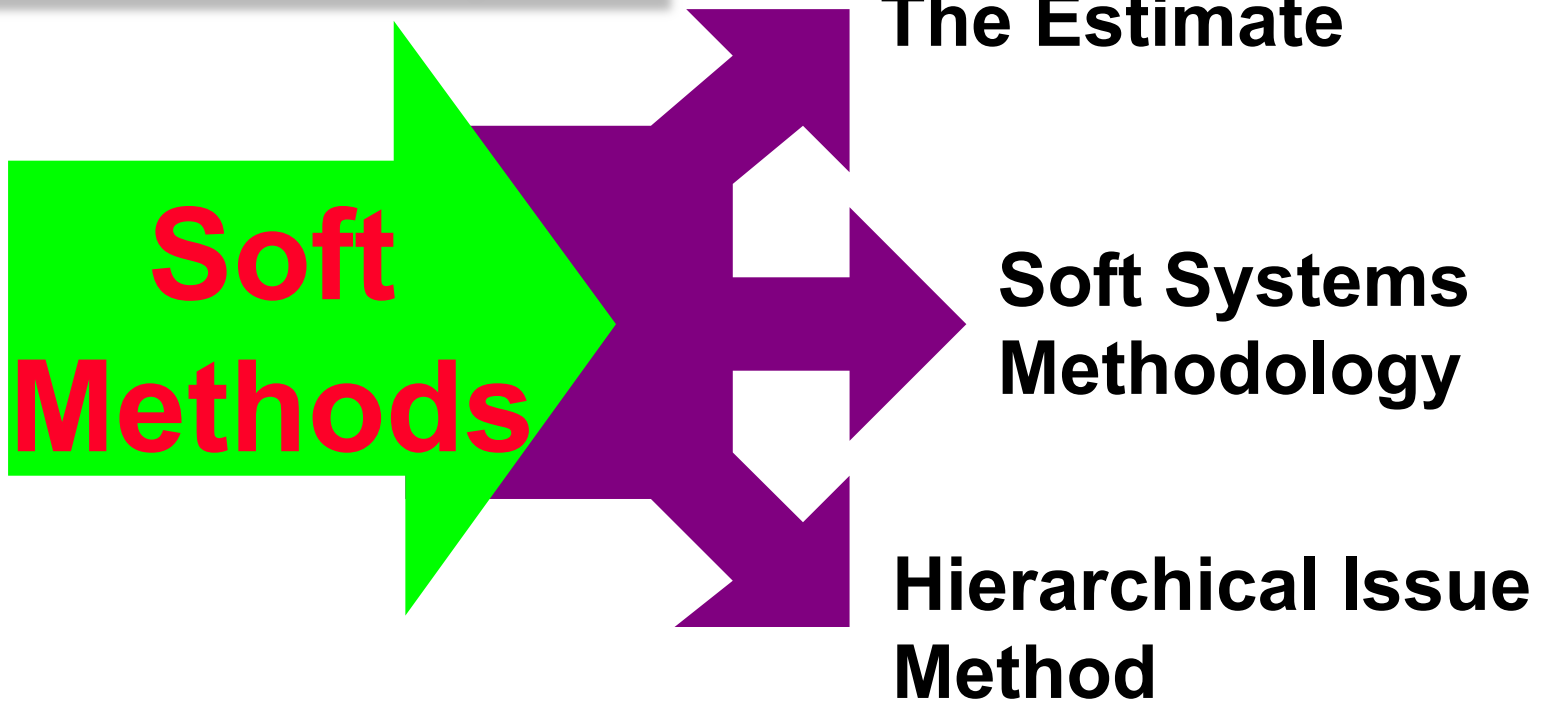
Largely ineffective against human/organizational /command/management problems

General Problem Solving Schemes



What are the Practical Choices?

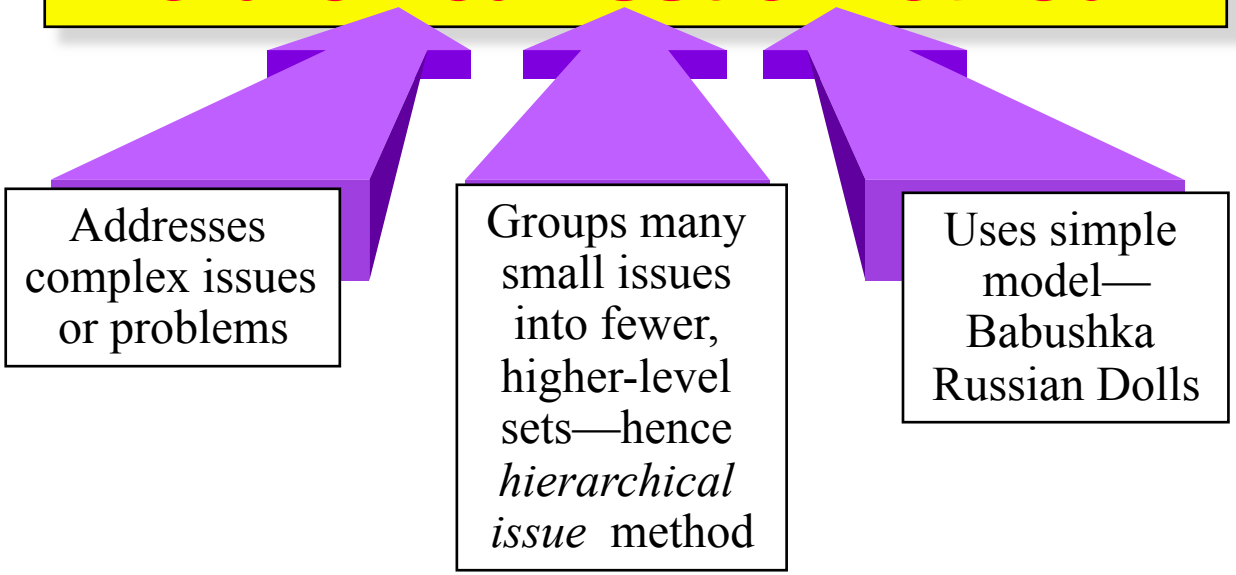
- **Hard methods**
  - –Multivariate analysis,
  - –Petri-Nets,
  - – stochastic models, etc.



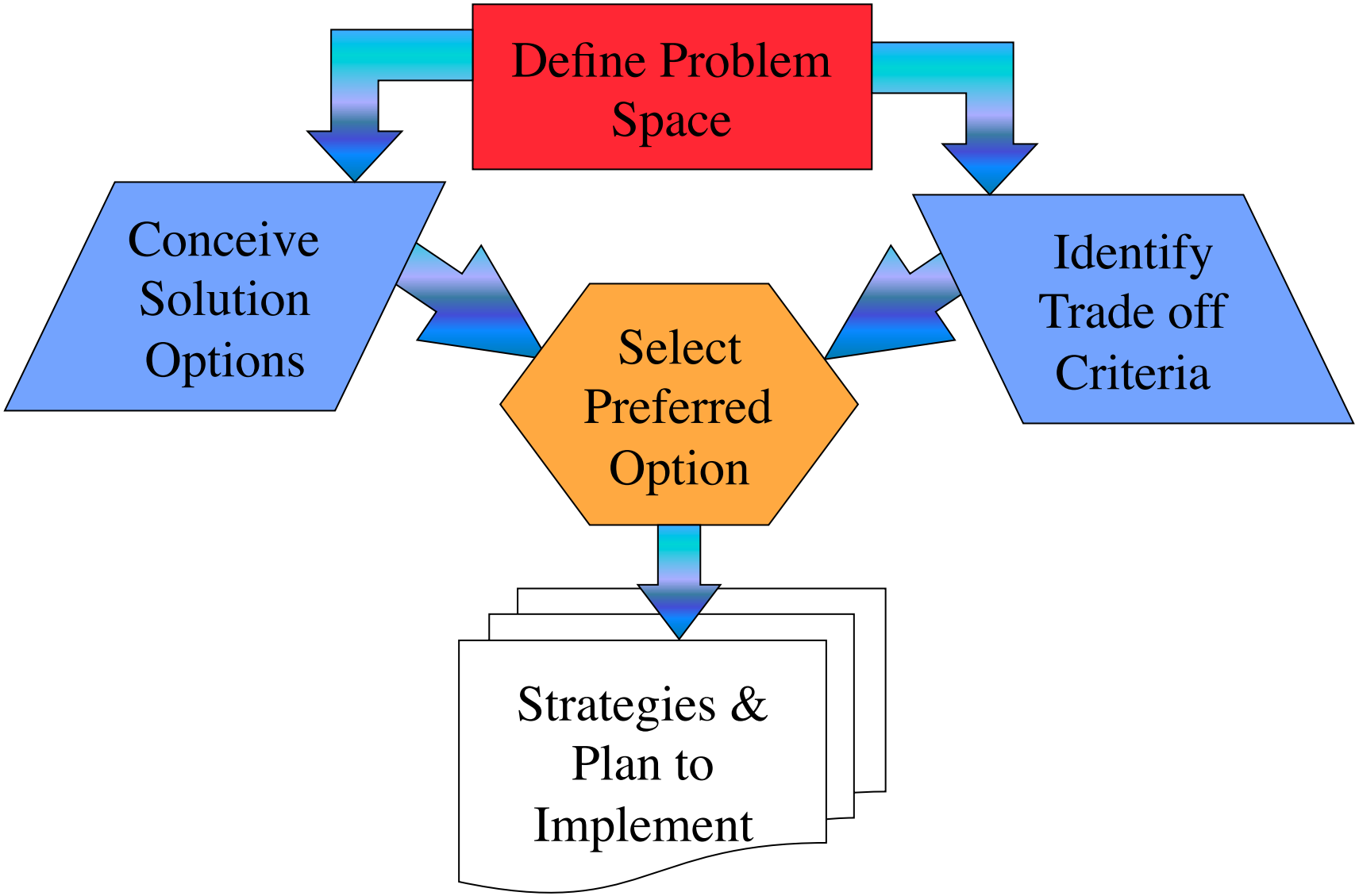
Status of Soft Methods

- **Estimate**: tried, trusted, tedious, seldom used "in anger", not tool supported. No overt reference model
- **Soft Systems Methodology**: current soft favourite, loose framework of steps, little guidance. Lack of rigour believed by many to be its *strength*—"framework for thinking". Not tool supported. Reference Model in abeyance
- **Hierarchical Issue Method**: new, seeks ***rigour for soft problems***, largely untried outside CIT/RMCS. Developing successful case-study record. Tool supported. Reference Model useful

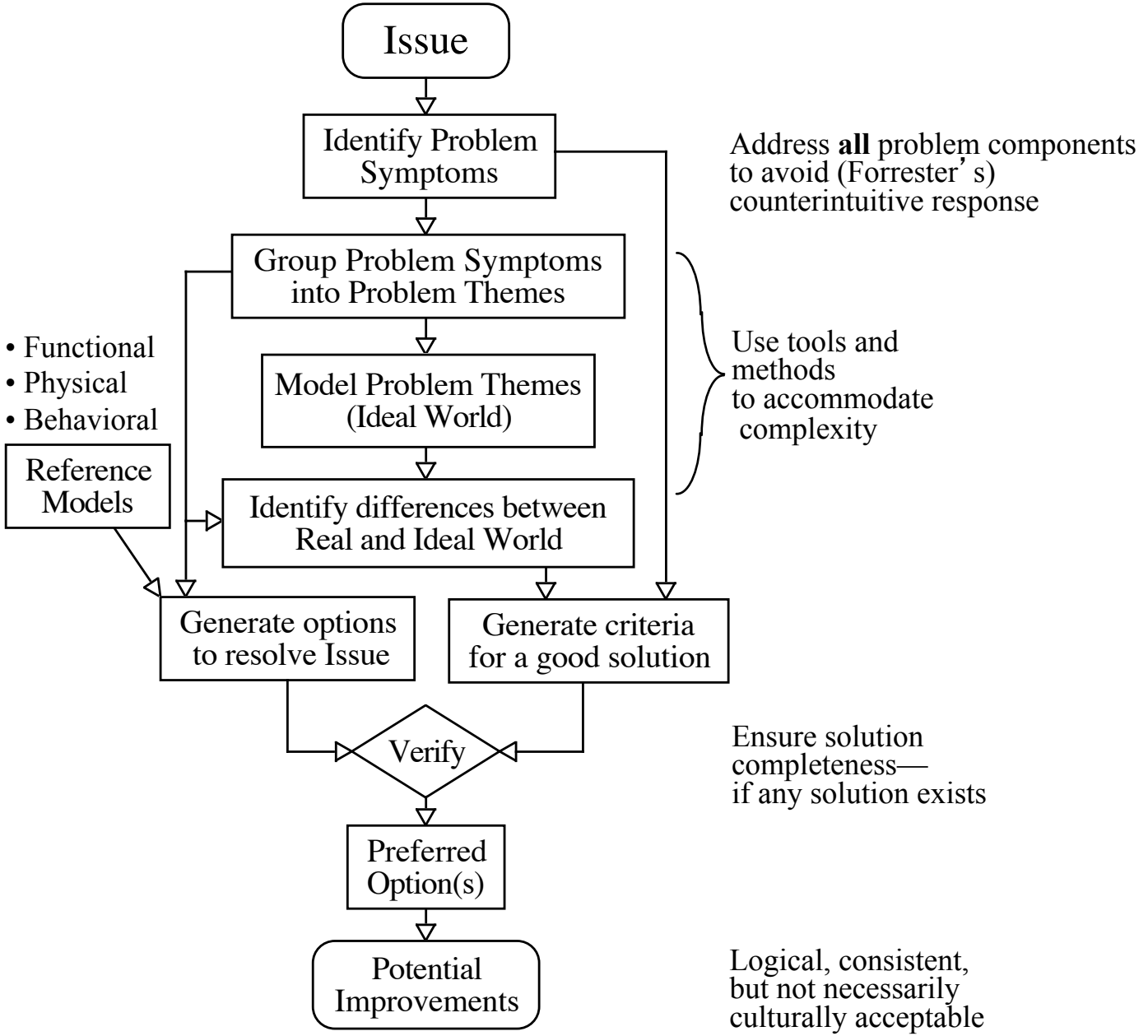
Hierarchical Issue Method…



Systems Engineering Paradigm



HIM combines GPSP and Systems Engineering Paradigm



Structure of HIM

- Made up from a number of simple techniques strung together
- Choice of techniques crucial to resolve vague issues:—
  - each technique must move the process forward
  - output from first must feed smoothly into second, etc.
  - none should eliminate useful information
  - each should encourage new ideas, understanding—especially that developing during the HIM process
- Whole must provide a clear audit trail
- Whole must exhibit rigour, i.e. clear, comprehensive, rationale
- Yet, whole must encompass eclectic viewpoints, information, cultures…

HIM Techniques—1

- System models—provides simple hierarchy framework
- "How-can-we?"—simply asking the right kind of question
- Cause-effect analysis—works from Issue symptoms back to (probable) causes
- Why-Why analysis—reduces superficial treatment of Issue symptoms
- Causal Loop Modelling—systems thinking technique—interrelates symptoms, promotes completeness
- POETIC—acronym for promoting completeness
- Dynamic Systems Modelling—object-oriented systems thinking, using computer simulation
- N^2 and ©CADRAT—Organizational structure analysis and hierarchy shifting, with computer support
- System Diagramming—high-level presentation technique

HIM Techniques—2

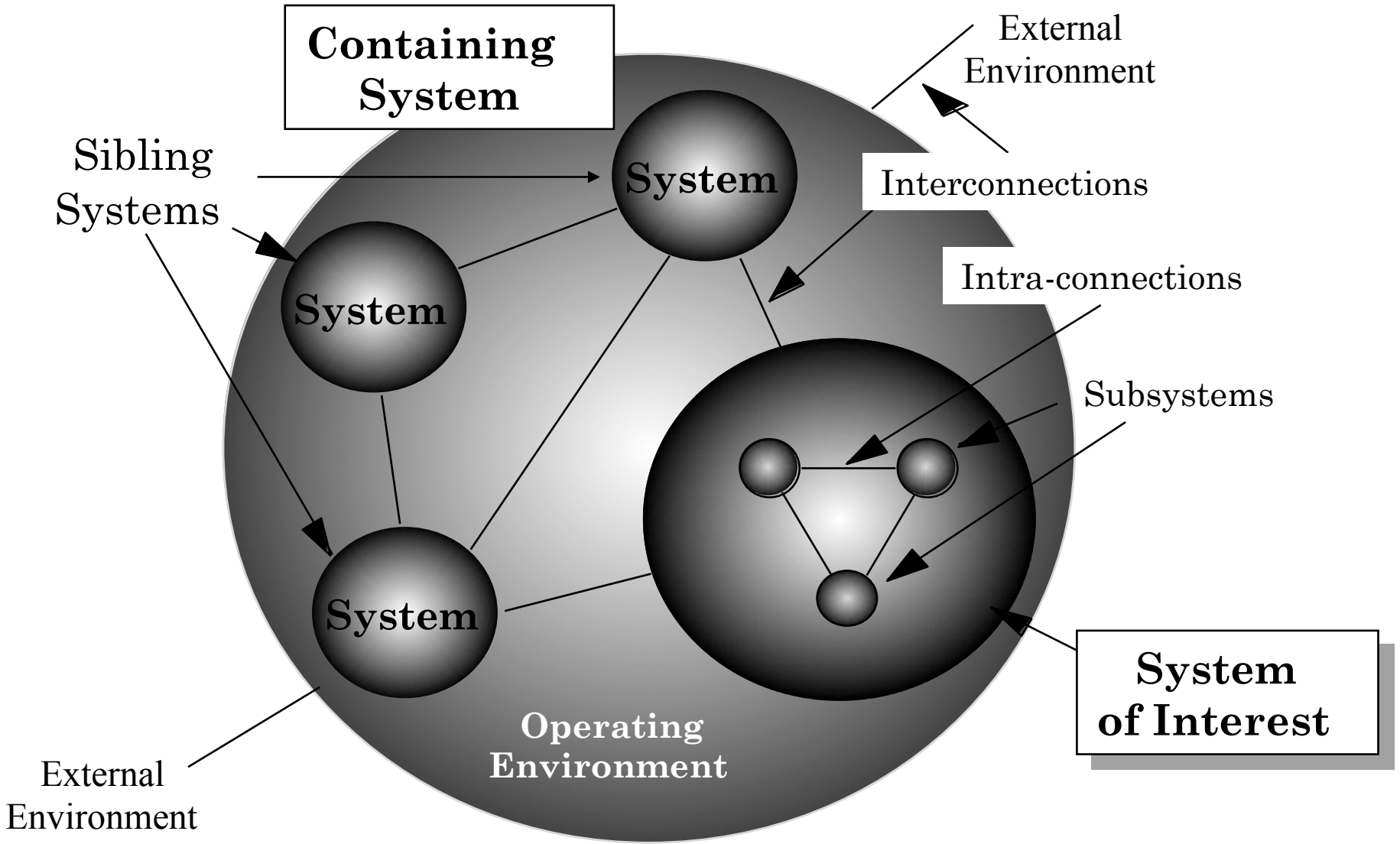
- Each of the techniques is useful on its own
- Strung together, they provide a powerful suite of techniques for addressing the most complex of issues *rigorously*
- Other techniques can be *plugged-in*, with care, e.g. Nominal Group Technique, Interpretive Structural Modelling
- Warnings:—

1. It does not follow that there is always a resolution to an Issue
2. Using the full HIM takes time, patience and (ideally) a team of people with complementary backgrounds
3. Those unfamiliar with such techniques will experience culture shock on meeting them for the first time, therefore…
4. Do **not** show all your analysis to a customer, unless they either ask, or challenge your results

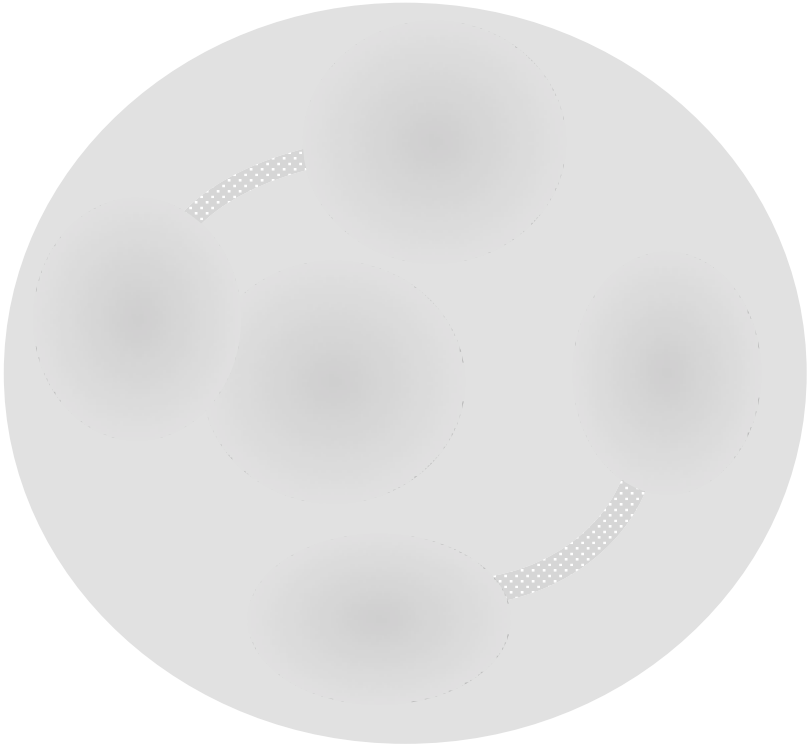
Babushka Russian Dolls

- Systems exist within systems exist within systems…*ad infinitum*
- Babushka Russian Dolls fit one inside one inside one…
- In general, systems fit several related subsystems inside one system

The System Model…



…or are Systems less distinct?



- Systems and their interactions may be difficult to see
- System boundaries may be fuzzy
- Systems may overlap each other
- Subsystems may exist in two or more systems at once

Contained and Containing

- Contained systems exist within a Container or Containing System
  - » Contained systems referred to as siblings, Containing Systems as parents
- Better analogy—mother, father and children contained within Family Containing System
- Hard view places a system uniquely in a Container
  - » module in sub-assembly, in assembly, in unit, in…
- Soft view allows "multiple simultaneous containment" in more than one Container
  - » bus driver in bus, in social group within bus, in TGWU, in his/her family, in local church, in ethnic group. Bus driver's thoughts and actions may be influenced by any or all of these Containers.

Why is HIM different?

- Uses context-free, computer-based tools
  - retains "softness", yet…
  - …can tackle large/complex problems
- Can be "proved" mathematically
  - raises confidence in soft rigour
- Highly traceable
- Works well with multi-disciplinary, multi-viewpoint teams
  - suitable for teams, syndicates, working parties, etc.
- Automatically develops team/individual briefing material

Where can HIM work?

- Intended for soft, works for hard, too
- Right up front, when it is difficult to get started and the wood gets in the way of the trees
- Where superiors/customers may demand justification,
  - e.g. spending public money
  - briefing superiors
- Where a group needs to reconcile differing viewpoints under time pressure

HIM Cons

- Like the Estimate and SSM, takes practice
  - some users find modelling hard at first
- Can drag users into areas of little understanding
- No substitute for knowing your subject
  - experience of problem domain essential
- HIM helps users to understand requirements
  - it does not write the requirement, improve the situation, change behaviour, etc.
  - other methods essential to complement HIM

The GP Approach

- Visit to the doctor
  - "Doc, I don't know what's wrong, but I feel out of sorts…"
- Doc looks for symptoms
  - "What do you do, what has happened to you recently?"
  - checks for deficiencies, excesses, out of balances
    - » urine, blood, electrolytes, sugar levels, etc.
    - » spots, discoloration, temperature, bloodshot eyes, etc.
- Greater variety of symptoms, greater prospect of diagnosis
- Postulates potential causes for each symptom, then…
- …potential causes common to several symptoms
- Hence diagnosis from cause(s) common to many/all symptoms

HIM operates on similar lines

HIM—Seven Steps to…

Step 1. Appreciate broad area of concern

Step 2. Find the symptoms causing concern

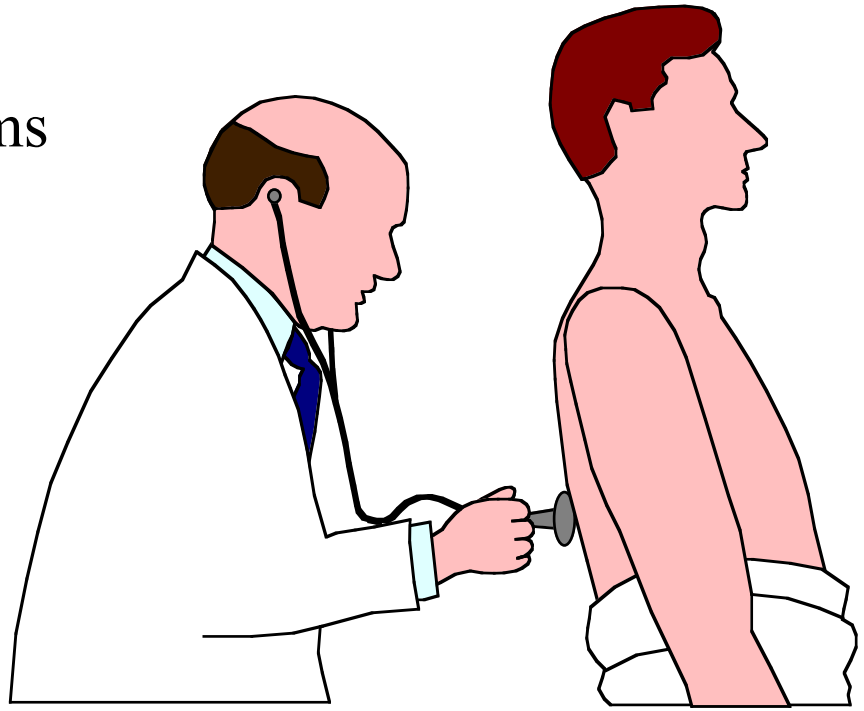
Step 3. Find suspect *implicit* systems

Step 4. Group suspect *implicit* systems into sets

Step 5. Highlight set deficiencies compared with ideal

Step 6. Propose requirements (remedy) for cure

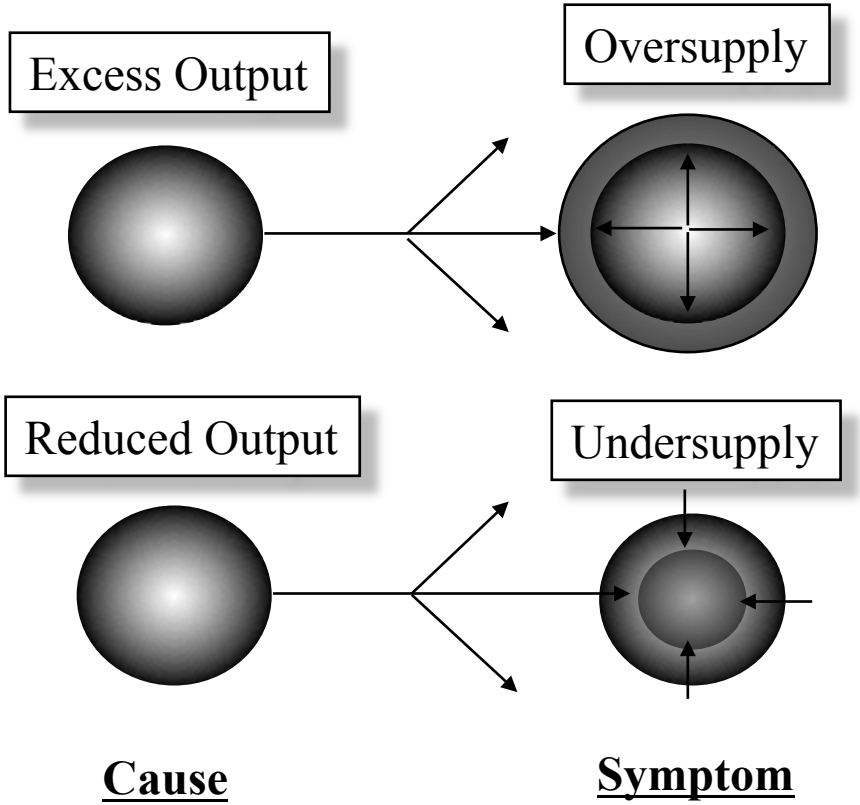
Step 7. Check requirements (remedy) resolve all symptoms

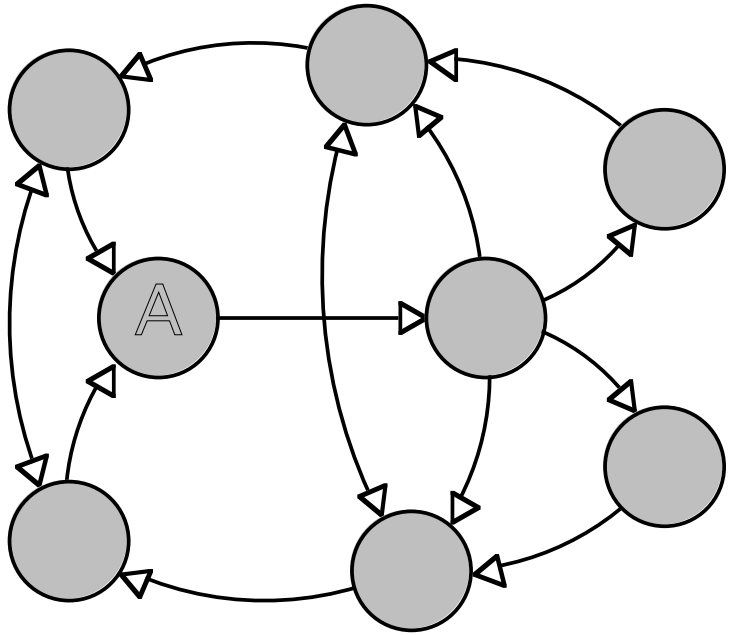


Getting started—finding Issue Symptoms

- Symptoms are indications of change from a previous, supposedly-satisfactory state
- Symptoms can be found by:—
  - asking questions, interviewing, from reports, statistics
  - observation
- Some symptoms arise from lack of co-operation (synergy) between the various people/parts in a complex system where, perhaps, co-operation previously existed
- Other symptoms arise from culture—people caught in the trap of their experience, unable/unwilling to see other viewpoints:—
  - MacGregor's Theory X and Theory Y

Symptoms Arise where the Problem Isn't





Q. If A changes its output, where will the symptom appear?

What causes symptoms?

- Symptoms often occur where the problem isn't(sic)
  - » Pain in left arm from heart attack
  - » Poor performance from lack of training
  - » Poor reception from weak transmission
- Symptoms arise due to an imbalance between previously-balanced system pairs:—
  - » Pain from imbalance between *system for supplying blood* and *system for energising muscles*
  - » Poor performance from imbalance between *system for setting training* needs and *system for training*
  - » Poor reception from imbalance between *system for generating signals* and *system for receiving signals*
- One symptom may arise from several causes/imbalances:—
  - » Pain in left arm from imbalance between *system for sensing pain* and *system for suppressing pain*
  - » Poor performance from imbalance between *system for directing personnel* and *system for following directions*
  - » Poor reception from imbalance between *system for amplifying signals* and *system for suppressing noise interference*

The "How-can-we"s

- Symptom categories emerge according to question posed.
- "How can we…?" elicits perceived current barriers to improving group situation/performance/effectiveness, efficiency, quality, etc.
- "What do *you* think is wrong?" elicits parochial views, cultural perceptions, pet cures
- Responses convert to symptoms:—
  - » "How can we become more efficient?"—perceived low efficiency
  - » "How can we improve morale?"—perceived low morale
  - » But—"I think that the management doesn't know what it is doing"—lack of confidence, low morale?
  - » and—"I think we should change our suppliers—they're hopeless!"—pet cure, may be incorrect diagnosis, but worth following up?

The Five Whys

- Popular in Japan—ask why up to five times
- Why are you inefficient? Because we waste effort
- Why do you waste effort? Because we don't plan carefully
- Why don't you plan carefully? Because we are in too much of a hurry
- Why are you in too much of a hurry? We're trying to do too much with too few people in too little time
- Why are you trying to do too much…? We underestimate the amount of work needed to address tasks properly

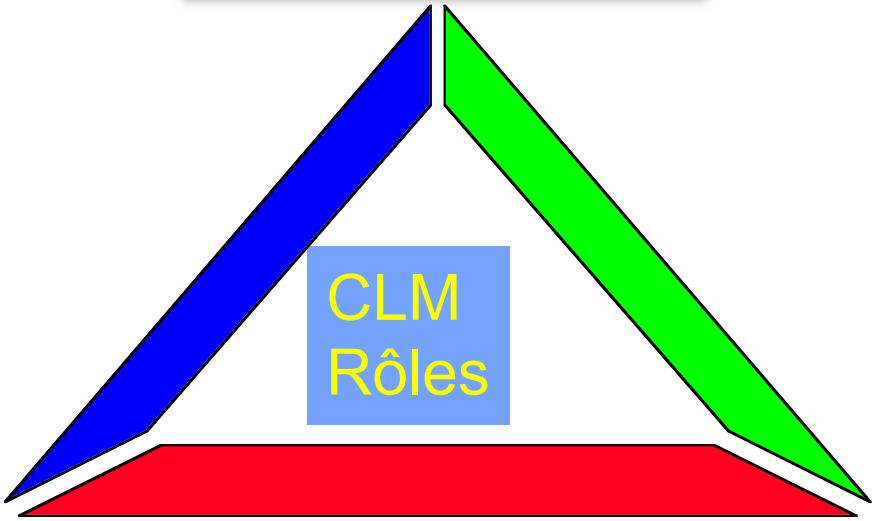
Real causes of inefficiency:—

overstretched resources—imbalance between resource estimation and tasks

Locus of Possible Causes

- For any given symptom there may be several potential causes—generally, impossible to be sure
- Must—identify all possible causes, treat all as suspect—hence, "locus of possible causes"
- Later HIM steps sort *probables* from *possibles*

Rôles for CLM



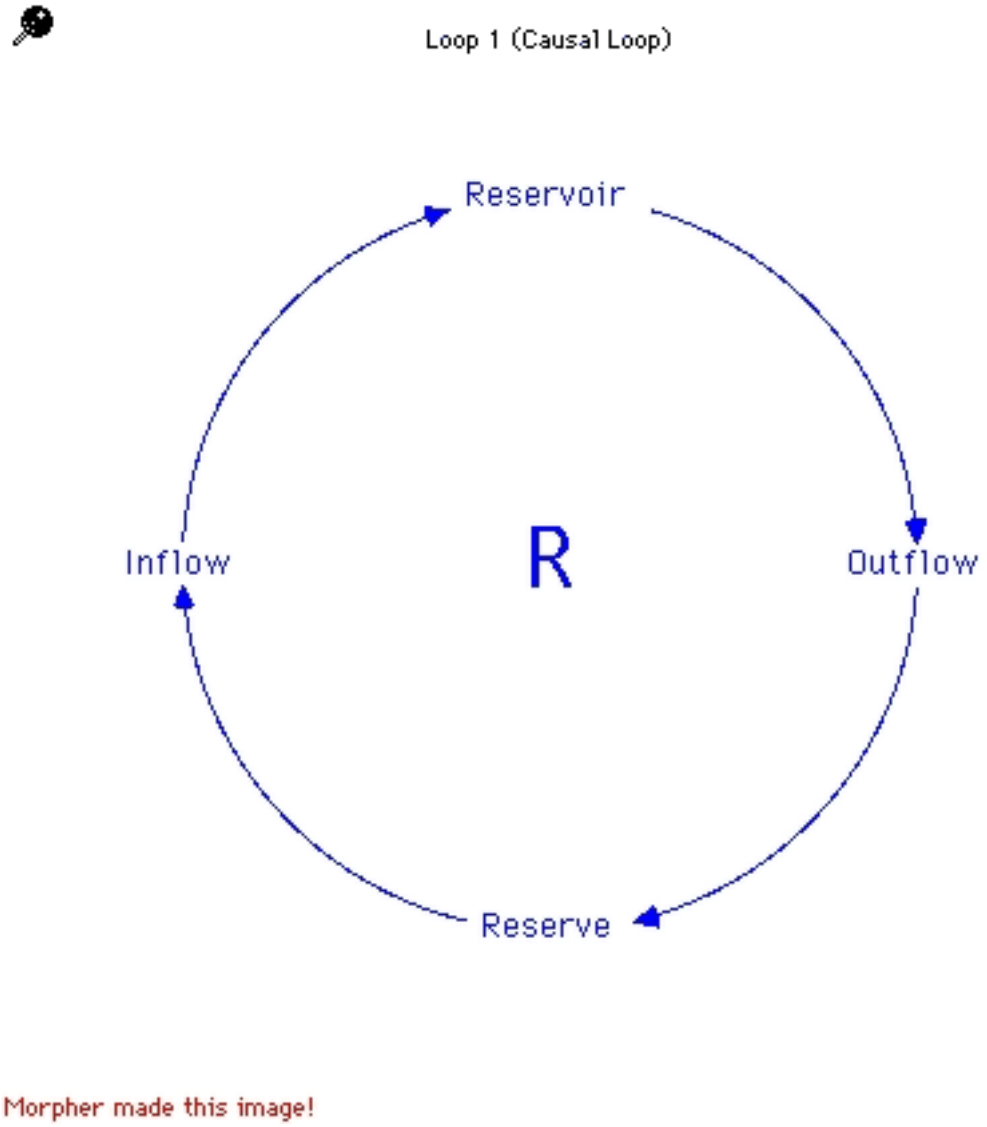
The Rôles of Causal Loop Modelling (CLM)

Rôle A: Possible causes of symptom arise in same overall system. CLM used to find relationships between possible causes. Seeking loop closure often reveals new factors—additional possible causes

Rôle B: Possible causes of symptom represent potential problem areas—negatives. CLM developed without negative concepts, producing Ideal World model directly from possible causes.

Rôle C: CLM is ideal start point for iThink™/STELLA™ or similar dynamic modelling tools

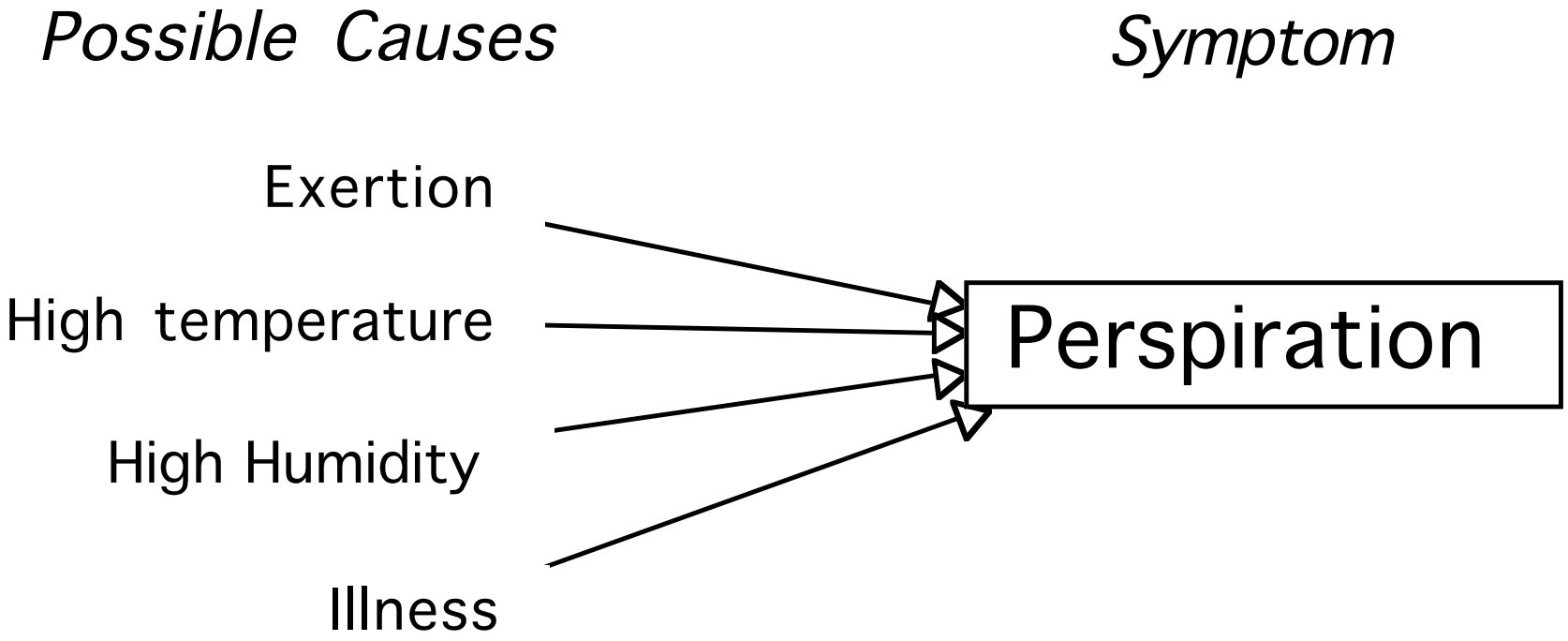
From Causal Loop to STELLA™



Laundry Lists and CLMs

"We are trained to think in Laundry List fashion"

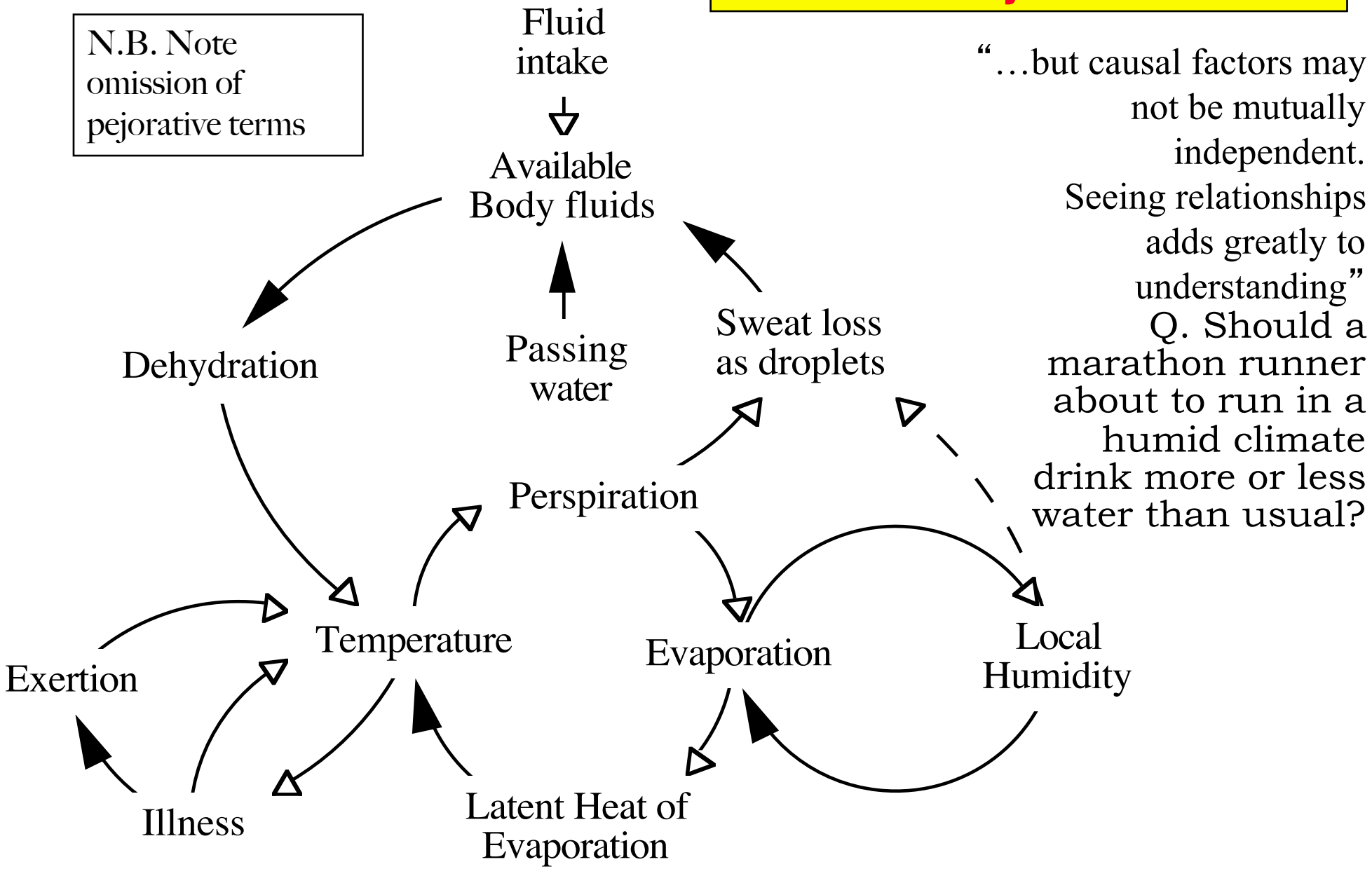
Barry Richmond, High Performance Systems Inc



Laundry List mentality helps generate possible causal factors,
but the process misses out the relationships between the causes

From Laundry Lists to CLMs

N.B. Note omission of pejorative terms



"…but causal factors may not be mutually independent. Seeing relationships adds greatly to understanding"

Q. Should a marathon runner about to run in a humid climate drink more or less water than usual?

Creating CLMs

1 Identify the symptom

2 Establish a Laundry List of contributing factors, including organizational, technological, cultural, political, economic, etc., according to Issue

3 Develop a series of simple CLMs combining contributing factors, using nouns or noun phrases only and dropping any features from the Laundry List which suggest bias, such as 'low', 'heavy', 'poor', 'hot', etc.

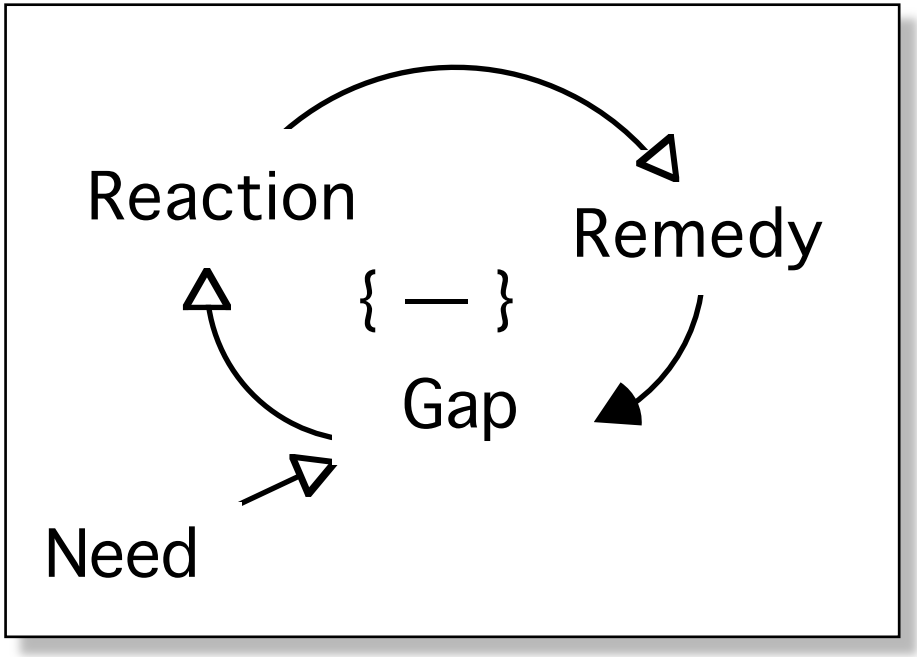
4 Integrate the set of simple CLMs into a fuller single version, including the Entity to be modelled.

Archetypal CLM—1

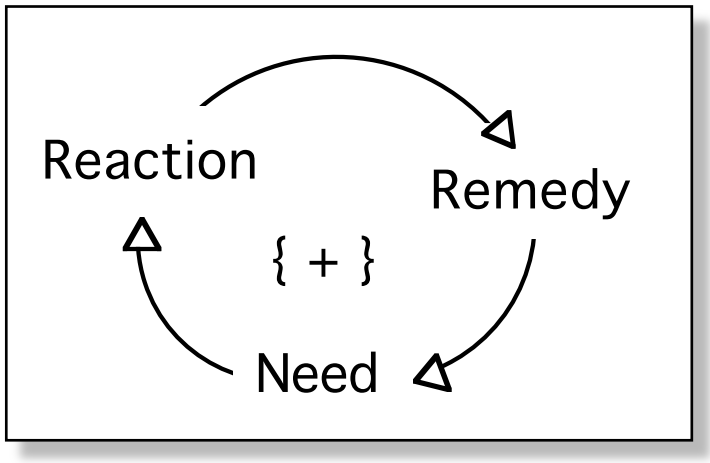
Often a good way to start when addressing requirements.

Need is perceived as a shortfall, or gap (which can be excess as well as shortfall)

Need creates some reaction—management response, complaint—which results in a proposed remedy, which begins to close the gap (black arrow-head). As presented, a negative feedback, or control, concept…

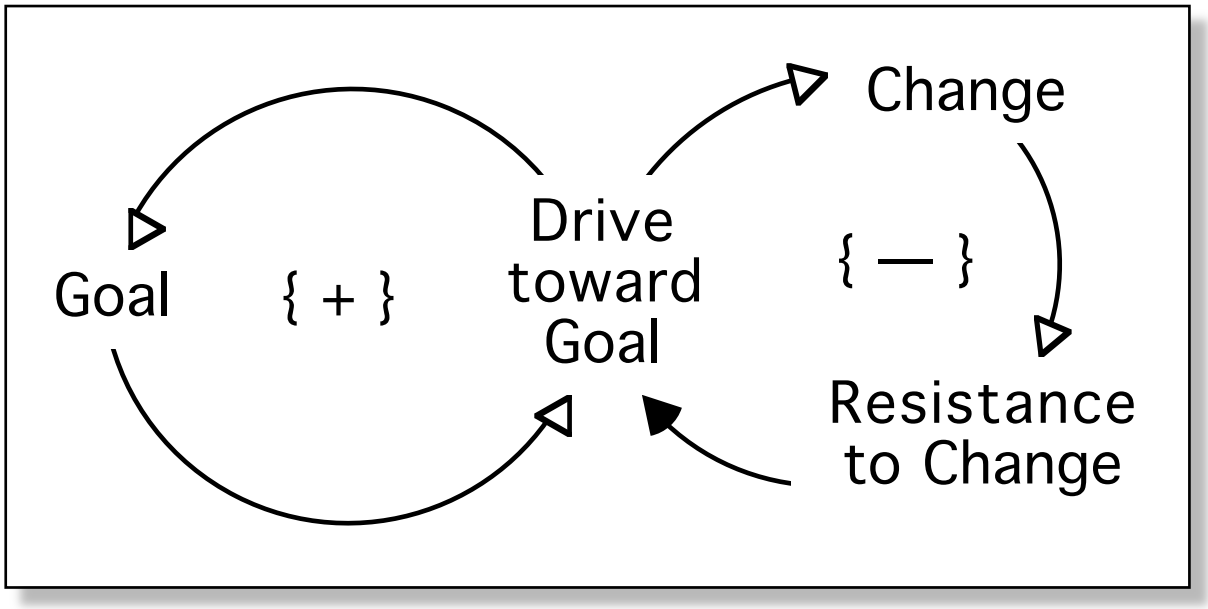


…but equally valid as a positive feedback loop in which case it presents a continual self re-inforcing loop, able to spin up—or spin down!



Archetypal CLM—2

after Peter Senge, *The Fifth Discipline*

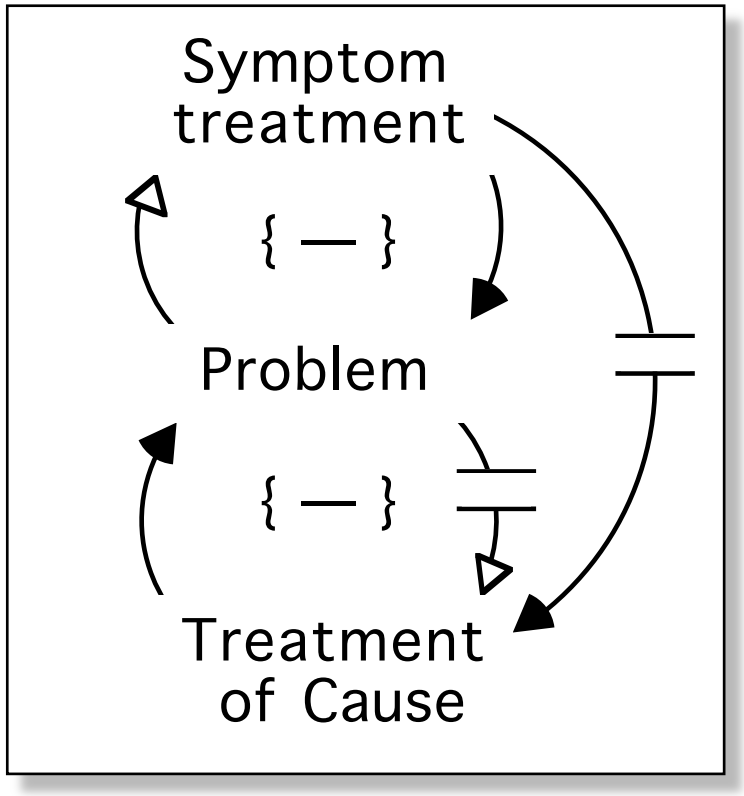


- Classic resistance to change
- Best seen as a basis for explaining organizational behaviour

Archetypal CLM—3

after Peter Senge, *The Fifth Discipline*

- Upper loop represents treating the symptoms rather than the underlying cause
- Lower loop invokes in-depth treatment of the underlying cause, but only after some delay —represented by the parallel lines—and expense needed to do the job properly
- Outside connection shows that effort expended on treating symptoms detracts from effort available to treat real cause. i.e. management short-termism



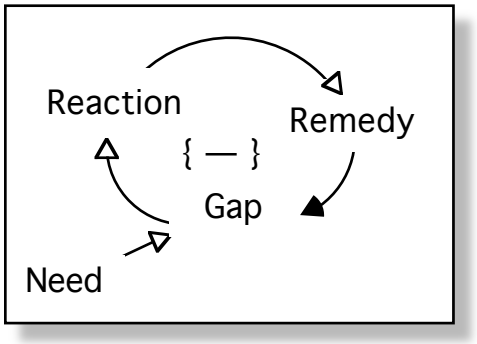
Assignment

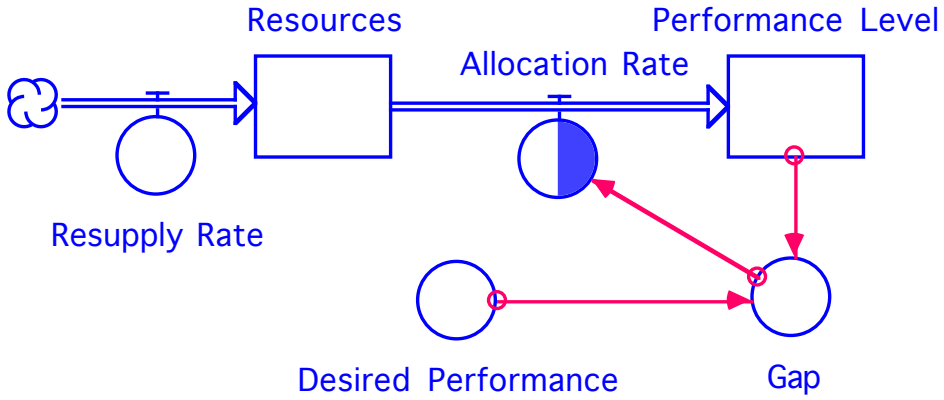
- "Overheard in the Local"—you overhear a conversation (provided) in a public house or restaurant. Identify the Issue, pick out the six symptoms you consider most important
- Bring the symptoms together into a causal loop model, identifying any additional symptoms necessary to close the loop
- Apply the Why-Why Technique to each symptom in turn, to identify the root cause or causes—there may be more than one—using POETIC as your guide
- Bring the root causes together into a CLM, identifying any additional symptoms necessary to close the loop
- Compare and contrast the two CLMs

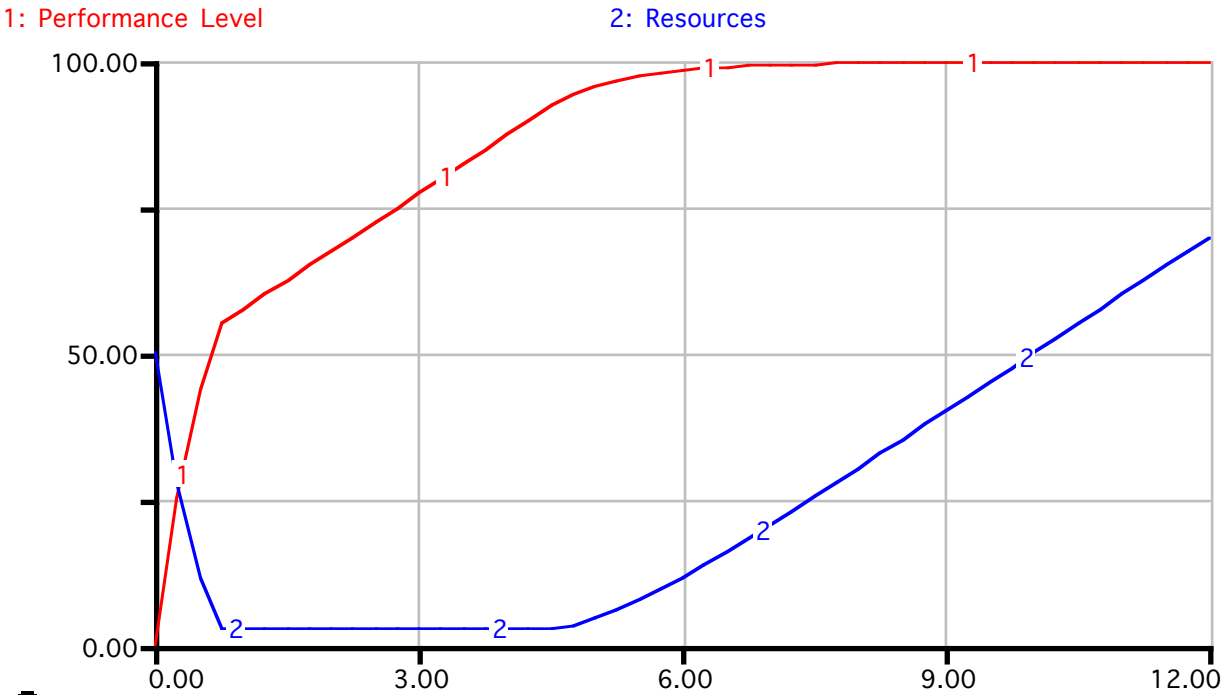
Exploring CLMs—if Necessary

- Causal Loop Models are all very well but…
- …they have limits
  - how long does it take to go round?
  - can behaviour represented by loops be unstable?
  - interactions between loops can be difficult to interpret
- *Sometimes* it is helpful to dig deeper
- iThink™/STELLA™ is a convenient tool for next-level analysis—there are may others…

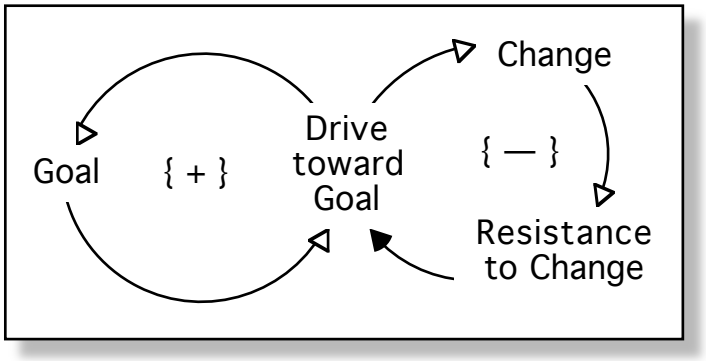
STELLA™ and CLM Archetype—1

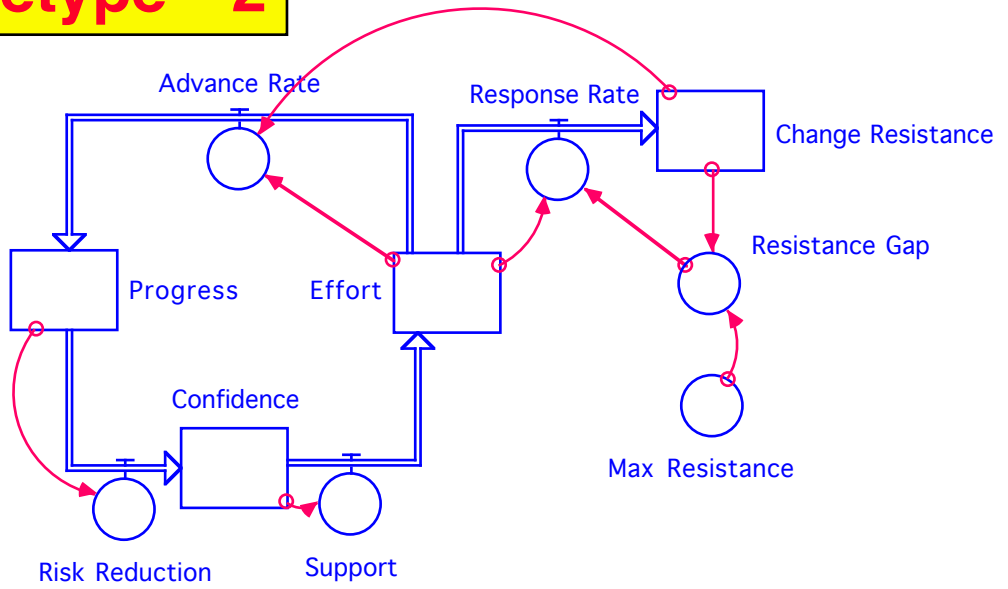


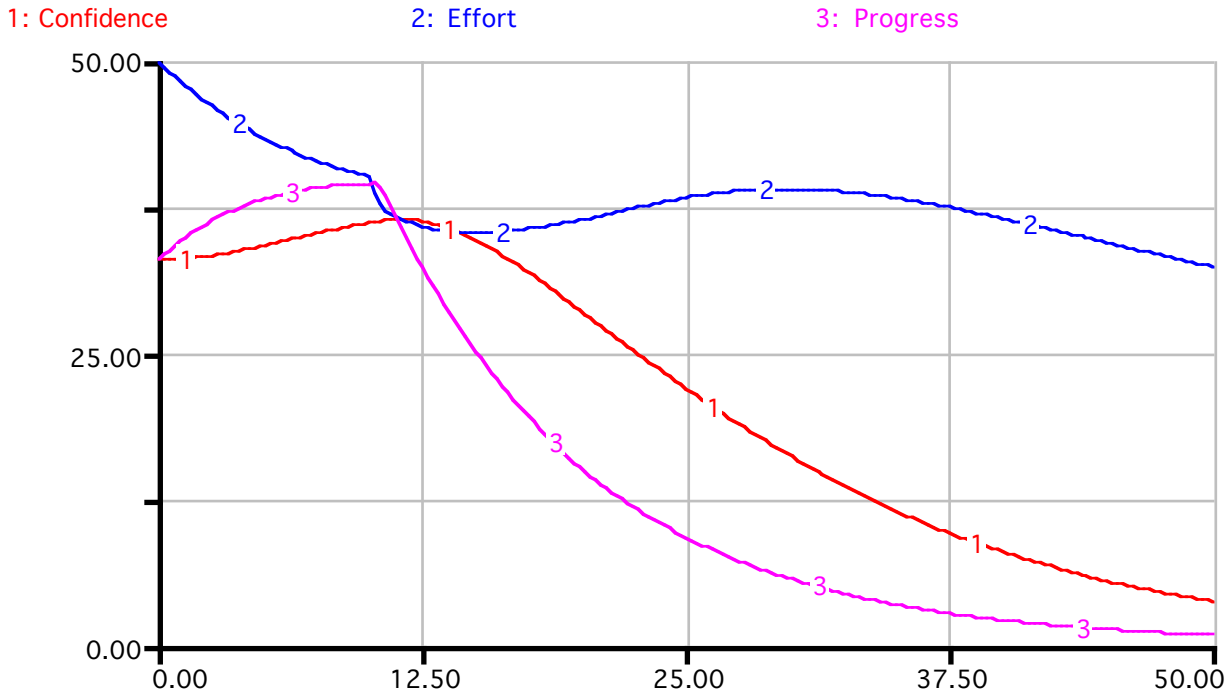




STELLA™ and CLM Archetype—2

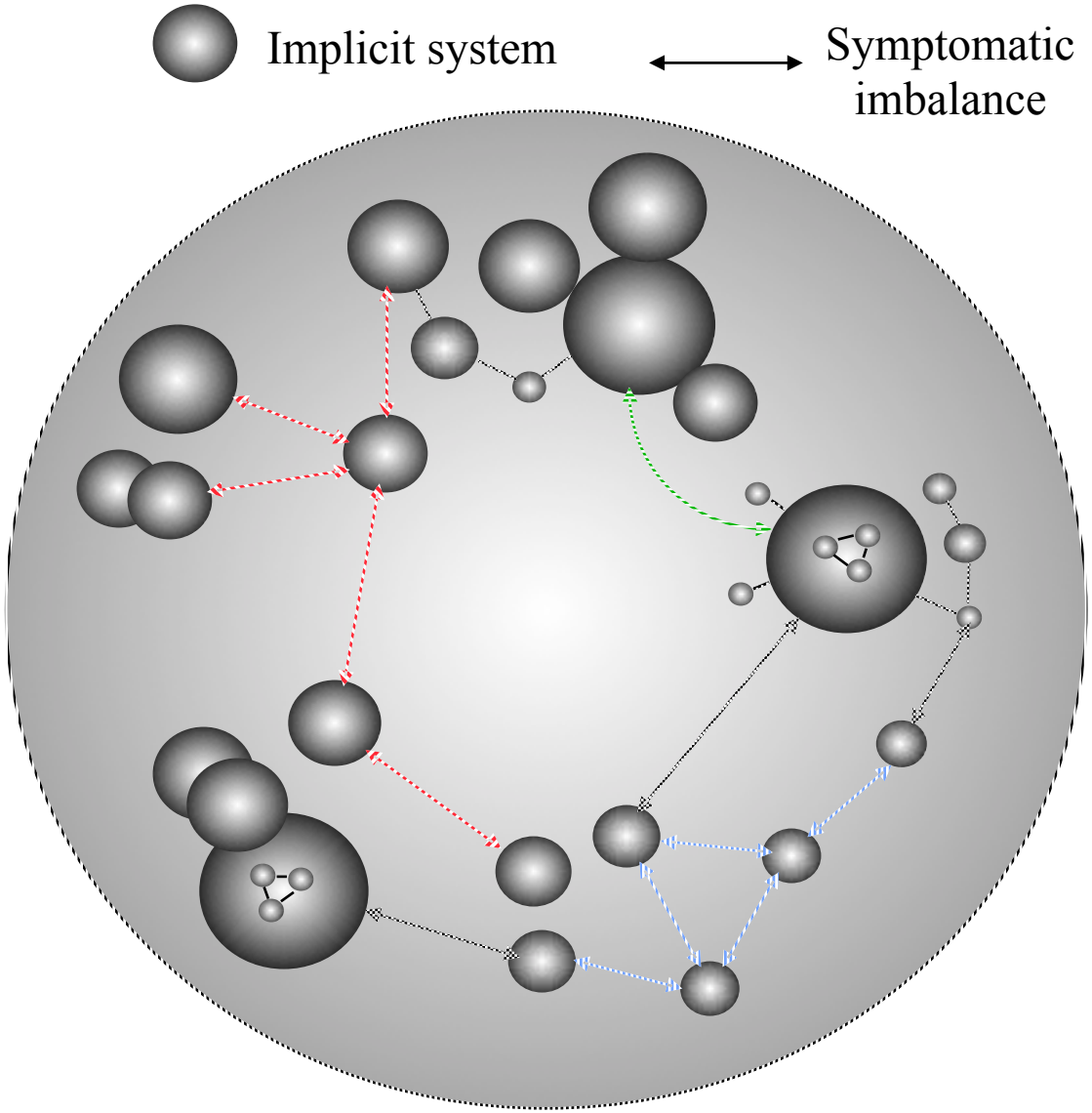






Notional Systems View of Issue, with Issue Symptoms & Implicit Systems

- Issue contains many suspect implicit systems, identified by the Issue symptoms
- Task is to:
  - identify, sort into sets, find common themes,
  - understand Issue, postulate requirements which—if met— would resolve all symptoms—
  - hence resolve Issue too



From Symptom to Implicit Systems

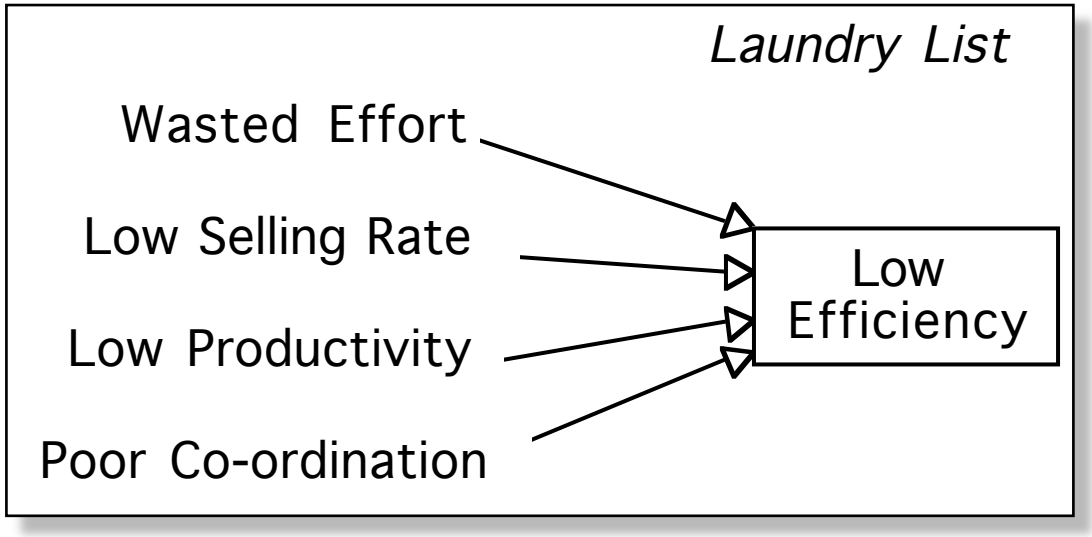
- Sometimes it is straightforward to go from a symptom direct to the implicit systems which must be in some state of imbalance either within themselves or in their mutual interchanges
  - e.g. low power may be caused by inadequate generation or excessive consumption
- At other times it is less obvious,
  - e.g. locus of possible causes for low morale, poor performance, inefficiency
- In latter cases, a method for "thinking aloud" is useful
  - shown in following slides
  - tackles low efficiency

How Much Depth and Detail?

- If a symptom appears to emerge from within a single system, rather than from between two systems, the de-composition is insufficient
  - e.g. symptom:—
    - » power failure—may be inadequate to say it comes from a single system…for supplying power. Gives inadequate diagnosis—dependent on context
  - e.g.symptom:—
    - » imbalance between system for generating power and system for conveying power, or between system for supplying energy (mains, battery, petrol engine, etc.) and system for generating power.Gives diagnosis which may be sufficient in context
- Identifying imbalance between pairs of implicit systems determines minimum analysis depth

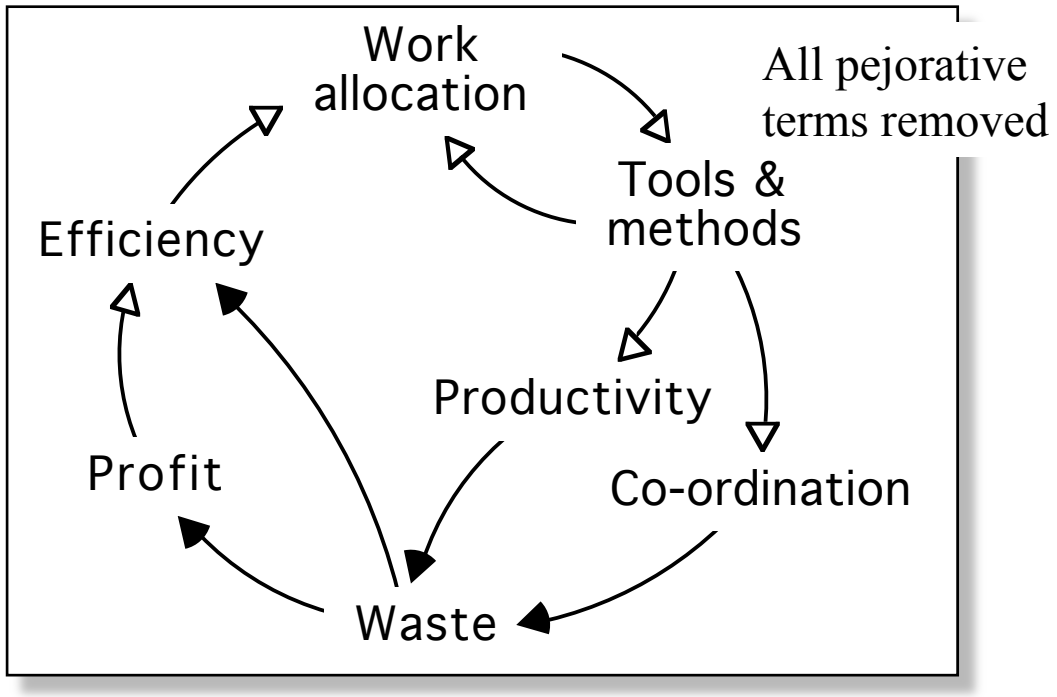
Developing a Simple CLM—Company Efficiency

Reproduced by permission of BSC Partnership



- Reasons for low efficiency provided by members of company, statistics, comparison with other companies, etc.
- Symptom is Low Efficiency
- Symptom and suspect causes expressed in pejorative form

Efficiency CLM

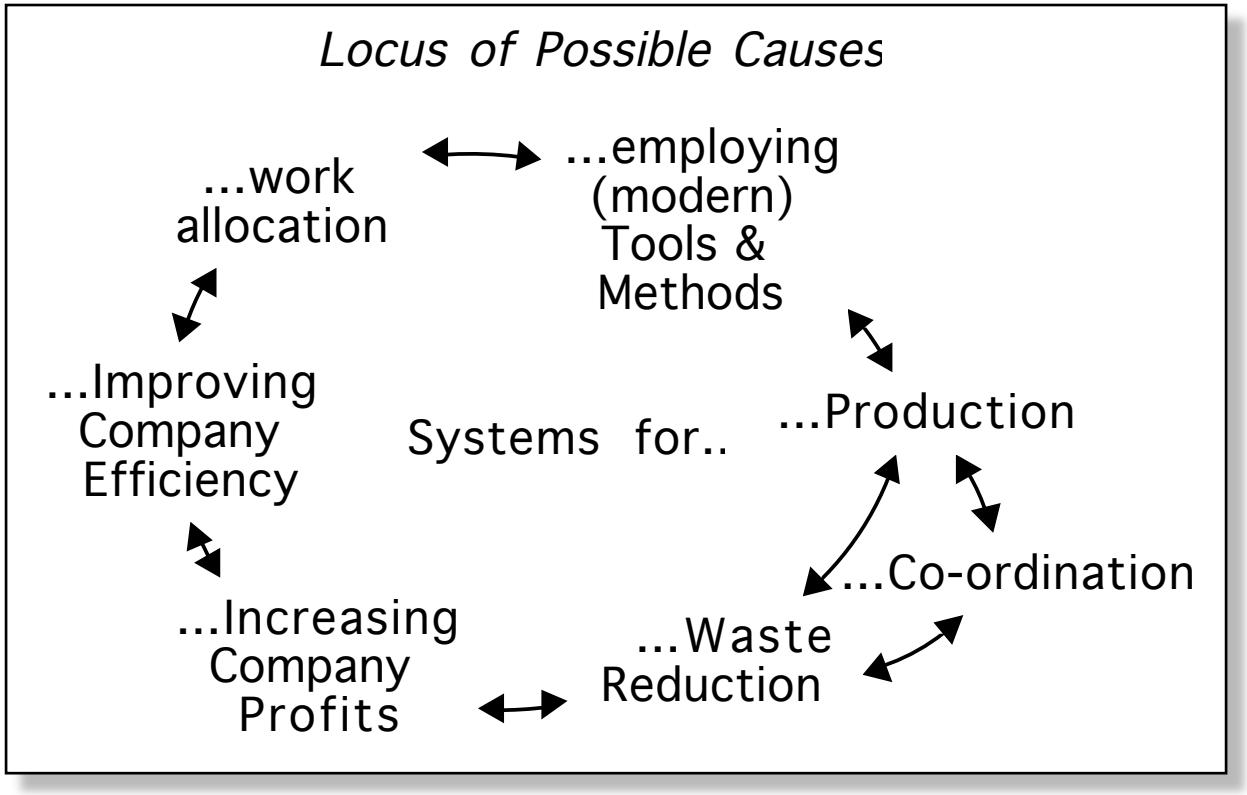


- (Drive for)Efficiency causes improved work allocation which causes/is enabled by better tools and methods which enable better productivity and co-ordination…
- Loop works for improving and degrading efficiency
- Work allocation and Tools and Method emerged as part of "thinking round" the loop—could be added to original LL

The meaning of "Implicit"

- Implicit systems exist in practice, but need be neither tangible nor coincident with an organizational boundary
  - » e.g. A system for maintaining discipline
  - » e.g. A system for marketing
  - » e.g. A system for supplying power
  - » e.g. A system for leading the team
- Related *implicit* systems are *implied* by the symptom:—
  - "low efficiency" implies *a system for undertaking work* and *a system for judging the effort expended against some norm.*
  - "Lack of plans" implies *a system for planning* and *a system for requiring/using plans*
- Practice shows that starting the description of an implicit system with the words: "A system for…" results in a useful, soft description of a purposeful/purposive system

Low Efficiency—Locus of Possible Causes



- Possible causes of the symptom then translate directly into implicit systems as "systems for…"
- Locus of possible causes then lies in the implicit systems and in the interchanges between the systems, e.g. systems for… production and …waste reduction, systems for…improving company efficiency and …work allocation, etc.

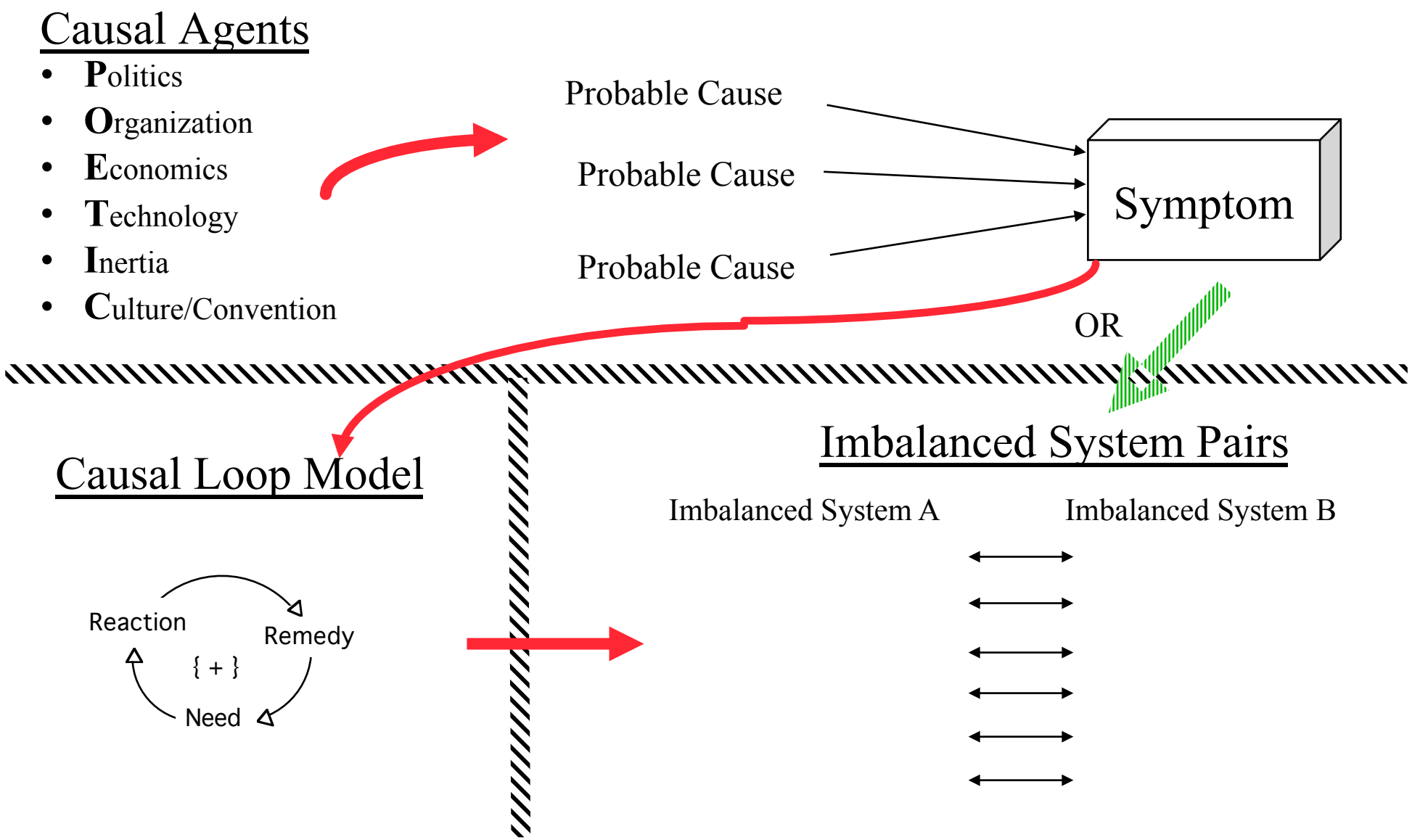
Implicit System Pairs

- Generated by working around the loop, identifying pairs of systems

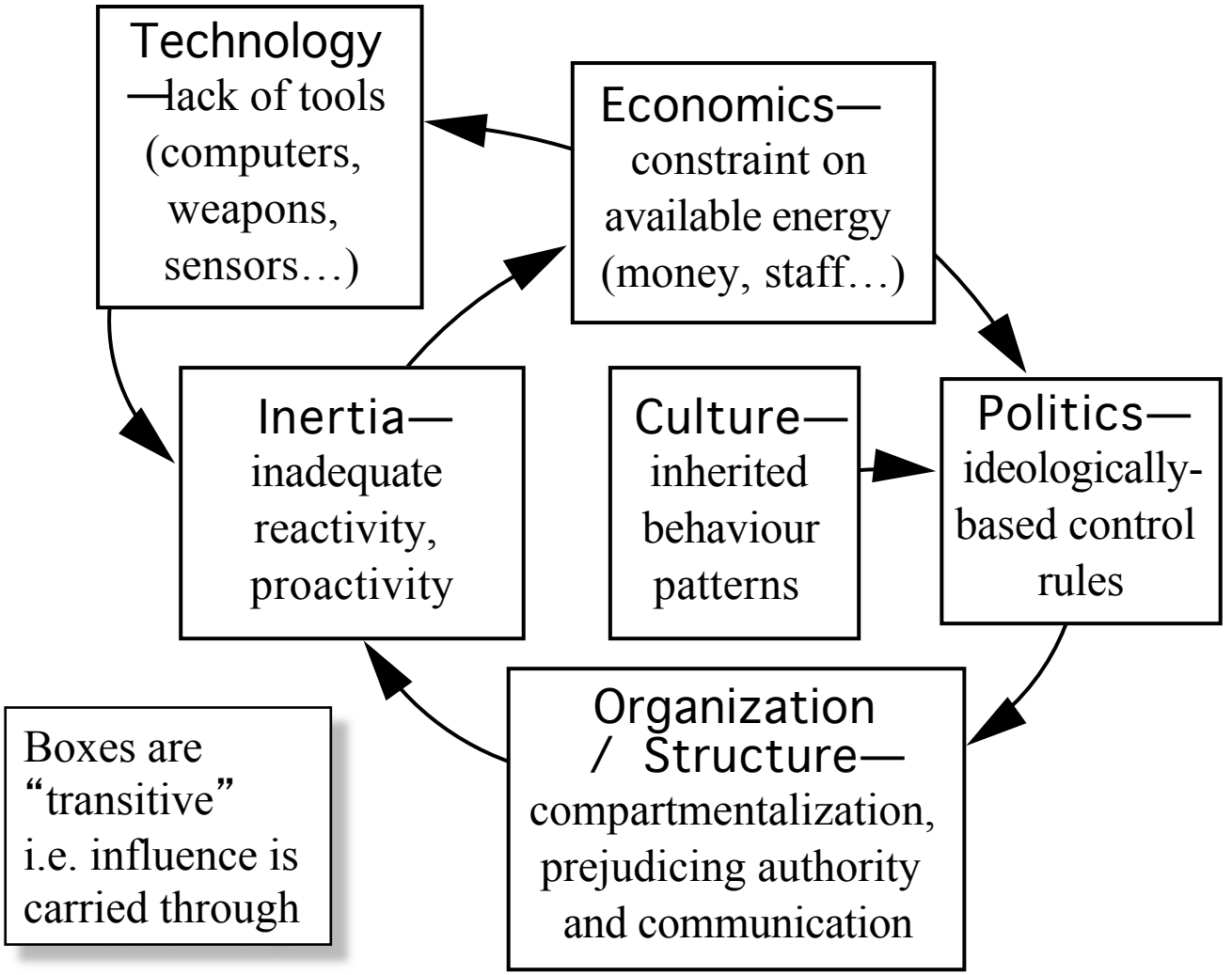
Imbalanced System A		Imbalanced System B
…improving Company efficiency	⟷	…work allocation
…work allocation	⟷	…employing tools and methods
…employing tools and methods	⟷	…Production
…Production	⟷	…Co-ordination
…Production	⟷	…Waste Reduction
…Co-ordination	⟷	…Waste Reduction
…Waste Reduction	⟷	…Increasing Company Profits
…Increasing Company Profits	⟷	…improving Company efficiency

- No significance in which column
- Exercise repeated (with or without LL &CLM) for all symptoms
- Provides rich base for subsequent Issue appreciation

Template for Generating the Locus



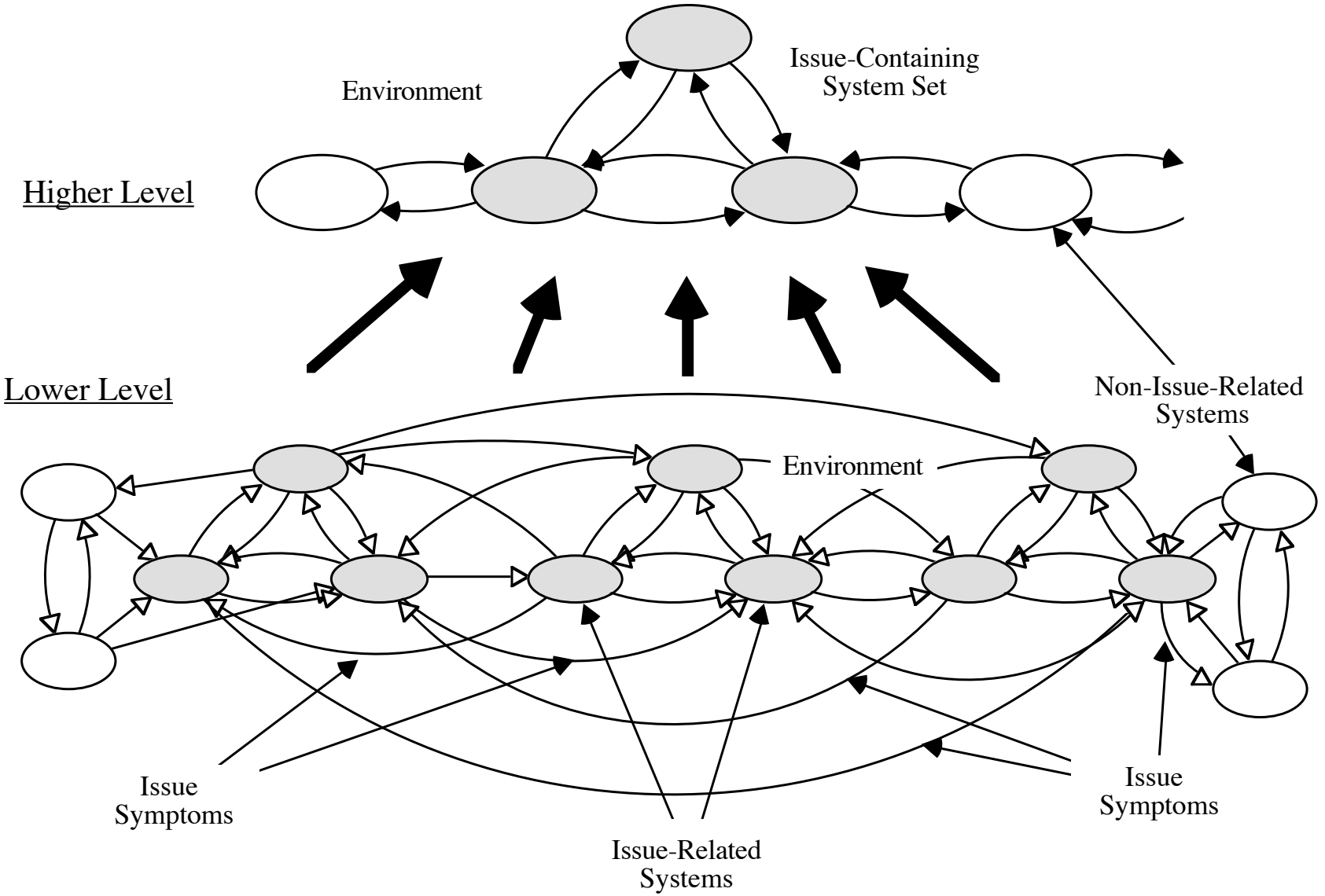
P.O.E.T.I.C.—Likely Causal Agents



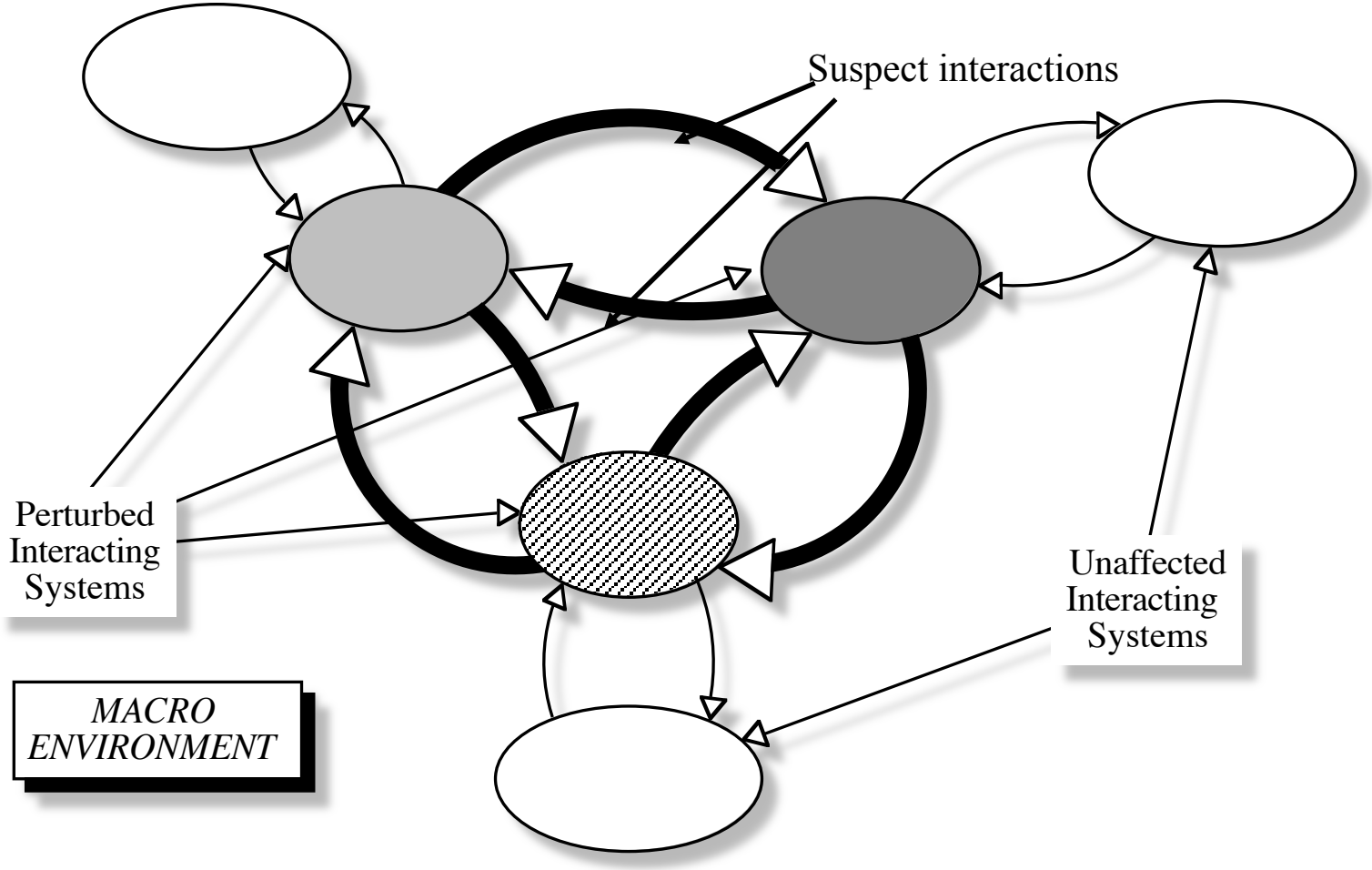
Tackling the Complexity

- V. unlikely that the variety, profusion of implicit systems and likely causes can be sensibly addressed by normal intelligence
- Tackled by grouping implicit systems, and their symptomatic imbalances into groups—Containing Systems
- With many fewer groups (Containing Systems), may be practicable to appreciate, understand, propose sensible resolution

Synthesis by Hierarchical Aggregation



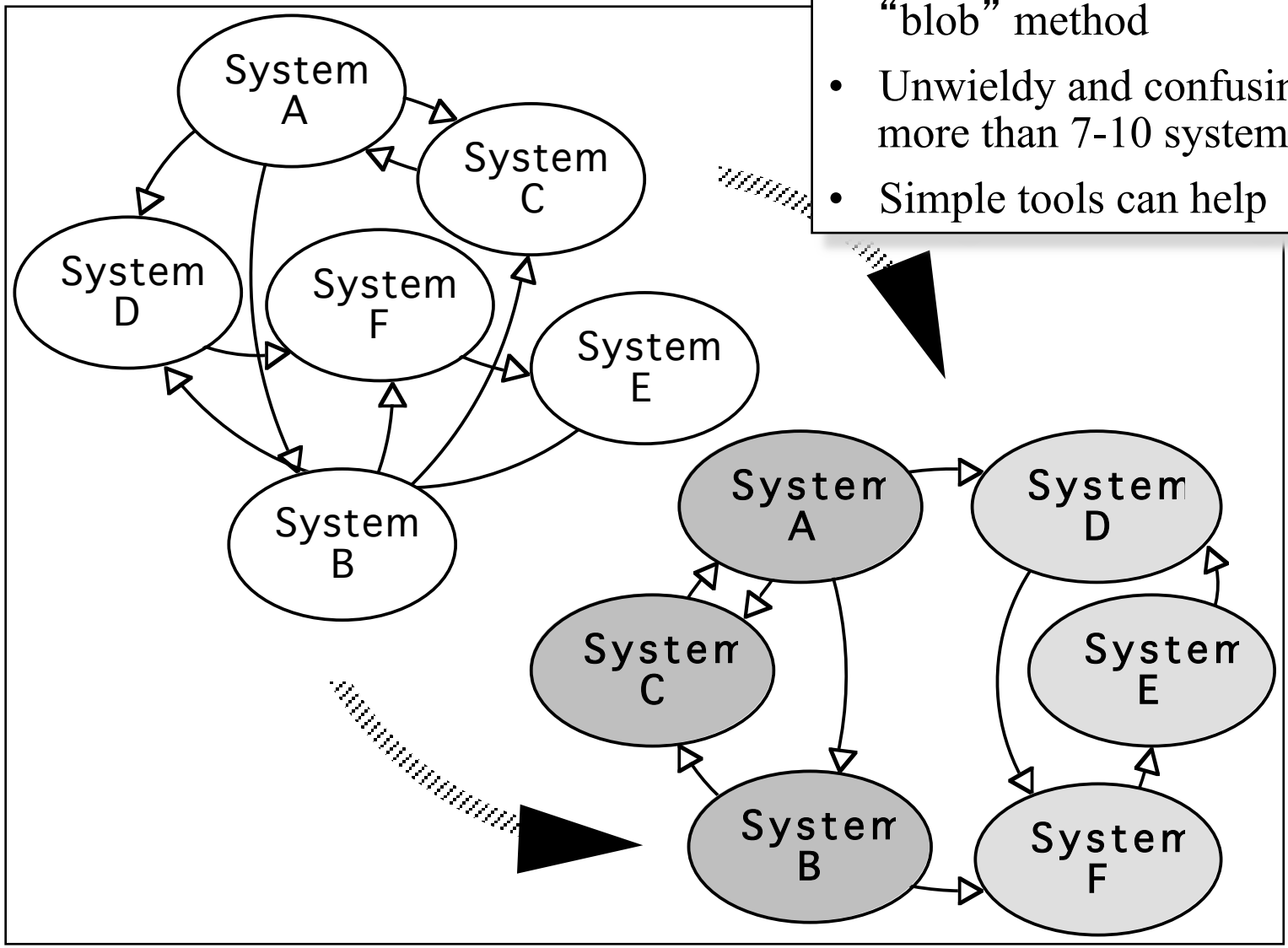
Up one Hierarchy Level



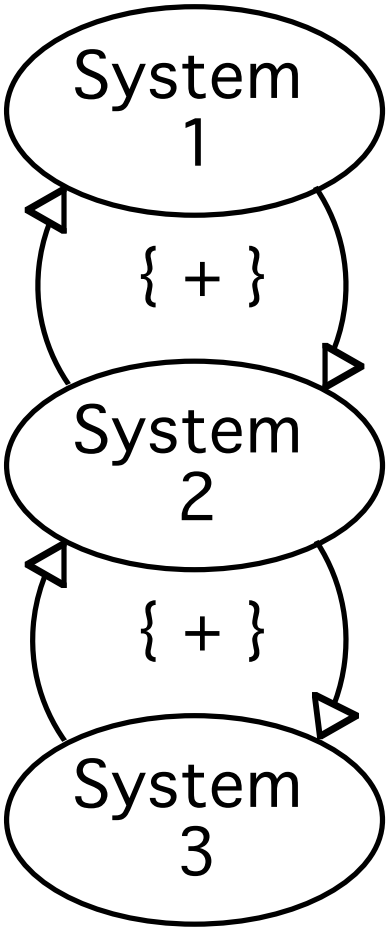
- Possible—but still difficult—to resolve issue at this higher level owing to fewer variables/dimensions
- Note, even three Containing Systems have 6 suspect interaction channels, variable response with time.

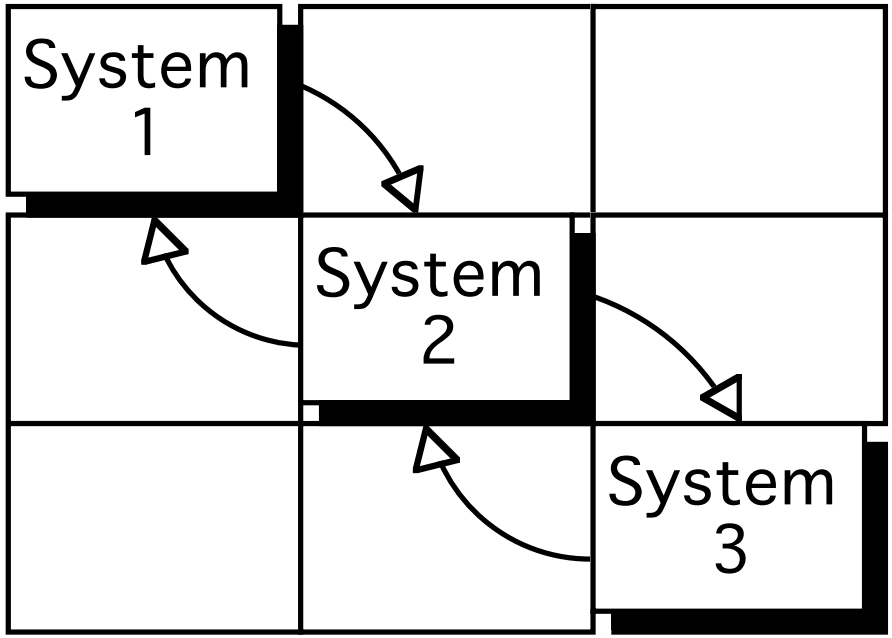
Grouping and Clustering Implicit Systems

- Can be done by conventional "blob" method
- Unwieldy and confusing for more than 7-10 systems
- Simple tools can help



Loops, Chains and Squares





- Interacting systems can be presented as square matrices
- Imbalances appear in off-diagonal squares
- Potential for major reduction in perceived complexity

From Imbalanced Systems to N2

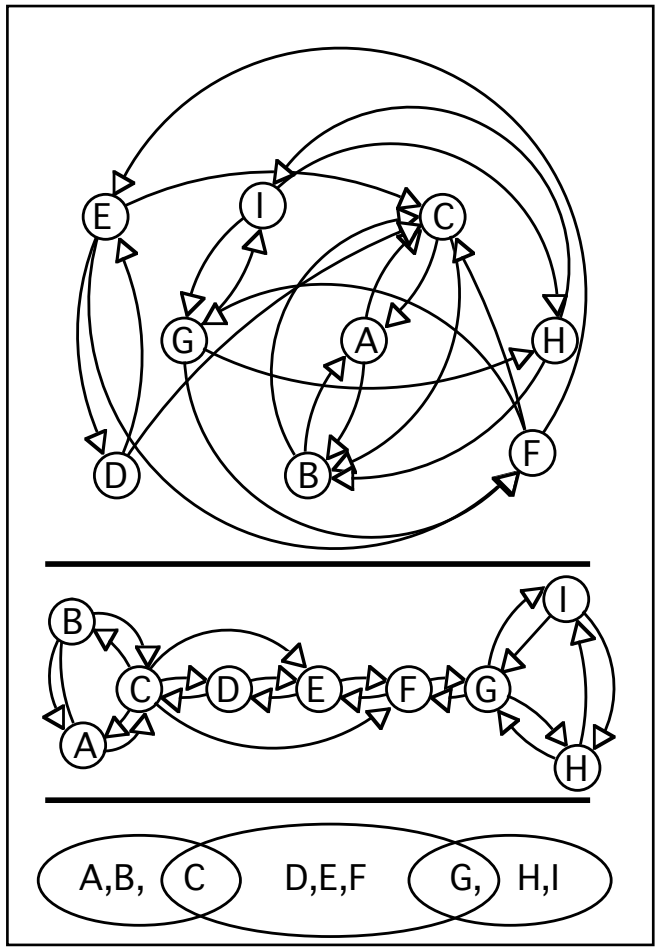
Improving Company Efficiency	✖					
	Work allocation	✖				
		employing tools and methods	✖			
			Production	✖	✖	
				Co-ordination	✖	
					Waste reduction	✖
✖						Increasing Company Profit

Measuring Disorder, Evolving Order

Tangled set of implicit systems, connected by their mutual imbalances

Untangled set

Perceived set of Containing Systems



E		1				1		1
	I		1		1			
		C		1			1	
	1		G		1			1
		1		A			1	
	1		1		H			
1		1				D		
		1		1			B	
1		1	1					F

A	1	1						
1	B	1						
1	1	C						
		1	D	1				
		1	1	E	1			
		1		1	F	1		
					1	G	1	1
						1	H	1
						1	1	I

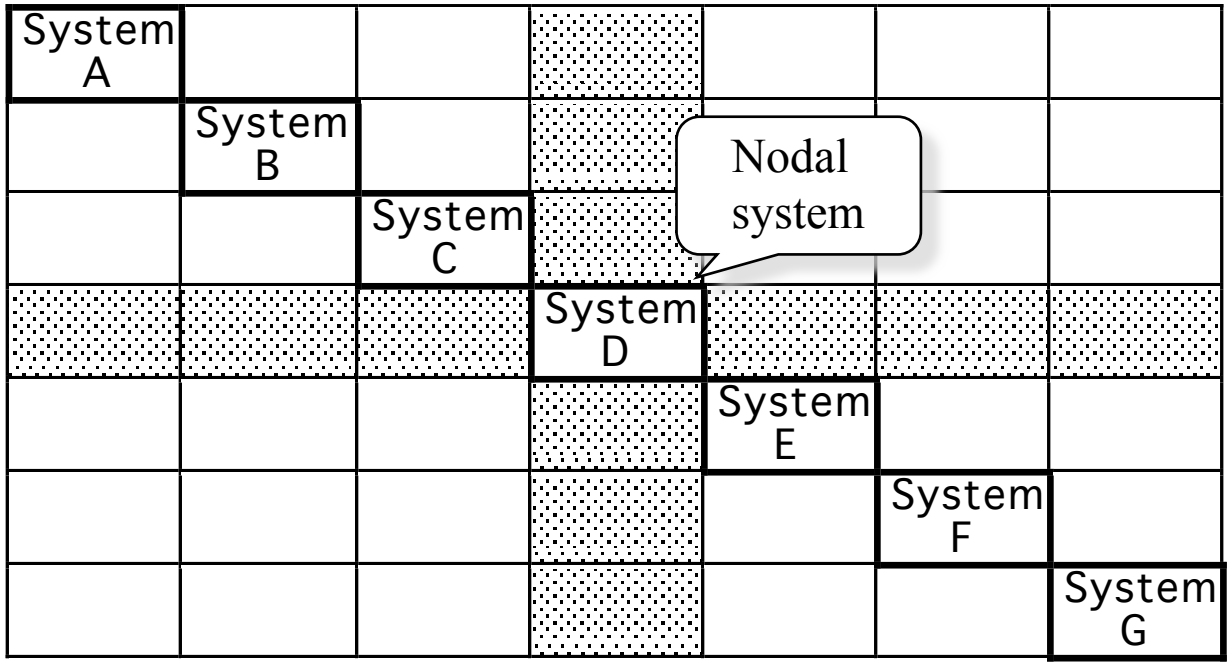
Matrix scored by interface x distance from entity

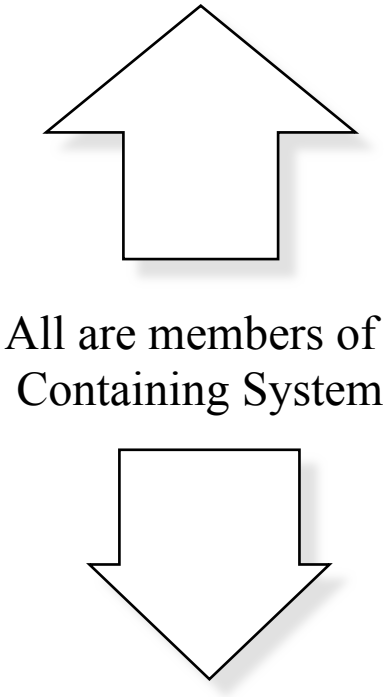
Upper matrix scores 86.

Lower matrix scores 28

Program uses genetic algorithm

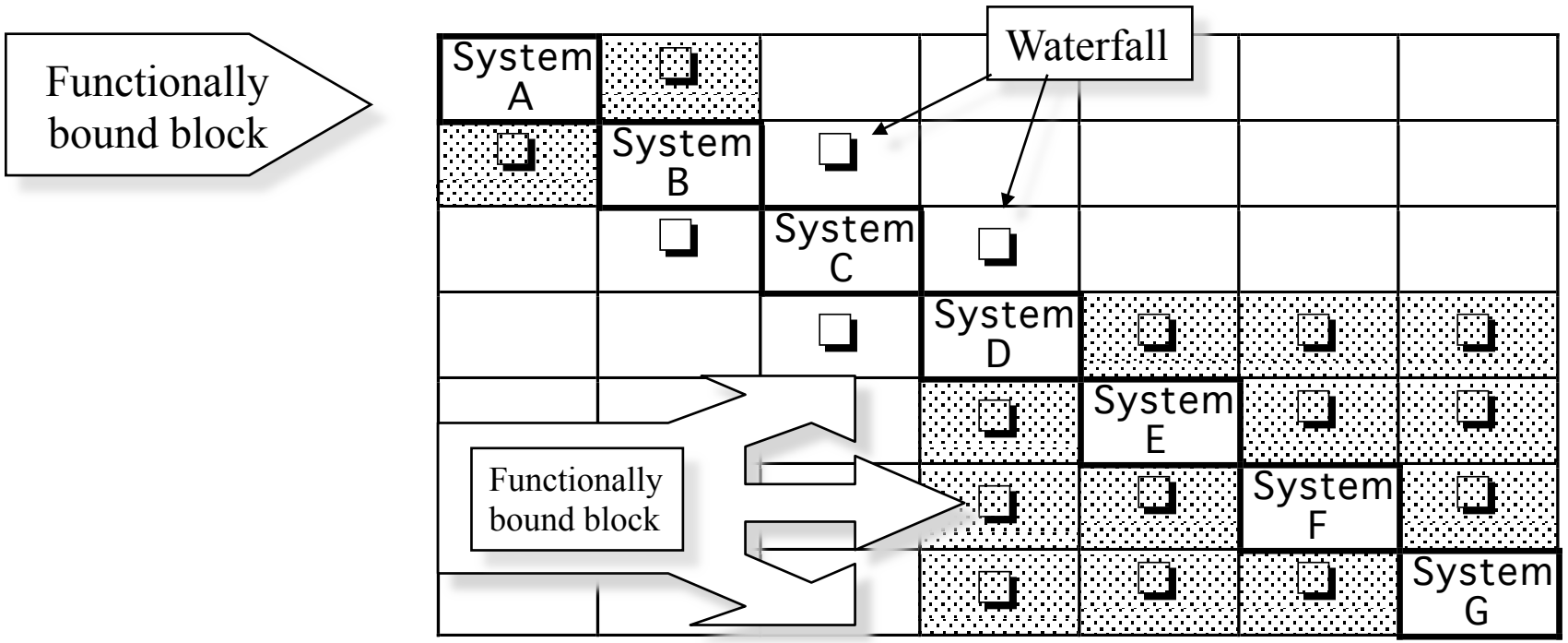
Interpreting Clusters as Sets—the Node or Nexus





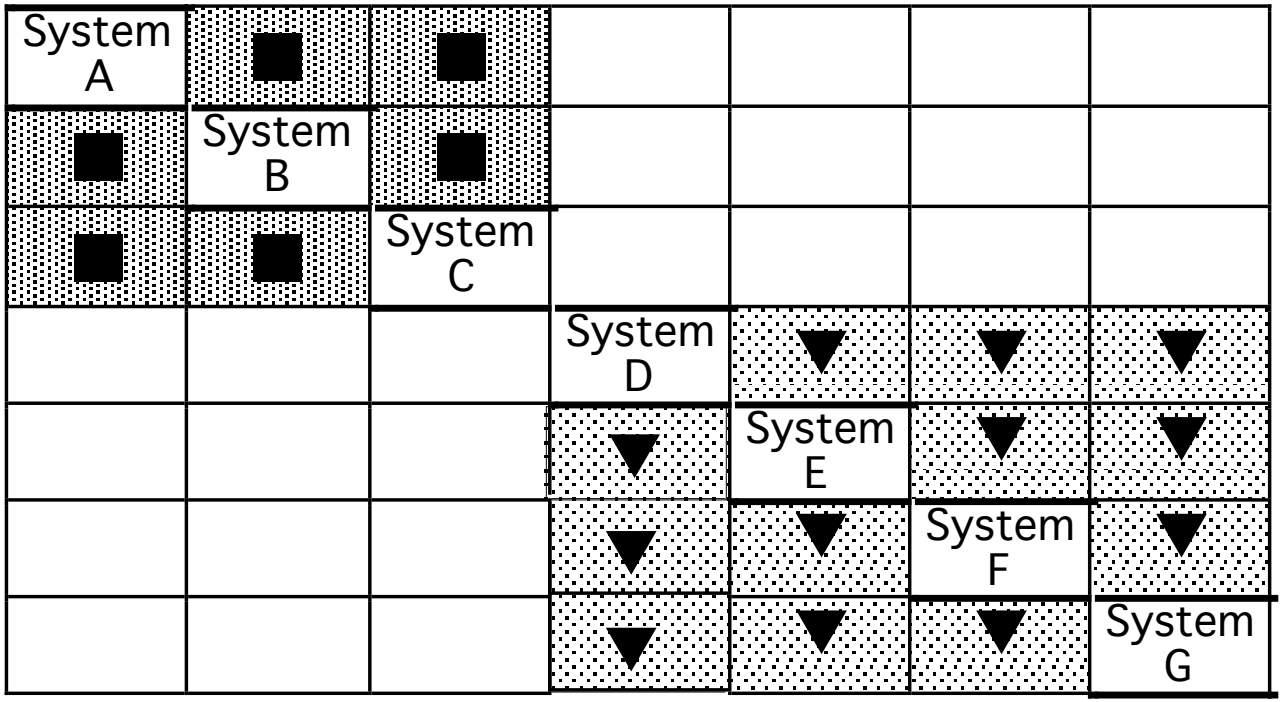
- The **node** or **nexus**. All systems have an interface (imbalance) with System D.
- The probability that System D is a culprit increases with every pair of imbalances in which it participates.
- The node always forms a cross on the N^2 chart—the members of the cross form a Containing System

Interpreting Clusters as Sets—Other Patterns



- Functionally bound blocks have all (or most) of their mutual interfaces active—each system mutually interdependent on the others, the locus of possible cause may exist within the set, but there is no node
- Waterfalls characterise suspect chains of command and reporting
- System C is a (suspect) "post-office" between two functionally bound blocks

Disjoint Sets



- A,B,C and E,F,G are disjoint sets (no interfaces/connections) but originate from same Issue
- Either
  - a relationship between sets is missing, or…
  - …the two sets are at different hierarchy levels, or possibly…
  - …a symptom has been addressed which does not relate to this Issue

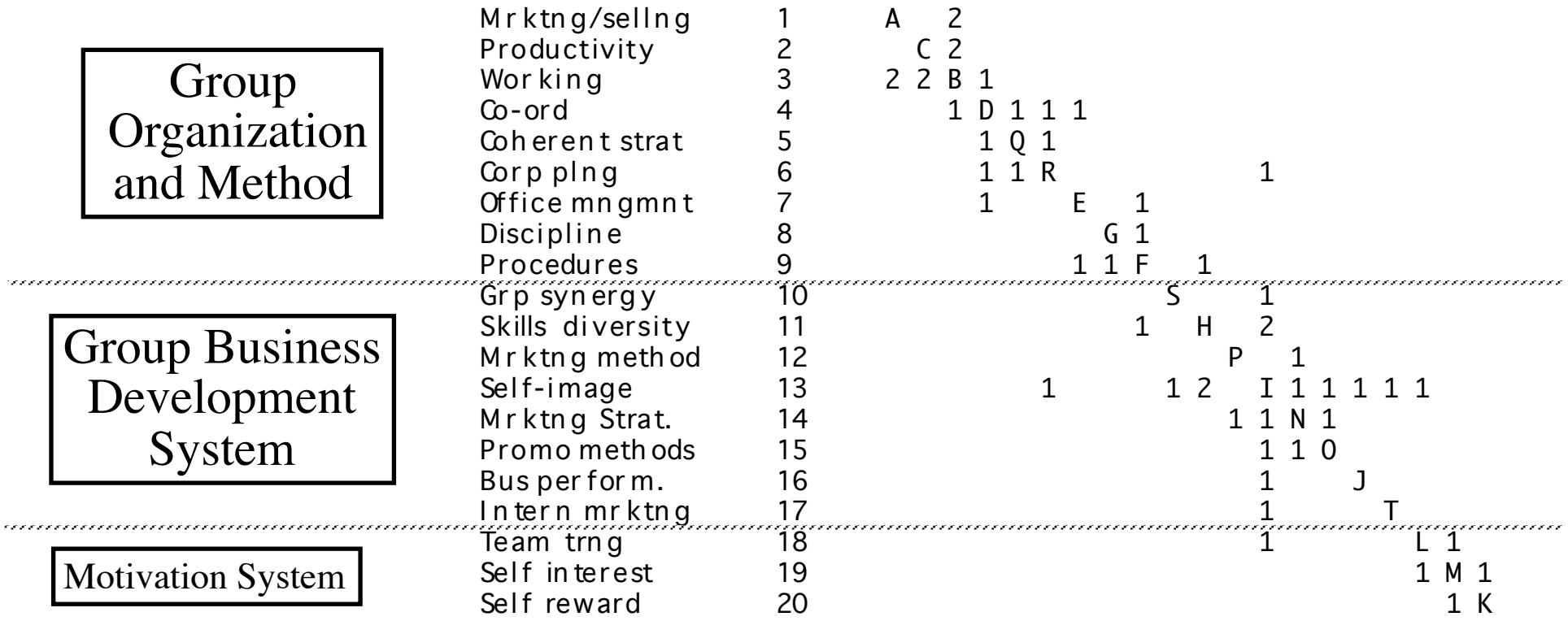
Assignment

- Create a N^2 Chart for a military Command HQ, comprising:—
  - An operations cell, concerned with identifying and responding to threats and opportunities
  - A logistics cell, concerned with the four Ms—men, machines, materials and money
  - An Intelligence Cell, concerned with information about the enemy position, status and intentions
  - An Engineering Support Cell, concerned with maintaining the HQ and overcoming obstacles to movement
  - A Command HQ Defence Unit, concerned with providing local area and point defence
- Identify any nodes, functionally bound blocks, external interfaces

Modelling Containing Systems

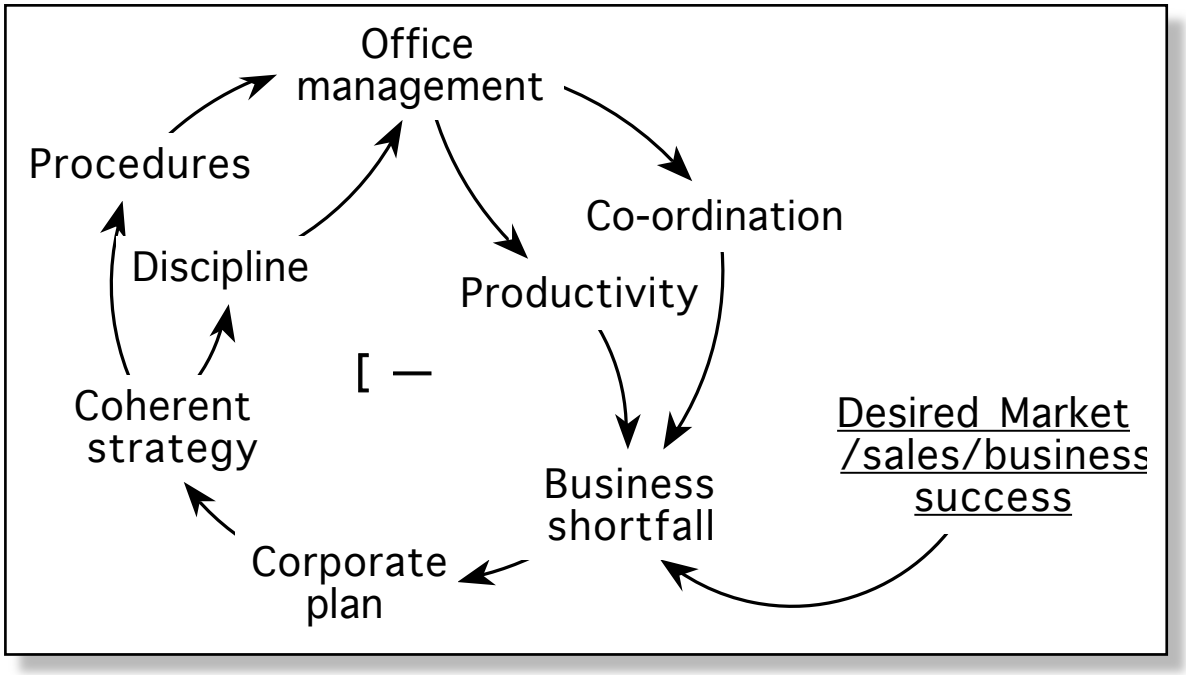
- For each Containing System, convert implicit systems into a laundry list of possible Issue Causes
  - » "System for co-ordination"—(suspect) poor co-ordination as cause of (In)efficiency
  - » "System for waste reduction"—(suspect) excessive waste as cause of (In)efficiency
- Then…same process as for each implicit system
  - – model each Containing System to understand how it works
  - – use CLM—closure for completeness of symptoms
  - – Back up with STELLA™ if needed

Containing Systems



- Practical example—clustered implicit systems, grouped into Containing Systems
- Each Containing System modelled using its implicit systems as symptoms
  - e.g. Marketing/selling ➔ "inadequate marketing and selling"
  - e.g. Group synergy ➔ "inadequate group synergy"
  - e.g. Skills diversity ➔ "inappropriate skills diversity"
  - e.g. Team Training ➔ "inadequate team training"

Example—Group Organization and Method

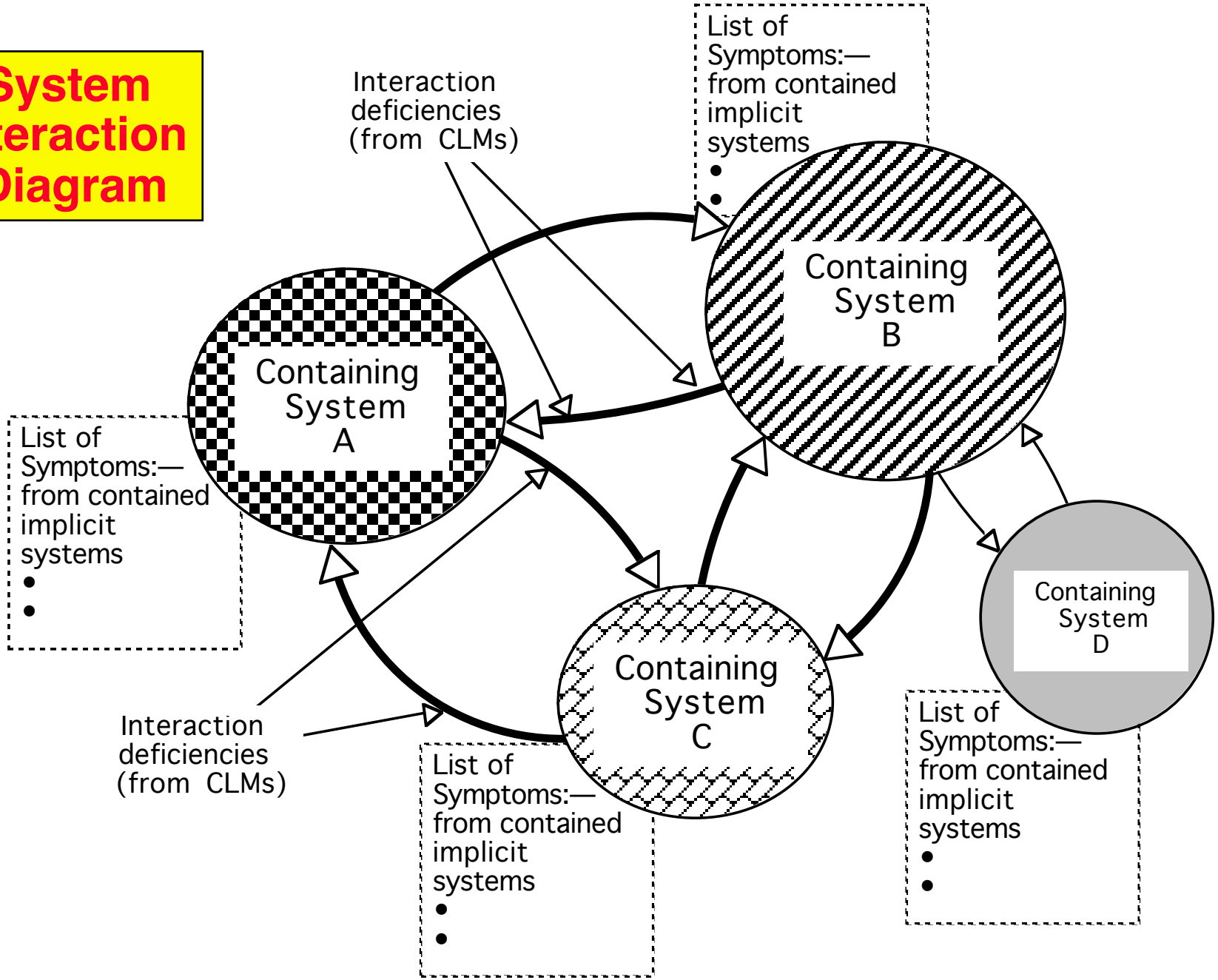


- Developed from implicit systems read as symptoms
- Repeat for each Containing System
- Link Containing Systems to develop SID
  - » identifying links between clusters on N^2
  - » creating links to represent perceived deficiencies
- Two interaction (deficiencies) are v. likely to exist between each and every pair of Contained Systems—each identified/ reasoned interaction should be represented

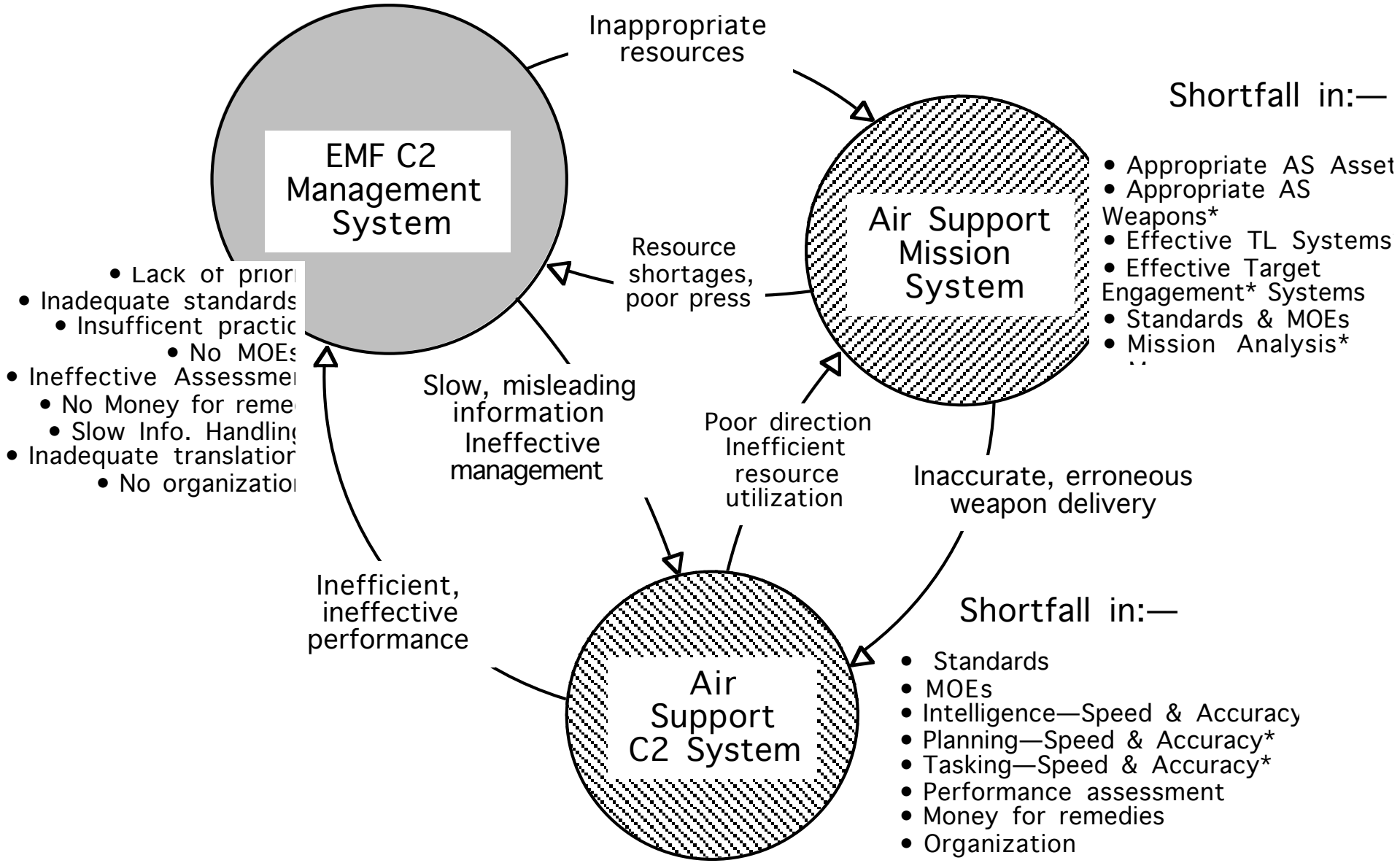
Creating the "Idealized" System

- Using pejorative terms in the Laundry List exploits a natural human behaviour—we see possible deficiencies more easily than possible benefits
- Dropping pejorative terms when developing the CLM from the LL produces an *idealized* organization of features
- This seemingly-simple process can appear almost miraculous at times:—
  - we start with symptoms of an Issue
  - we then use those symptoms via the simplest of methods to produce an idealized "world model", which appears without any special effort on our part
- Compare the idealized world model(s) with reality from the symptom-sets to identify differences and shortfalls

System Interaction Diagram



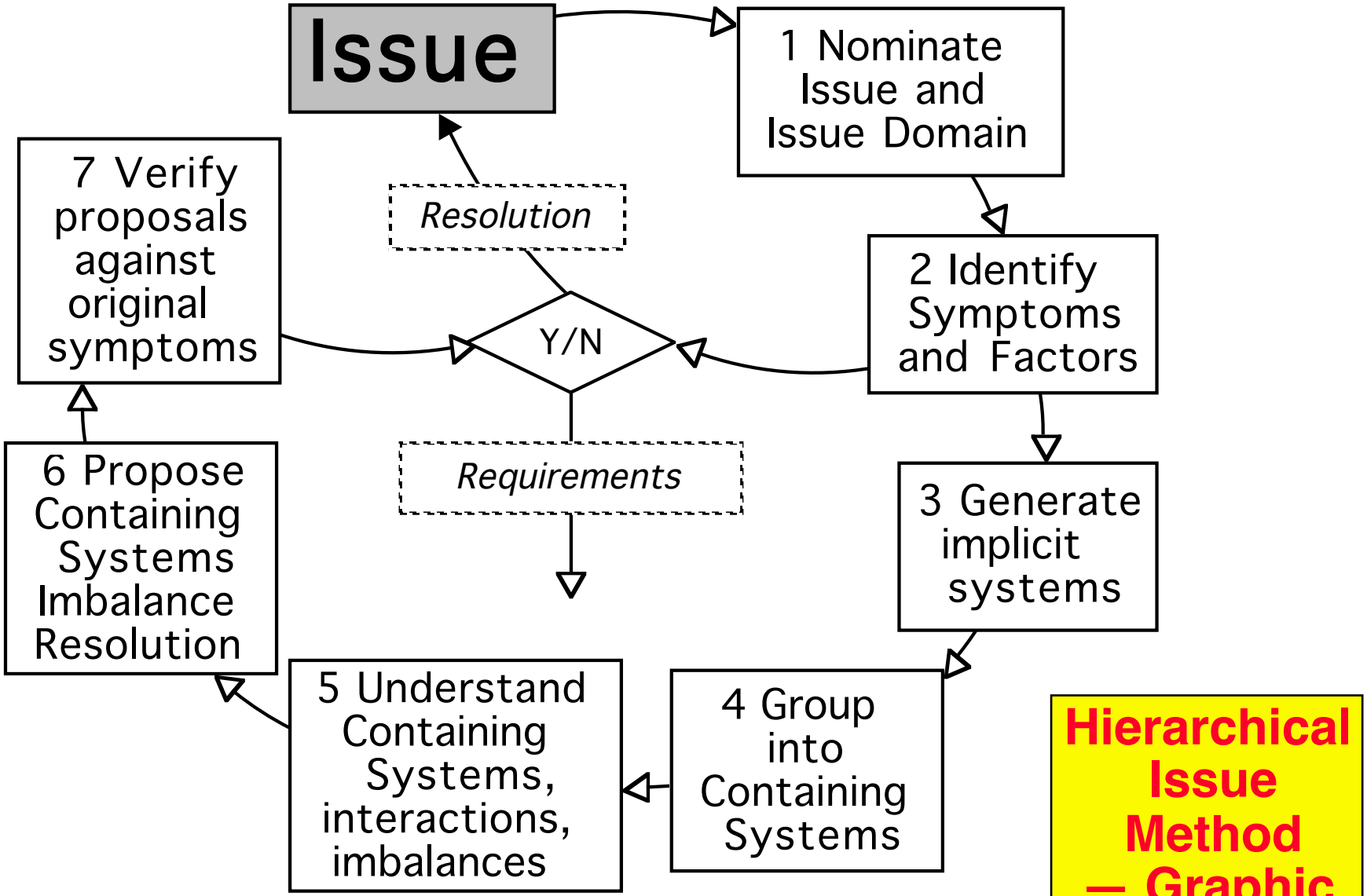
Typical SID

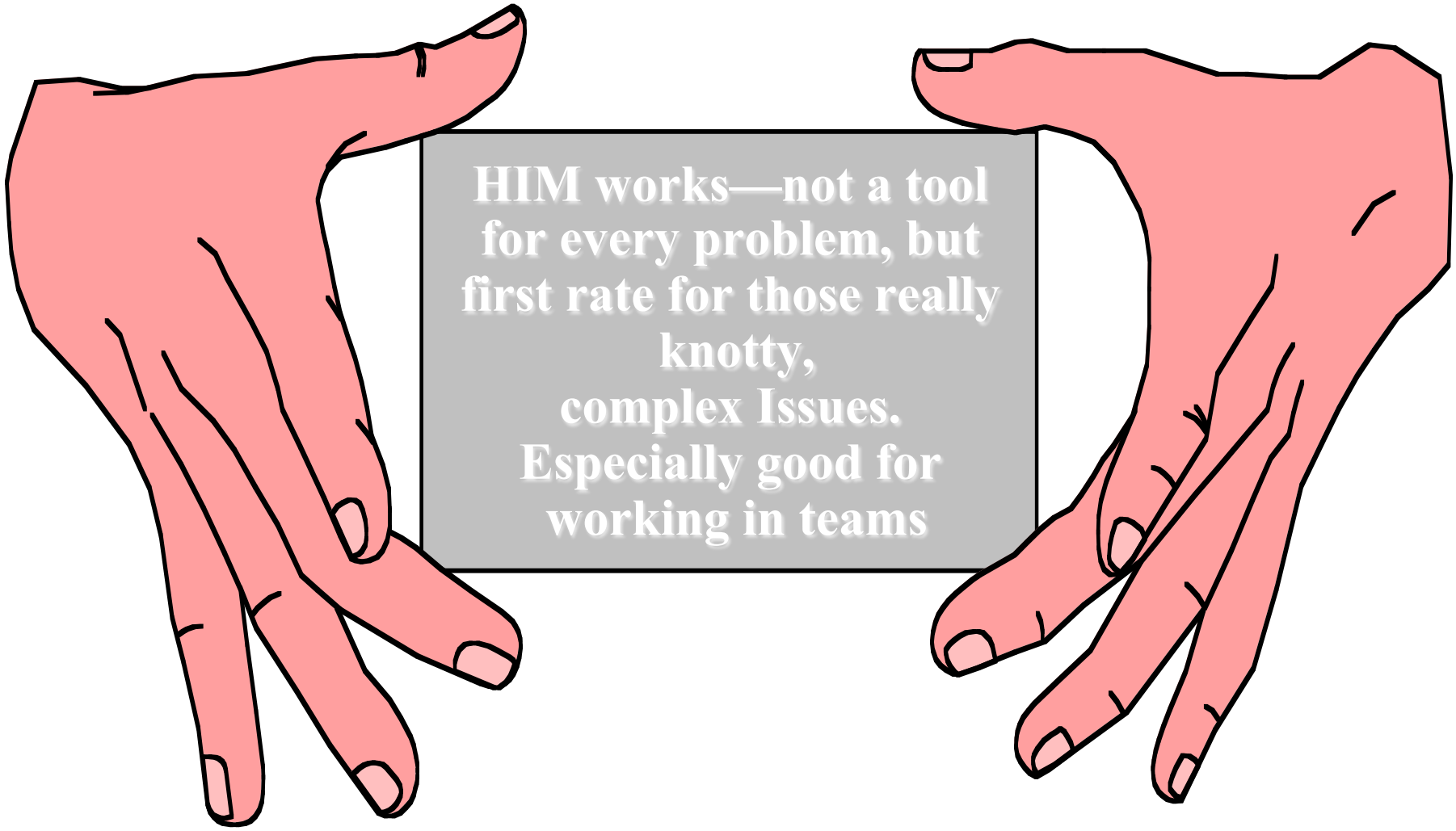

Inappropriate resources
EMF C2 Management System
Air Support Mission System
Shortfall in:—
• Appropriate AS Asset
• Appropriate AS Weapons*
• Effective TL Systems
• Effective Target Engagement* Systems
• Standards & MOEs
• Mission Analysis*
Resource shortages, poor press
• Lack of prior
• Inadequate standards
• Insufficent practic
• No MOEs
• Ineffective Assessmer
• No Money for reme
• Slow Info. Handlin
• Inadequate translatior
• No organizatio
Slow, misleading information
Ineffective management
Poor direction
Inefficient resource utilization
Inaccurate, erroneous weapon delivery
Inefficient, ineffective performance
Air Support C2 System
Shortfall in:—
• Standards
• MOEs
• Intelligence—Speed & Accuracy
• Planning—Speed & Accuracy*
• Tasking—Speed & Accuracy*
• Performance assessment
• Money for remedies
• Organization

Establishing the Requirements

- SID summarises (likely) Issue sources
- Containing Systems deficiencies propose their own remedies
- Interaction deficiencies between Containing Systems propose their own remedies
- *Matched set* of Issue-resolving requirements emerges
- Set tested against original symptoms to verify completeness and relevance

N.B. *All* requirement to be met—to meet only some is to risk counter-intuitive response from Issue systems


Issue
1 Nominate Issue and Issue Domain
2 Identify Symptoms and Factors
3 Generate implicit systems
4 Group into Containing Systems
5 Understand Containing Systems, interactions, imbalances
6 Propose Containing Systems Imbalance Resolution
7 Verify proposals against original symptoms
Y/N
Resolution
Requirements
Hierarchical Issue Method — Graphic


HIM works—not a tool
for every problem, but
first rate for those really
knotty,
complex Issues.
Especially good for
working in teams

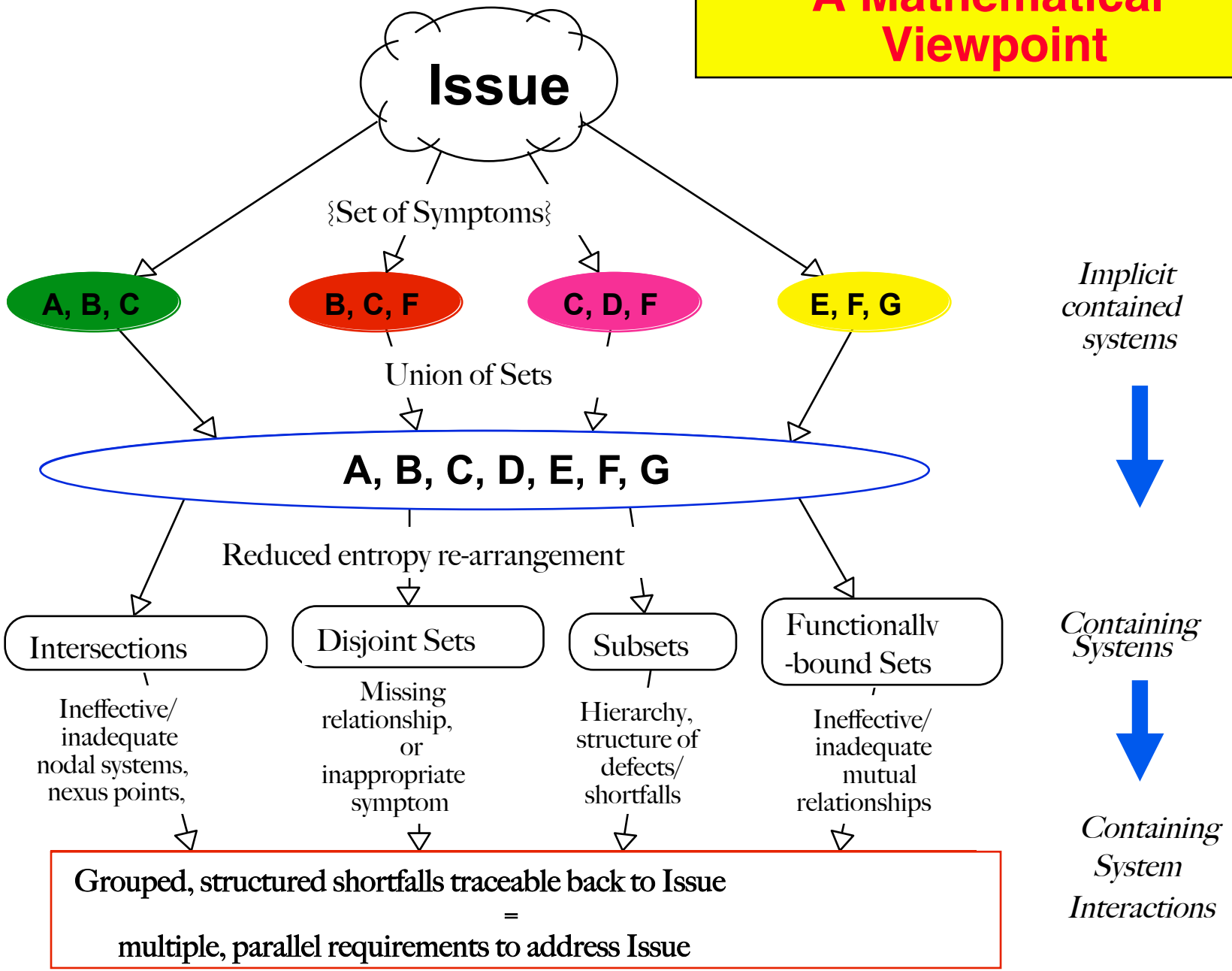
The Method

Step	Title	Action/Method/Tool/Technique
1	Nominate Issue and Issue Domain	Select a meaningful description of the Issue with the Client; detail the Issue environment and boundaries. Generally, an Issue is a vague “feeling of unease...”, “concern about...”
2	Identify Issue Symptoms and Factors	Develop set of elemental problems, symptoms of unease or disquiet, plus any evidently strong influences. Sort symptoms from “pet cures”
3A	Understand Interaction Imbalances	Develop a Laundry List of possible causes with the Client—POETIC. Model to understand.
3B	Generate implicit contained systems	From 3A, identify the implicit contained systems in imbalance
4A	Group into Containing Systems	Consolidate the list of implicit contained systems. Group to Identify Containing Systems
4B	Model Idealized Containing Systems	Treat Containing Systems as symptoms. Treat implicit contained systems as causal factors. Model to understand
5	Understand Containing System Interaction Imbalances	Develop interaction imbalances between Containing Systems—describe shortcomings and environment in a Systems Interaction Diagram (SID)
6	Propose Containing Systems Imbalance Resolution	Conceive set of requirements to address shortcomings and imbalances shown in the SID—if possible.
7	Assess requirements impact on all imbalances	Verify 6 against original symptoms.

What happened to the Uncertainty?

- Locus of possible causes encompassed all possible sources of Issue
- Hierarchy shift focuses on Containing Systems, and their interaction—perspective shift from (e.g.) tactical to strategic, micro to macro
- Requirements generated at macro-level, should address underlying weaknesses, shortcomings
  - » unlikely to concentrate on specific *and incorrect* cause, but…
  - » …could overlook genuine detailed cause
- Verification against initial symptoms ensures requirements are:—
  - a. necessary
  - b. sufficient

A Mathematical Viewpoint



HIM Set Theory

Issue $\Rightarrow$ {symptoms}

symptom $\Rightarrow$ {implicit contained systems}

(non - functional, one-to-many mapping)

$\therefore$ Issue $\Rightarrow \{ics\} \cup \{ics\} \cup \{ics\} = \mathrm{E}$

Within E there are intersections:

$\{ics\} \cap \{ics\} \cap \{ics\}$ which constitute an issue nexus or node

Within E there may be subsets found by rearranging E:

$\alpha \subset \mathrm{E}$, $\beta \subset \mathrm{E}$ which constitute higher level systems of problems, or problem themes: functional, many-to-one mapping.

Within E there may be disjoint sets,

$\lambda \cap \mu = \varphi$, which result either from relationships not evident in the analysis or owing to systems being identified at different hierarchy levels or may arise from misidentification of symptoms at the start.