# Management Cybernetics 1

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# Perspectives on Management

- Professional approaches:  finance, accounting, marketing, personnel admin.
- Disciplinary approaches:  organizational behavior, operations research, decision analysis, information systems
- Type of organization:  small business, international business, public administration

# Management Cybernetics

- Is an interdisciplinary approach
- Addresses organizations of any size or type
- Focuses on the organization as a whole rather than a part
- Emphasizes cognitive processes: information processing and decision making, learning, adaptation

# What will be discussed

- Edwards Deming – process improvement methods
- Stafford Beer – the Viable System Model
- Russell Ackoff – Interactive Planning
- Forrester and Senge – system dynamics
- Elliott Jaques – the quintave theory
- Gerard Endenburg -- sociocracy

# Themes in the tutorial

- There are MANY ways to think about the management of organizations
- Only a few attempt to take a holistic perspective
- But there are great differences even among the holistic views
- Can each of these views be “right”

# About management consulting

- Usually a management consultant is hired for his technical expertise
- But success depends more on emotional skill
- Often there is an underlying problem that is creating the perceived problem
- What are emotional or political reasons why the underlying problem is not addressed?

# Underlying themes

- Complexity is defined by the observer
- Using any analytic method is better than using no analytic method
- The reason is the law of requisite variety and the “magical number seven plus or minus two”

# Process improvement methods

- Are the most significant contribution to management thought in the last half of the 20th century
- Have had a dramatic effect on the relative competitiveness of nations
- Embody Ross Ashby's theory of adaptive behavior

# The most famous name in Japanese quality control is American

His name is Dr. W. Edwards Deming, and he's a quality control expert.

In 1950, the Union of Japanese Scientists and Engineers (JUSE) invited Dr. Deming to lecture several times in Japan, events that turned out to be overwhelmingly successful.

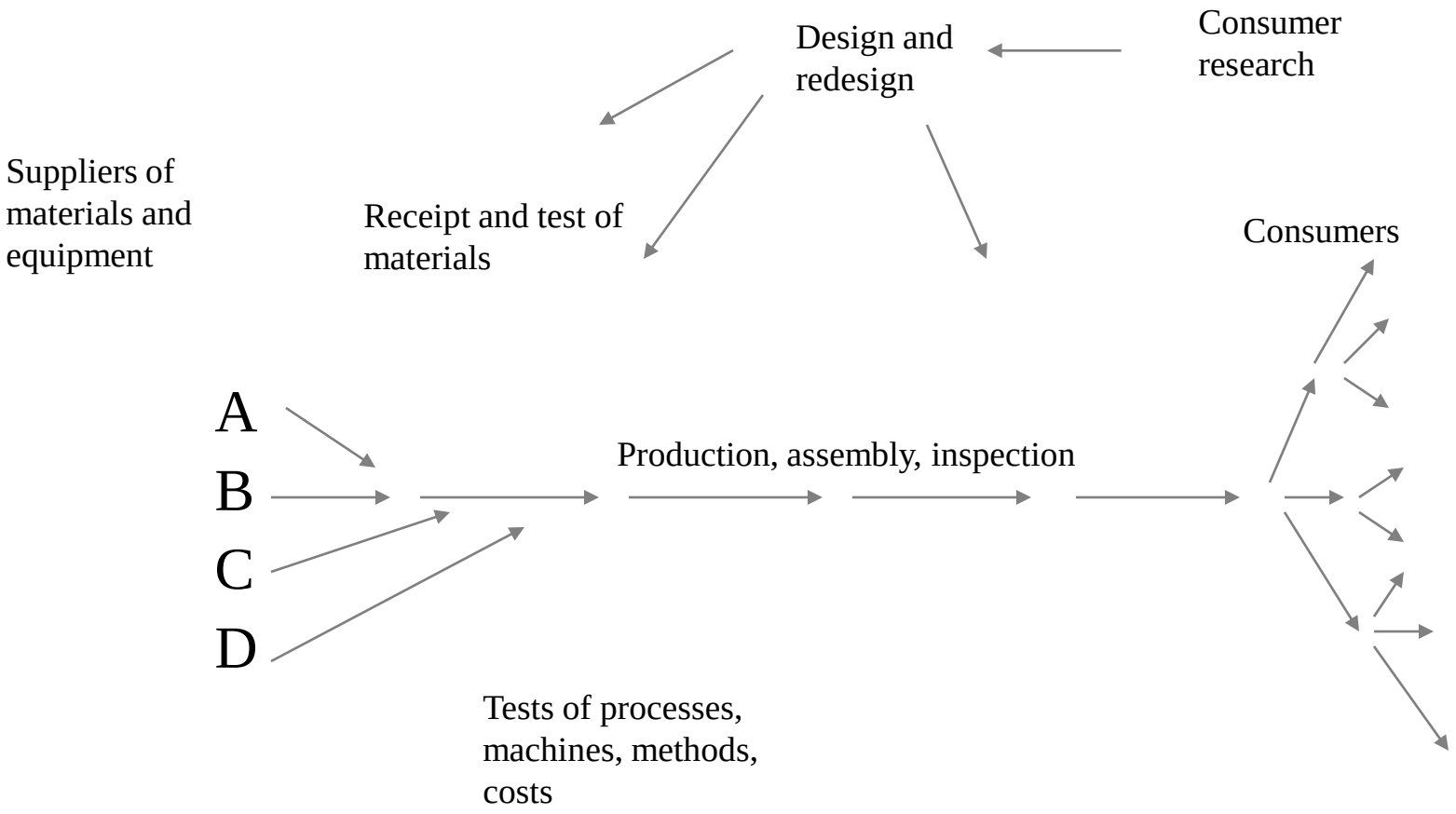
To commemorate Dr. Deming's visit and to further Japan's development of quality control, JUSE shortly thereafter established the Deming Prizes, to be presented each year to the Japanese companies with the most outstanding achievements in quality control.

Today, Dr. Deming's name is well known within Japan's industrial community, and companies compete fiercely to win the prestigious Demings.

In 1953, Sumitomo Metals was fortunate enough to win the Deming Prize For Application. In retrospect, we believe it may have been the single most important event in the history of quality control at Sumitomo. By inspiring us to even greater efforts, it helped us to eventually become one of the world's largest and most advanced steel-makers.

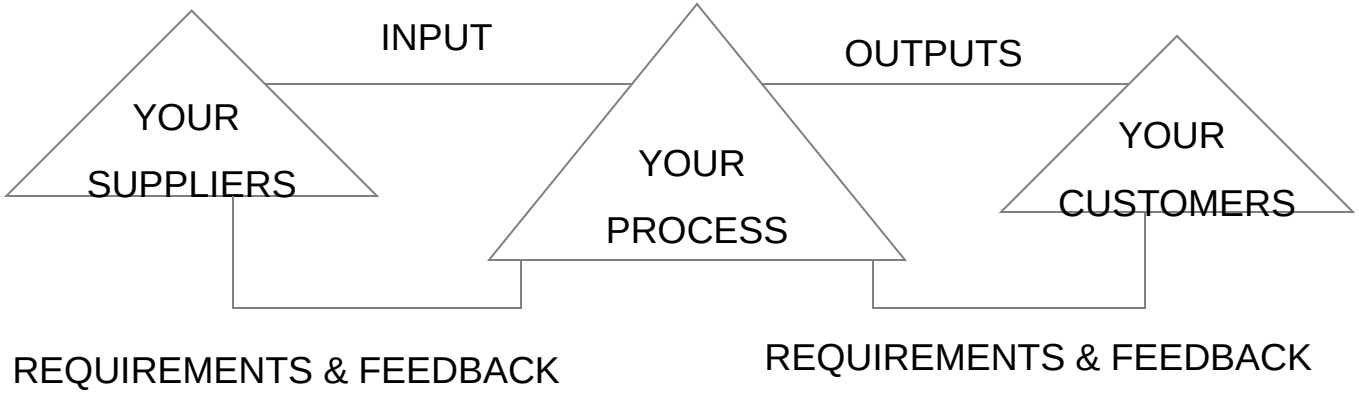
Sumitomo Metals owes a great deal to the American quality control expert who became one of Japan's greatest inspirations. On that point, the management and employees of Sumitomo metals would like to take this opportunity to say simply, "Thanks, Dr. Deming, for helping to start it all."

# THE DEMING FLOW DIAGRAM



# Worksheet

## Customer Model

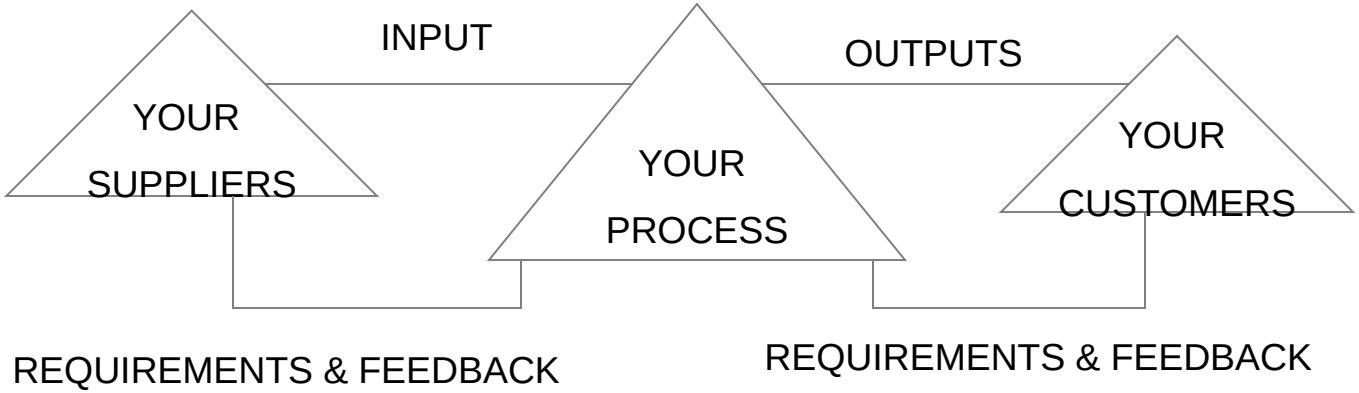



Name two or three of your most important CUSTOMERS and what you or your group provides:

| My customers: | What I provide them: | Is there a quality gap between what I provide them and what they want? |
|---|---|---|
| | | |

# Worksheet

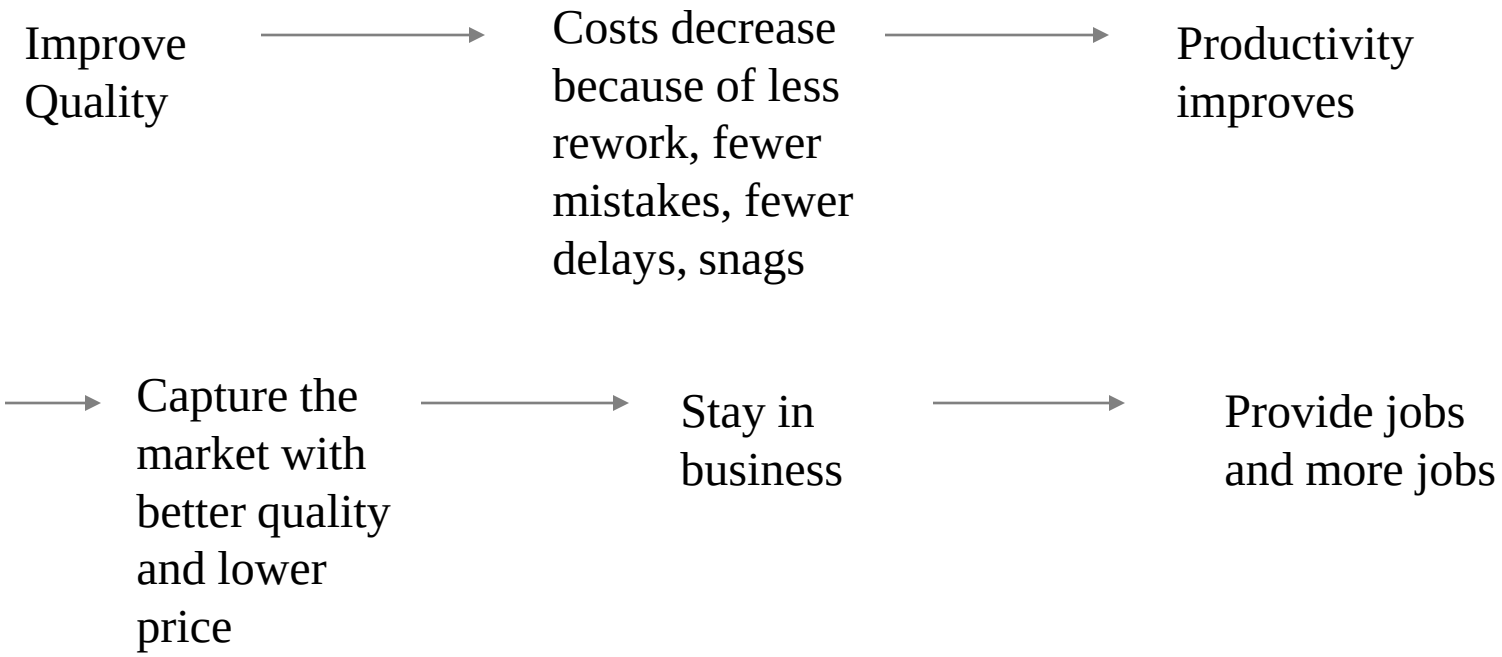
## Supplier Model



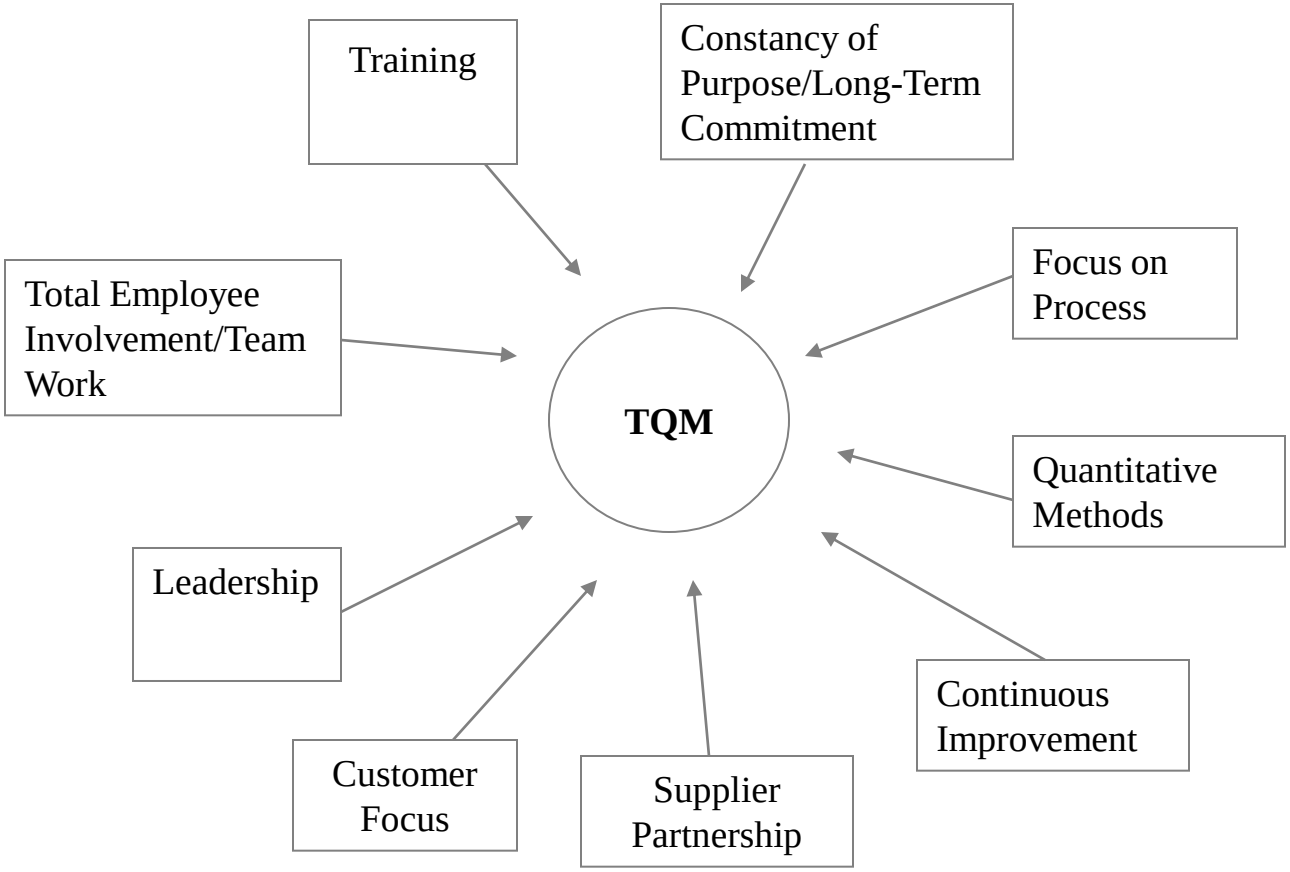

Name two or three of your most important SUPPLIERS and what they deliver or provide to you or your group:

| My suppliers: | What they provide me: | Is there a quality gap between what I get and what I want? |
|---|---|---|
| | | |

# The Deming Chain Reaction



# Elements of Quality Management



# The Old Way

1. Design it

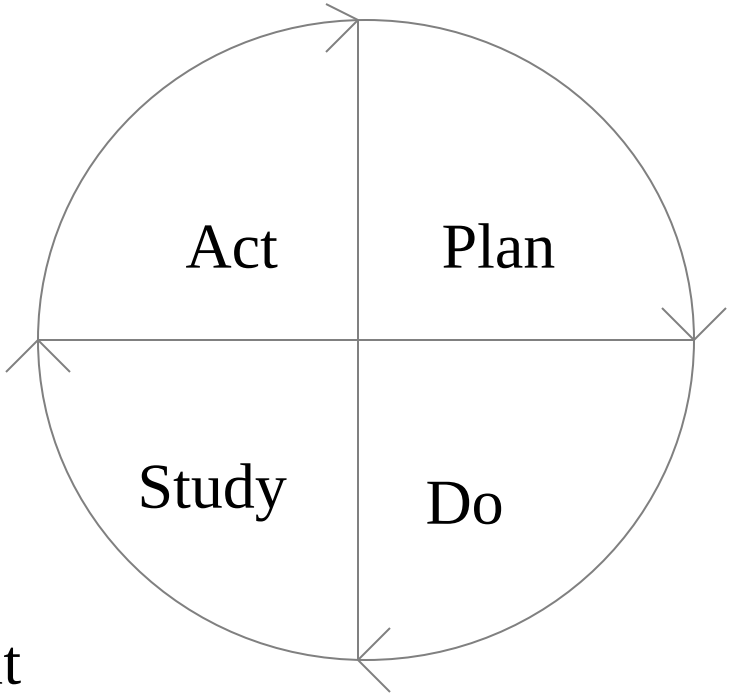
2. Make it

3. Sell it

# The Shewhart Cycle

5. Redesign

4. Test it in Service




1. Design it

3. Market it

2. Make it

# What's Different?

The New, Excellent Organizations Concentrate on Process, Not on Problems

| PROBLEM | PROCESS |
| --- | --- |
| Motivate People | Remove barriers |
| Who is wrong? | What is wrong? |
| Define: responsibility | Define: procedure |
| Watch bottom line | Watch quality |
| Measure people | Measure systems |
| Define job | Define customer |
| Fix deviations | Reduce variability |
| "Do your job" | "Can I help you?" |
| "Obey orders" | "Improve things" |

# The Concept of Two Processes

I. The Production Process:

The way we produce output.

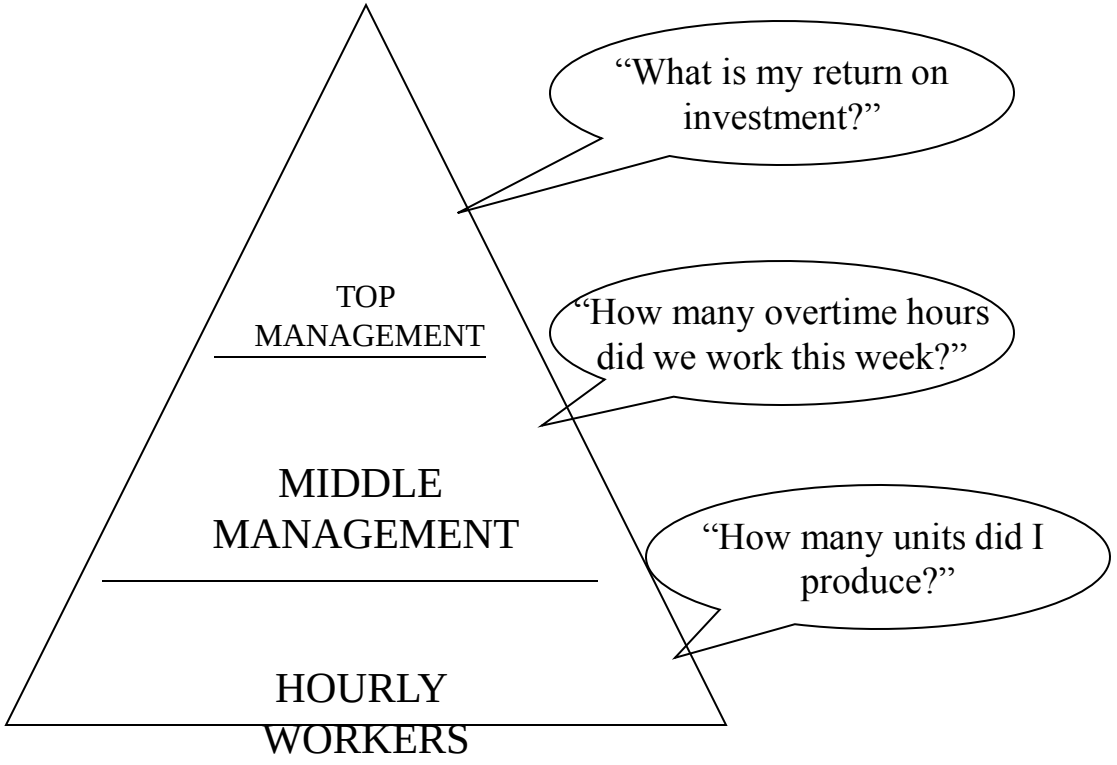
II. The Improvement Process:

The way we change process number 1.

*"People must be given time to work on the process, not just in the process."*

R. Reid

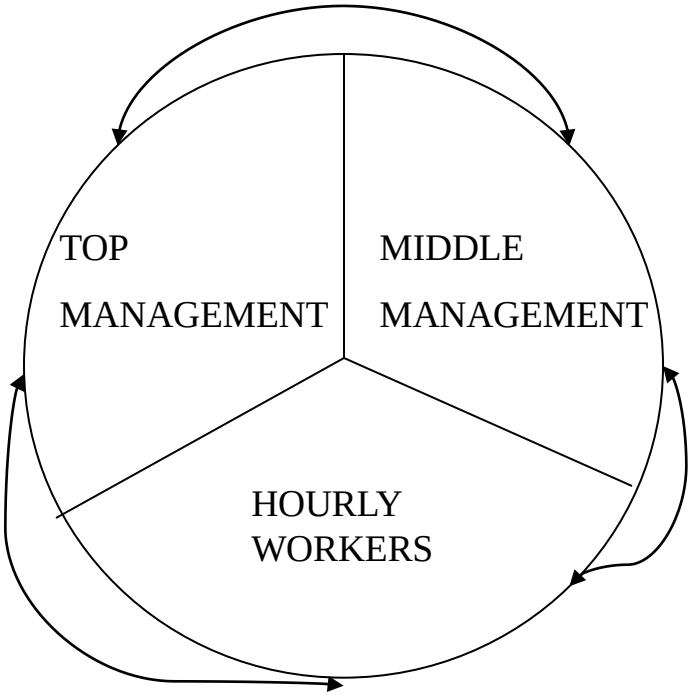
# Lack of Common Language




Juran's Pyramid of Power

One of the causes of the lack of two-way communication is that managers and workers do not share a common language. The language of quality is successfully being used in many organizations to develop meaningful two-way communication.

# Future State

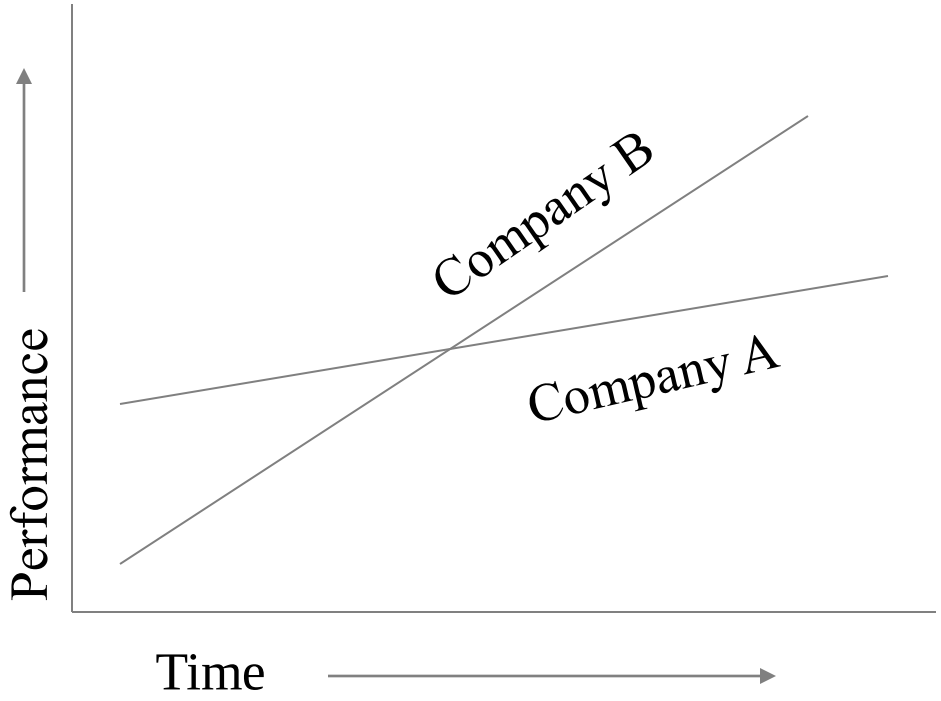



A common language:

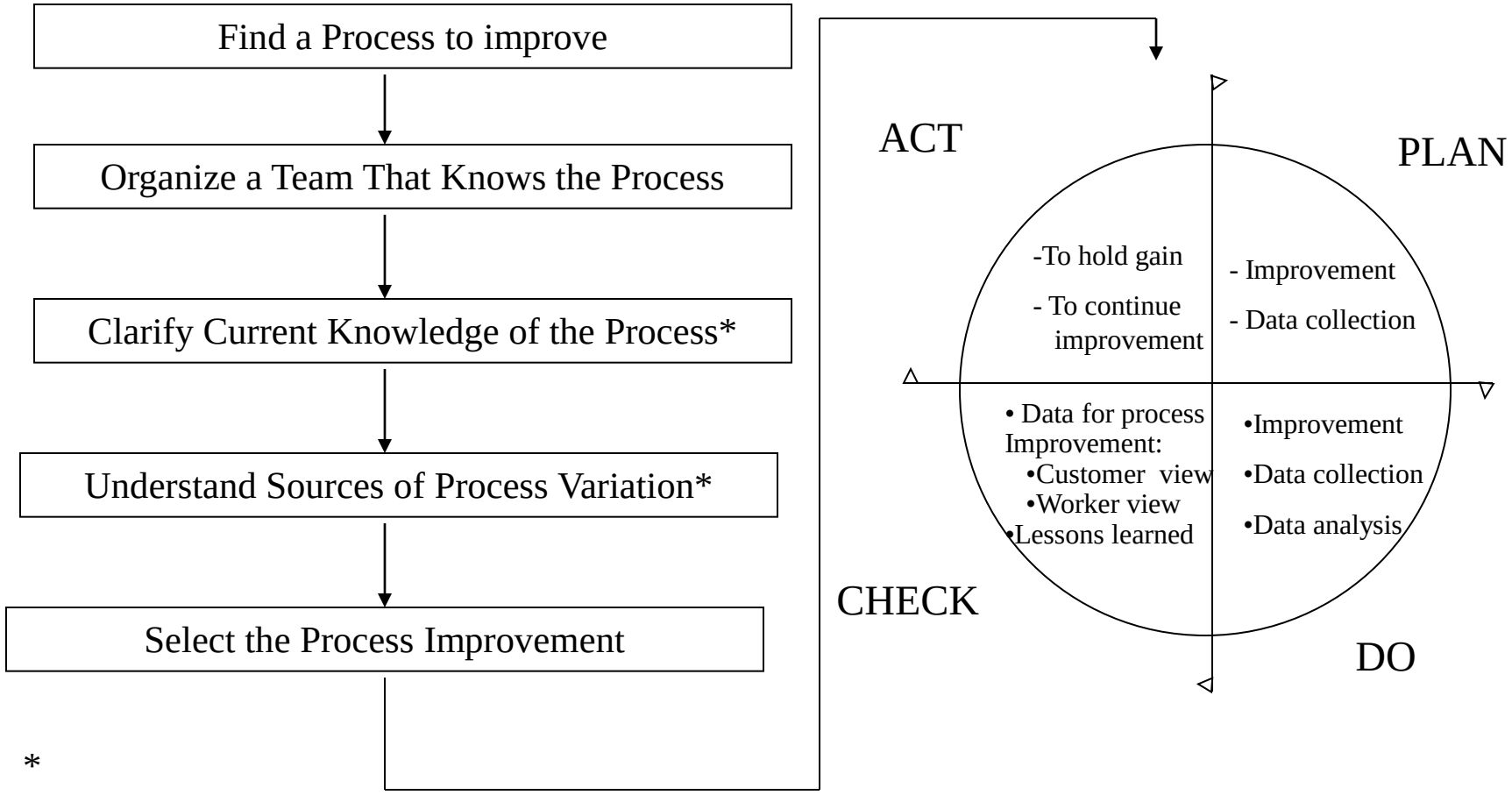
"What is the level of quality?"

Open Honest Two-Way Communication

# Getting Better Faster



# FOCUS-PDCA


Find a Process to improve
Organize a Team That Knows the Process
Clarify Current Knowledge of the Process*
Understand Sources of Process Variation*
Select the Process Improvement
*
ACT
PLAN
-To hold gain
- To continue improvement
- Improvement
- Data collection
• Data for process Improvement:
•Customer view
•Worker view
•Lessons learned
•Improvement
•Data collection
•Data analysis
CHECK
DO

# Ashby's theory of adaptation

- A system can learn if it is able to acquire a pattern of behavior that is successful in a particular environment
- This requires not repeating unsuccessful actions and repeating successful actions
- A system can adapt if it can learn a new pattern of behavior after recognizing that the environment has changed and that the old pattern of behavior is not working

# Two nested feedback loops

- A system with two nested feedback loops can display adaptive behavior
- The interior, more frequent feedback loop makes small adjustments and enables learning
- The exterior, less frequent feedback loop restructures the system (wipes out previous learning), thus permitting new learning

# Understanding Variation

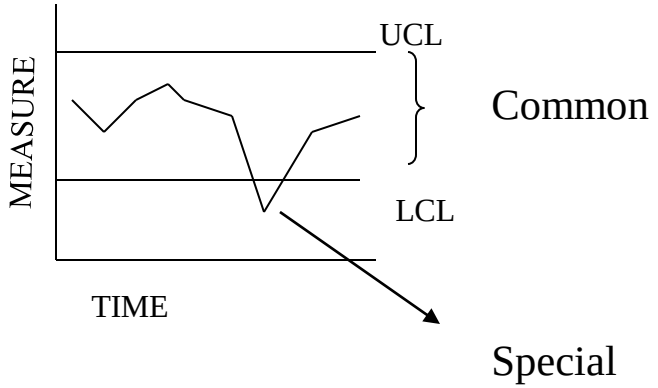
*"If I had to reduce my message for management to just a few words, I'd say it all had to do with reducing variation."*

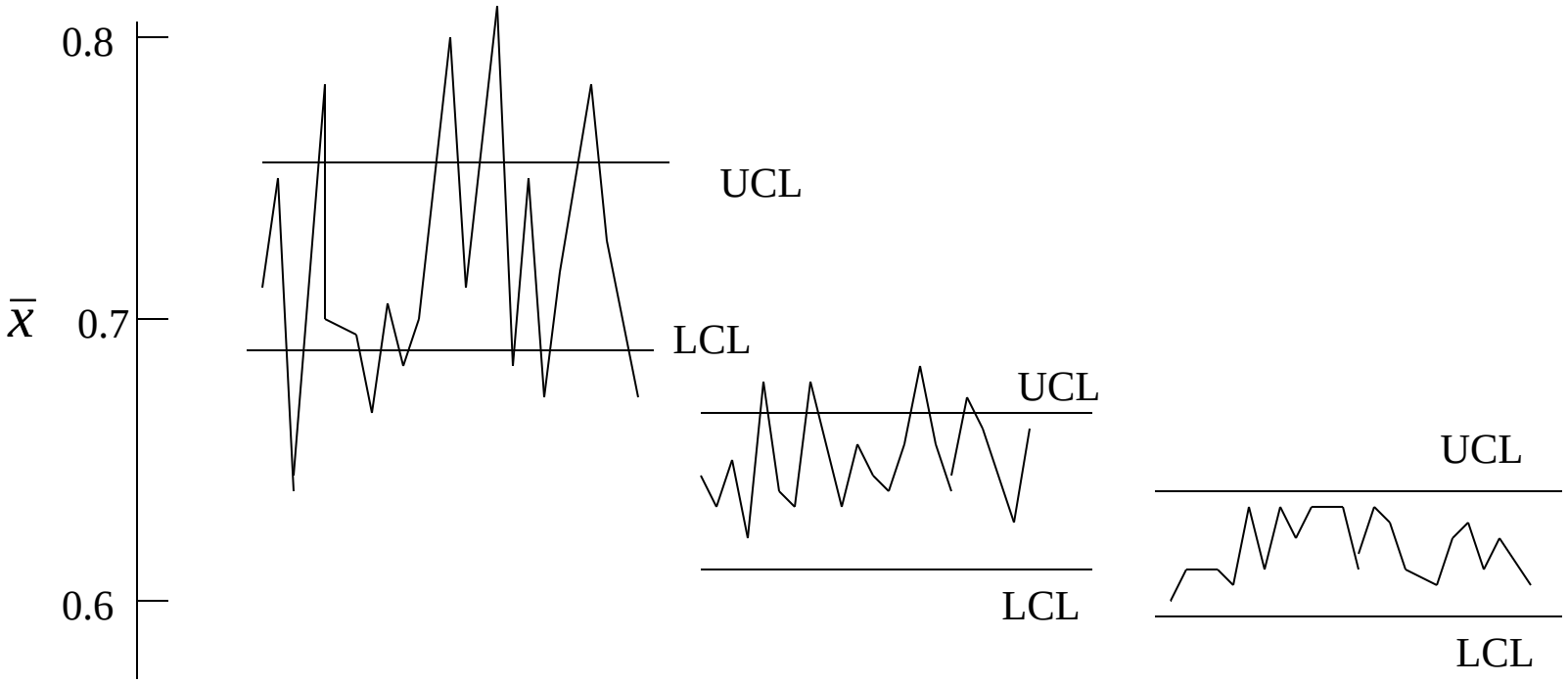
W. Edwards Deming

**Common Causes** - Causes of variation that are inherent in the process hour after hour, day after day, and affect every occurrence of the process.

**Special Causes** - Causes that are not in the process all the time or do not affect every occurrence but arise because of special circumstances.

**Tampering** - Reacting to an individual occurrence of a process when only common cause variation is present.





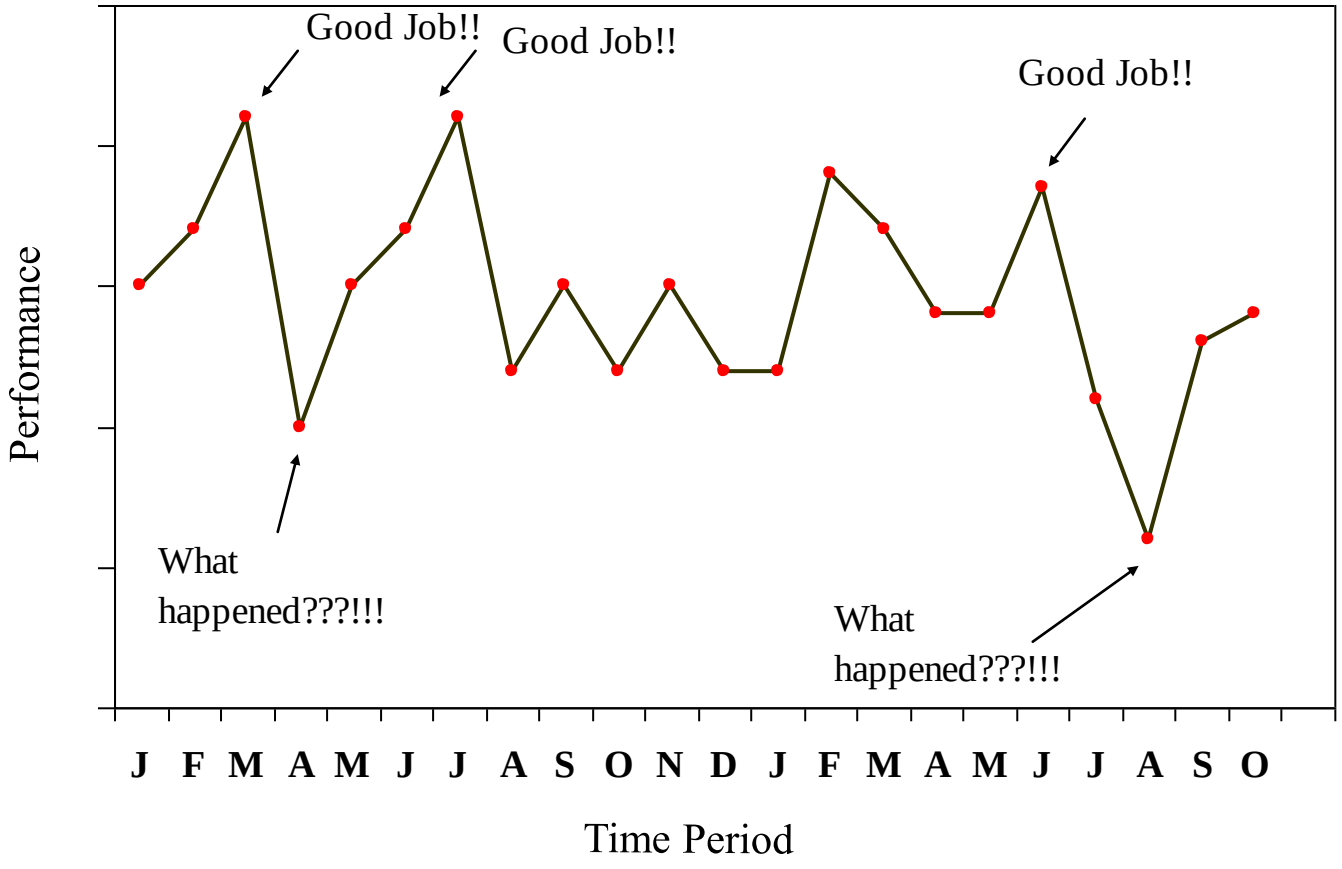

(1) Just before lessons began.

(2) 10 days after lessons began.

(3) 3 weeks after lessons began.

Fig. 31. Average daily scores for a patient learning to walk after an operation: (1) before lessons began; (2) 10 days after lessons began; (3) 3 weeks after lessons began. From Hirokawa and Sugiyama; reference in footnote. The control limits came from the whole group of patients.

# Management Reactions to Variation



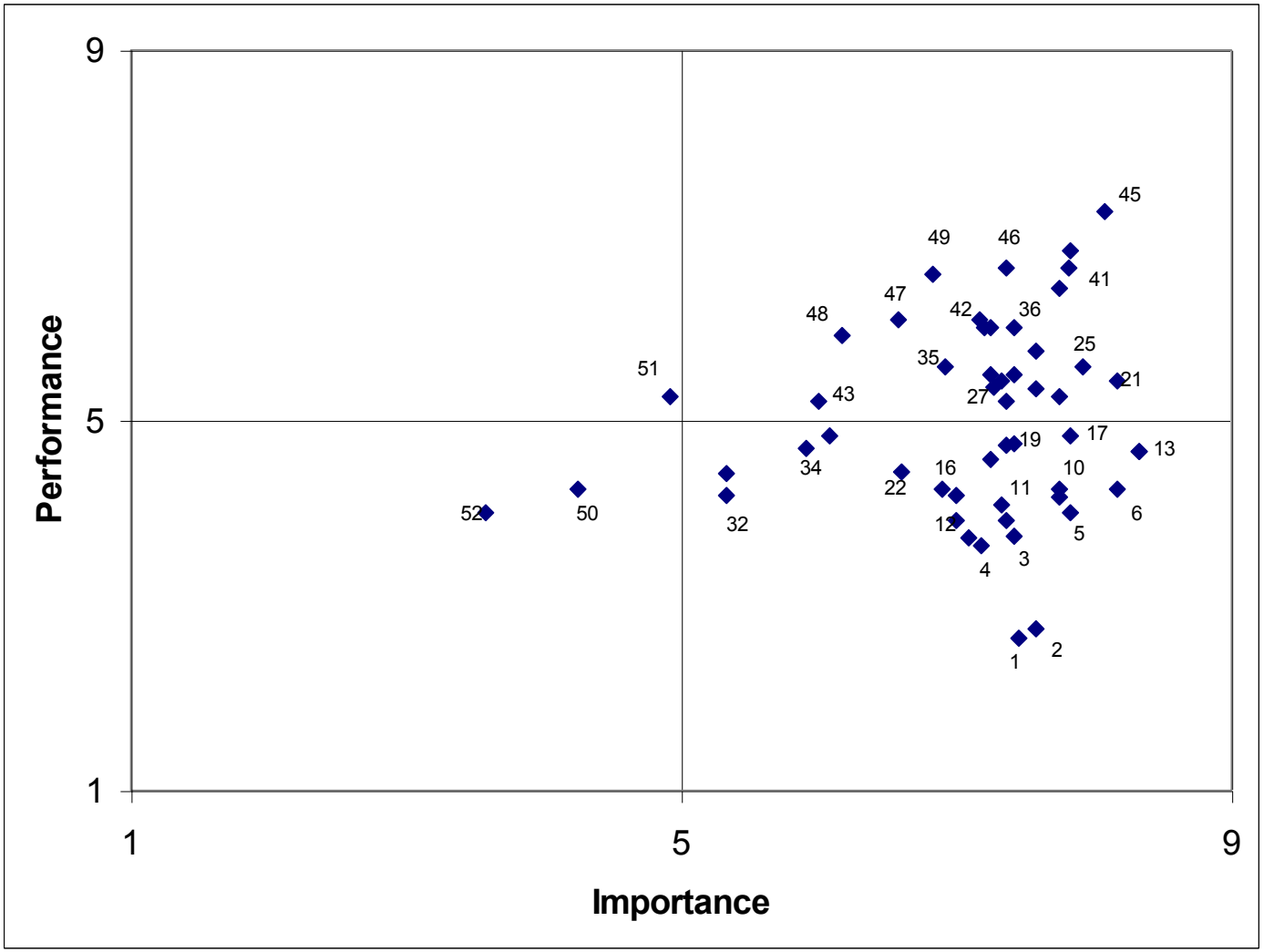

WHY IT DOESN'T PAY TO BE NICE

# Quality Improvement Priority Matrix

# Quality Improvement Priority Matrix (QIPM)

- 1995, 1996 Baldrige Award Conferences
- A method for achieving data-driven decision-making
- QIPM is a way of focusing management attention on high priority tasks.  It can be seen as an alternative to control charts
- Features of an organization (or product or service) are rated on two scales – importance and performance
- Scales range from 1 to 9
- The measures that result are averaged Importance (*I*), Performance (*P*), and Importance/ Performance Ratio (IPR)

# QIPM


9
5
1
Performance
1
5
9
Importance
45
49
46
41
47
42
36
48
25
35
51
21
43
27
19
17
13
34
16
10
22
11
6
52
50
32
12
5
4
3
1
2

Data was collected from members of the GWU Department of Management Science in 2001, 2002, 2003, and 2005

They evaluated features of the Department (a total of 52 features):

- Funds to support research
- Salaries
- Coordination with other depts.
- Computer labs
- Classroom facilities
- Classroom scheduling
- Office space for faculty
- Travel support
- Dept. and School websites
- Library book and journal collection
- Office security
- English skills of students
- Course evaluations
- Teaching assistants
- Faculty annual reports
- Conference room and other space
- Computer hardware and software
- Course catalogue
- Copiers
- Secretarial support
- Dept. strategic plan

# The most stable high importance features (always in the first 15) from 2001 to 2005

| **Feature** | Ave. Imp. |
|---|---|
| 1. Health care benefits | 8.72 |
| 2. Computer software | 8.65 |
| 3. Classroom facilities | 8.65 |
| 4. A supportive climate in the dept. | 8.60 |
| 5. Salaries | 8.58 |
| 6. Projection equipment | 8.48 |
| 7. Computer labs | 8.47 |

# The most stable low importance features (always in the last 15) from 2001 to 2005

| **Feature** | Ave. Imp. |
|---|---|
| 1. Recreational activities | 4.19 |
| 2. Social activities | 4.94 |
| 3. Faculty annual reports | 5.31 |
| 4. SBPM working papers series | 5.92 |
| 5. Faculty websites | 5.94 |
| 6. Annual retreat | 6.11 |

# The most stable low Performance features (always in the last 15) from 2001 to 2005

| **Feature** | Ave. Perf. |
|---|---|
| Help with writing research proposals | 3.34 |
| Dept. organization to implement its strategic plan | 3.54 |
| Use of continuous improvement methods in the Dept. | 3.74 |
| Conference room and other space | 3.81 |
| Dept. strategic plan | 3.89 |
| Building/ physical environment | 3.94 |
| Recreational activities | 4.06 |

# The most stable high Performance features (always in the first 15) from 2001 to 2005

| **Feature** | Ave. Perf. |
|---|---|
| Dept. head protects faculty from admin. interference | 7.76 |
| Computer hardware | 7.00 |
| A supportive climate in the dept. | 6.93 |
| Interlibrary loan | 6.85 |
| Computer software | 6.84 |
| Copiers | 6.72 |
| Fax machines | 6.62 |
| Course catalogue | 6.39 |
| Campus grounds | 6.17 |

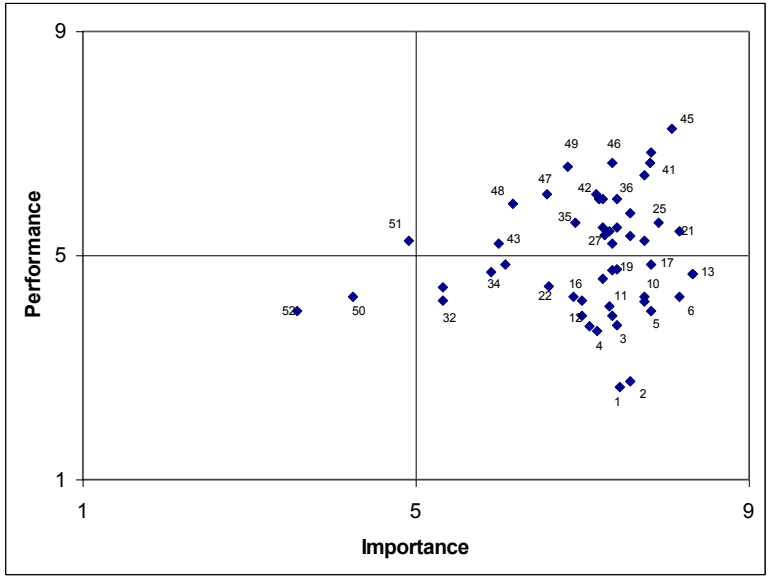
# The features always in the SE quadrant from 2001 to 2005

| **Feature** | Ave. IPR |
|---|---|
| 1. Dept. organization to implement its strategic plan | 2.06 |
| 2. Help with writing research proposals | 1.96 |
| 3. Dept. strategic plan | 1.95 |
| 4. Building/ physical environment | 1.95 |
| 5. Conference room and other space | 1.93 |
| 6. Classroom facilities | 1.89 |
| 7. Salaries | 1.88 |
| 8. Promotion of contract faculty | 1.87 |
| 9. Parking for students | 1.75 |
| 10. Funds to support research | 1.74 |
| 11. Computer labs | 1.72 |
| 12. Use of continuous improvement methods in the Dept. | 1.69 |
| 13. Coordination with other depts. | 1.65 |
| 14. SBPM working papers series | 1.62 |

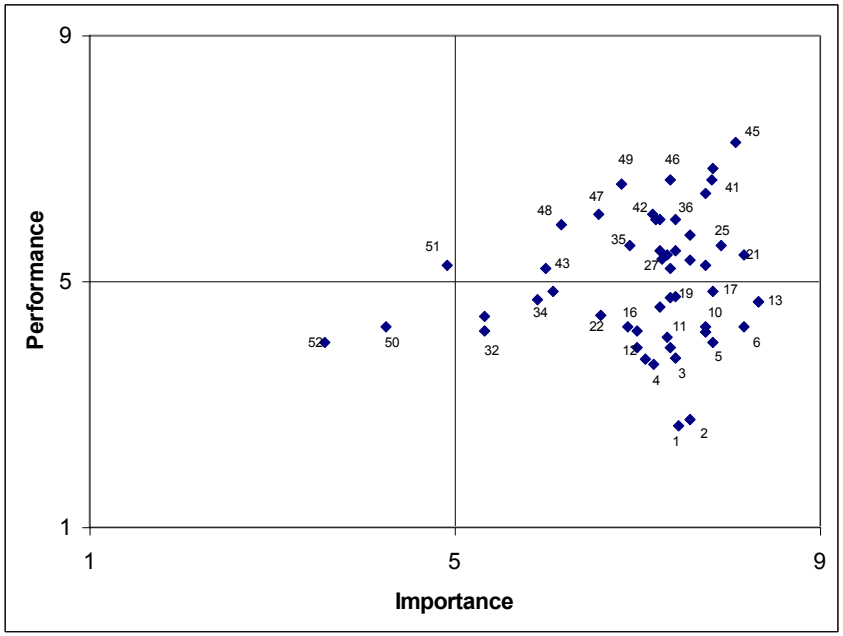
# A classical approach: features in the SE quadrant are considered to have a high priority

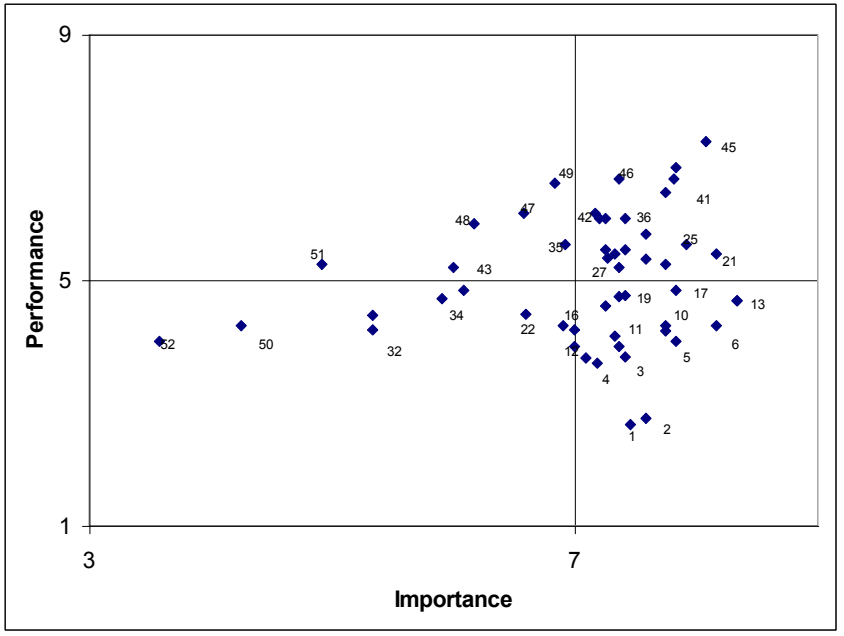
# Visual analysis of QIPM does not discriminate features' priorities sufficiently

- From 1/3 to 1/2 of all features routinely fall into the SE quadrant
  (e.g., 19 of 51 features in 2001, 17 of 52 in 2002, 23 of 52 in 2003, and 26 of 52 in 2005
- The "border effect"
- The problem of automatic clustering of factors by their priorities



# Using average Importance and Performance as a midpoint rather than the scale midpoint

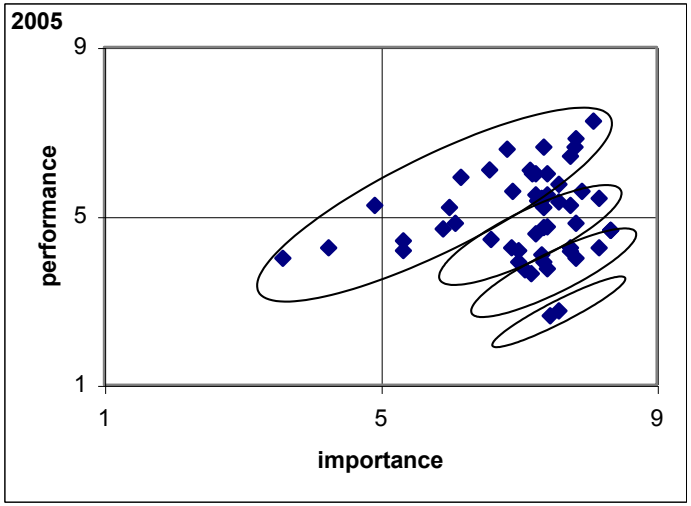


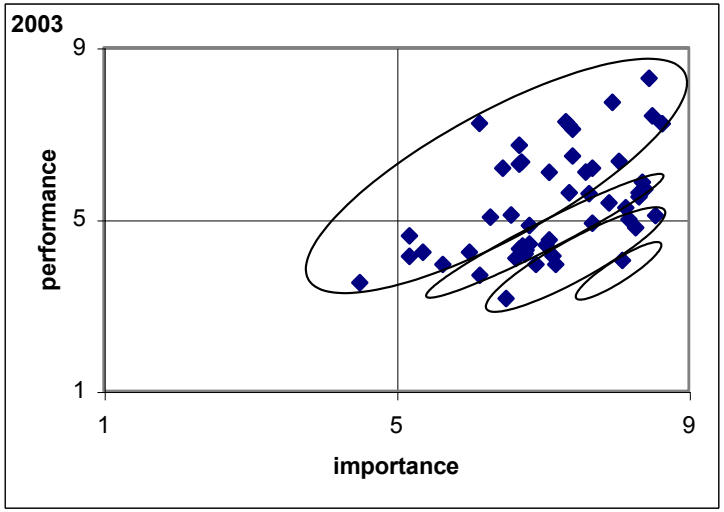



# Clustering features by the IPR interval

Cluster 0 (urgent) – *IPR*>2
Cluster 1 (high priority) – [1.5 – 2]
Cluster 2 (medium priority) – [1.25 – 1.5)
Cluster 3 (low priority) – *IPR*<1.25

$r_{IP}$ = 0.96 (0), 0.88 (1), 0.85 (2), 0.90 (3)
$r_{IP}$ = 0.18 (unclustered)




A way to automatically cluster features with different priorities is to choose intervals that create clusters with the highest correlation coefficient

# QIPM

- Is easy to understand
- Is efficient in terms of time and resources
- Provides enough precision for monitoring changes in priorities and performance
- Is based on subjective data, so can be used to extend process improvement methods beyond manufacturing into service-oriented activities

# SOURCES OF CUSTOMER INFORMATION

**Basic or Reactive Sources**

- Customer service
- Technical support
- Claims/refunds
- Sales force reporting

**Advanced or Proactive Sources**

- Focused questioning of selected customers
- Observing customers using the product or service
- Monitoring customer satisfaction
- Monitoring of broad market trends

# Result: quality improves and costs decline

Total costs = Cost of producing goods or services + Cost of producing waste or errors + Cost of doing quality improvement

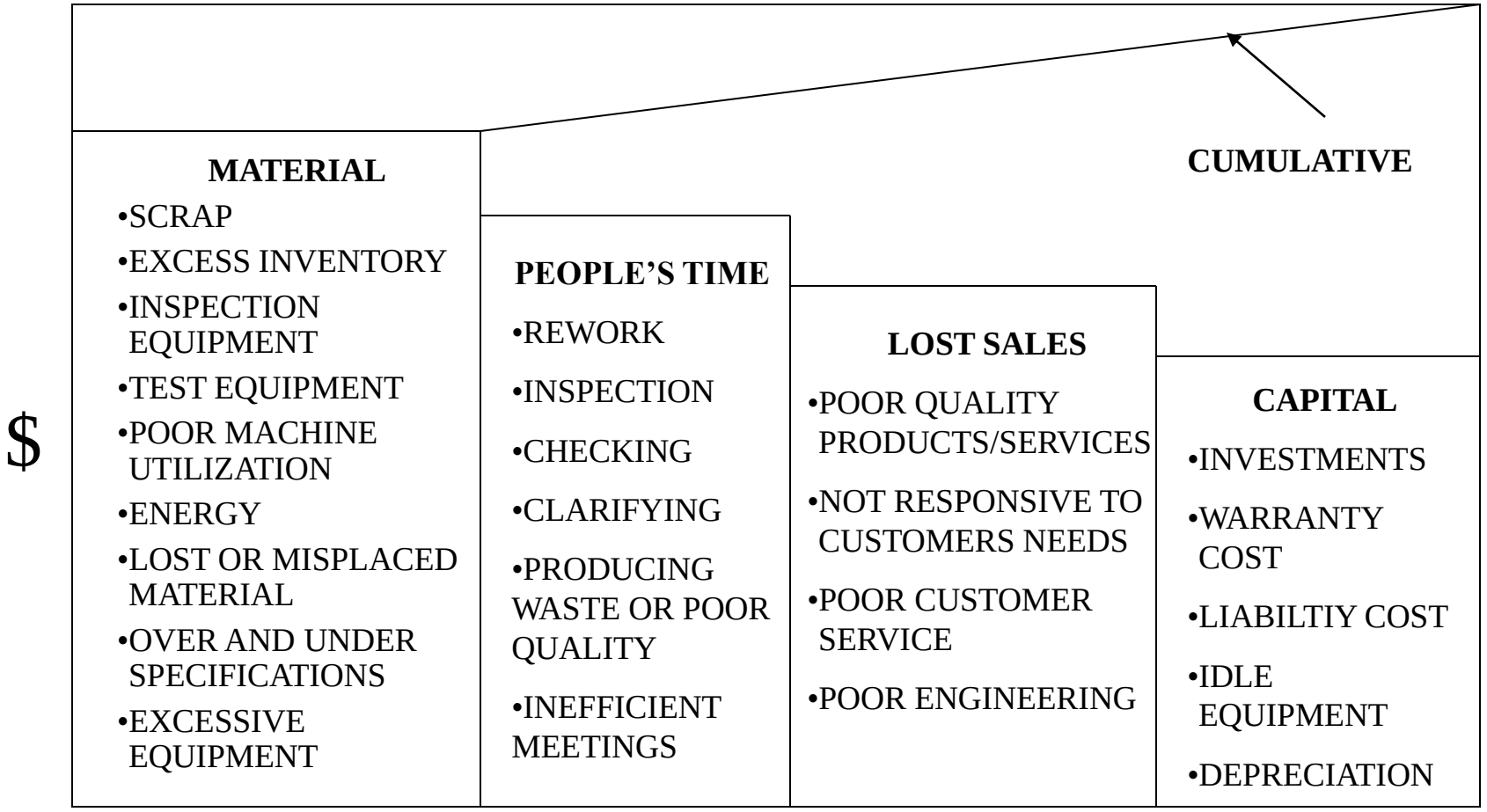


SAVE HERE



SPEND HERE

# Reduce Chronic Waste



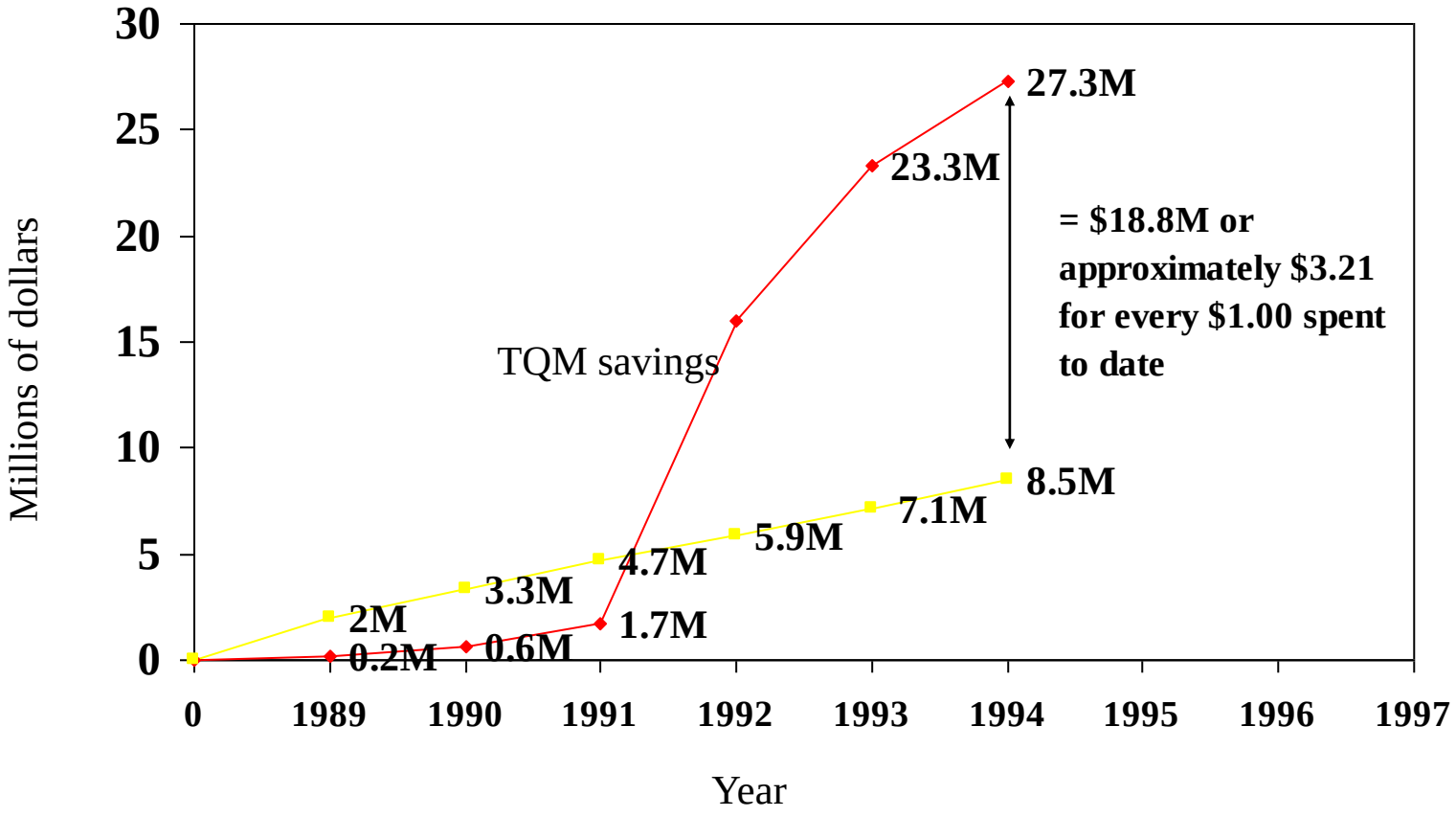



Figure 8. Return on TQL investment at Naval Air Warfare Center Aircraft Division, Lakehurst, New Jersey.

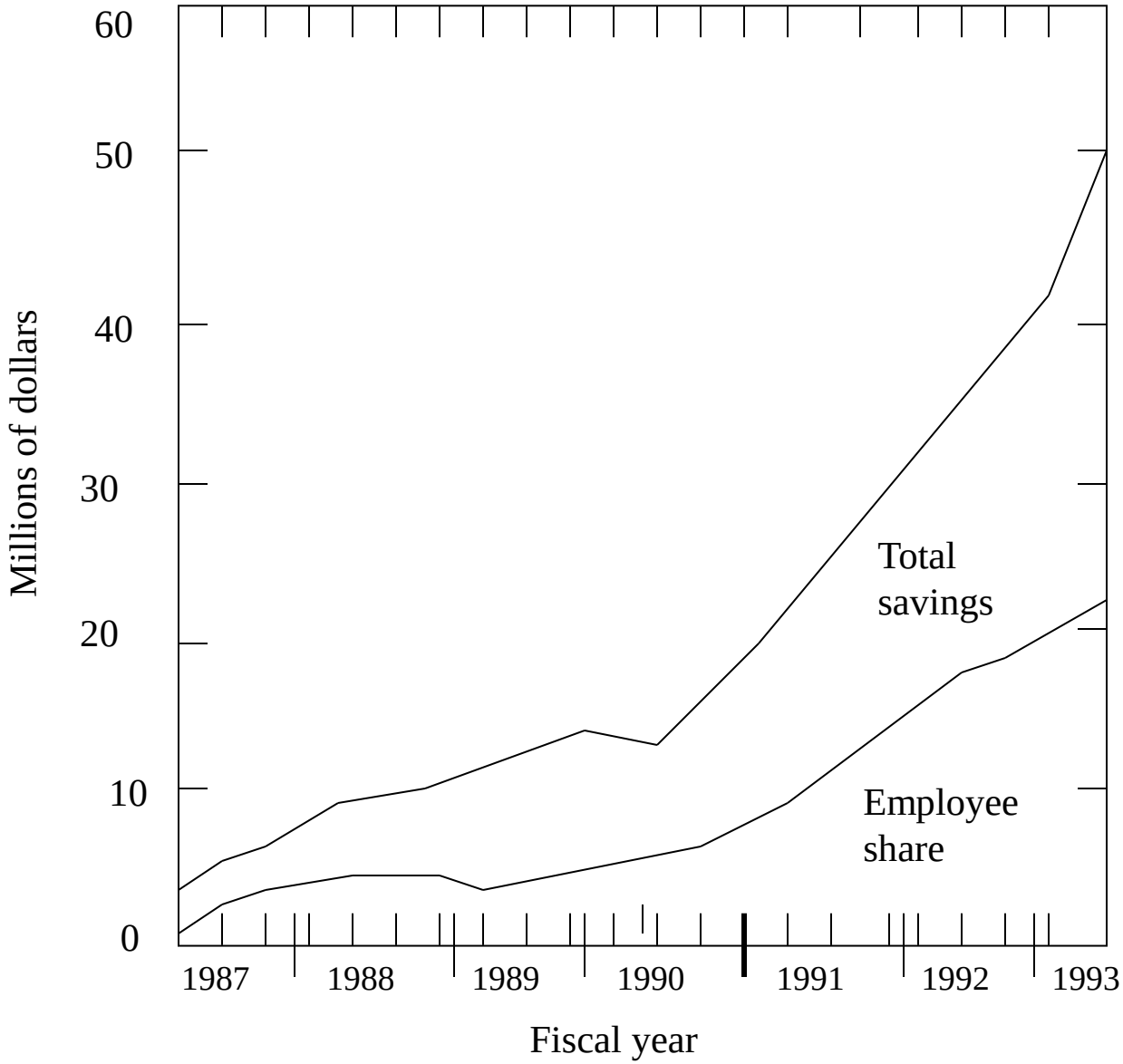
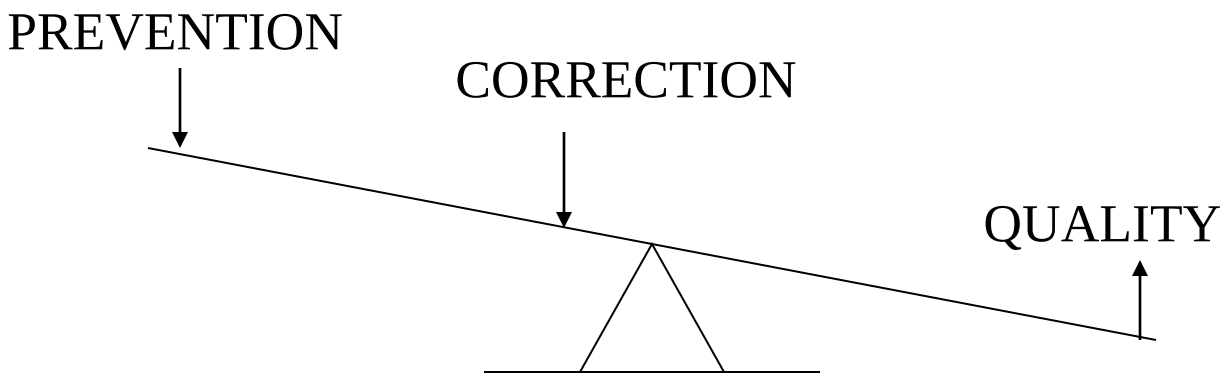



**Figure 7.** Savings associated with productivity gain sharing at the Naval Aviation Depot, Cherry Point, North Carolina.

# A manager who fails to provide resources and time for prevention activities is practicing false economy

Concentrate on Prevention, Not Correction




PREVENTION HAS MORE LEVERAGE WHEN IMPROVING QUALITY

# Process improvement and cybernetics

- Process improvement methods use the scientific method of testing hypotheses
- Improvements are made not just by scientists or engineers but by all workers
- Working both “in” the process and “on” the process illustrates learning and adaptation
- What is learned is immediately put into practice

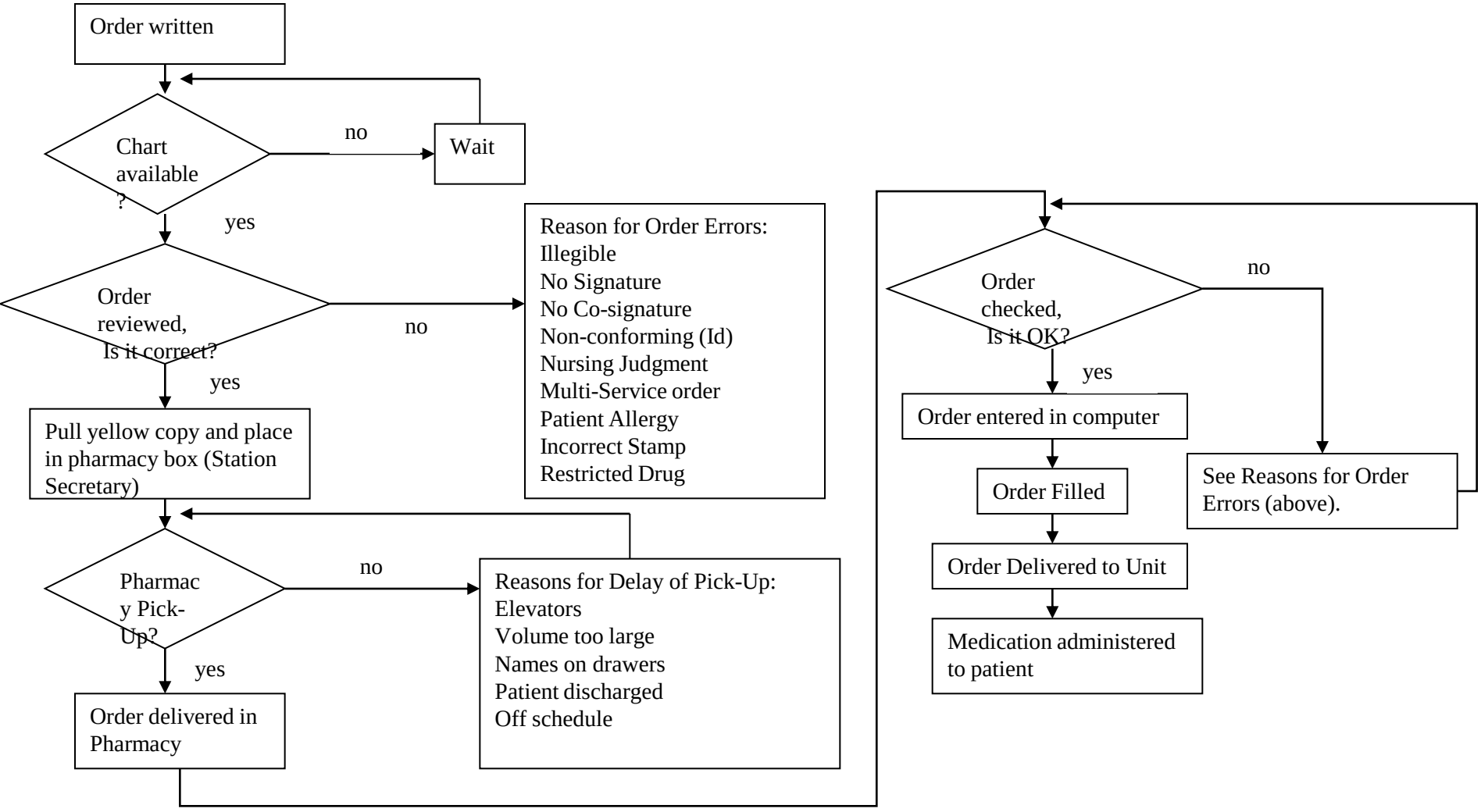
# An Example of Process Improvement in A University Hospital

# MEDICATION TURN AROUND TIME

## FIND AN OPPORTUNITY TO IMPROVE

- Nursing and Pharmacy departments had been in long-term state of war.
- Joint Nursing-Pharmacy Committee had met for two years to address medication turnaround time with little success.
- Quality improvement team formed. Formulated opportunity statement: “There is an opportunity to improve the medication turnaround process from the time a physician writes an order to the time it is administered. An improvement in the process will benefit the patients, physicians, nursing staff and pharmacy.”

# Medication Turnaround Time Process Flowchart



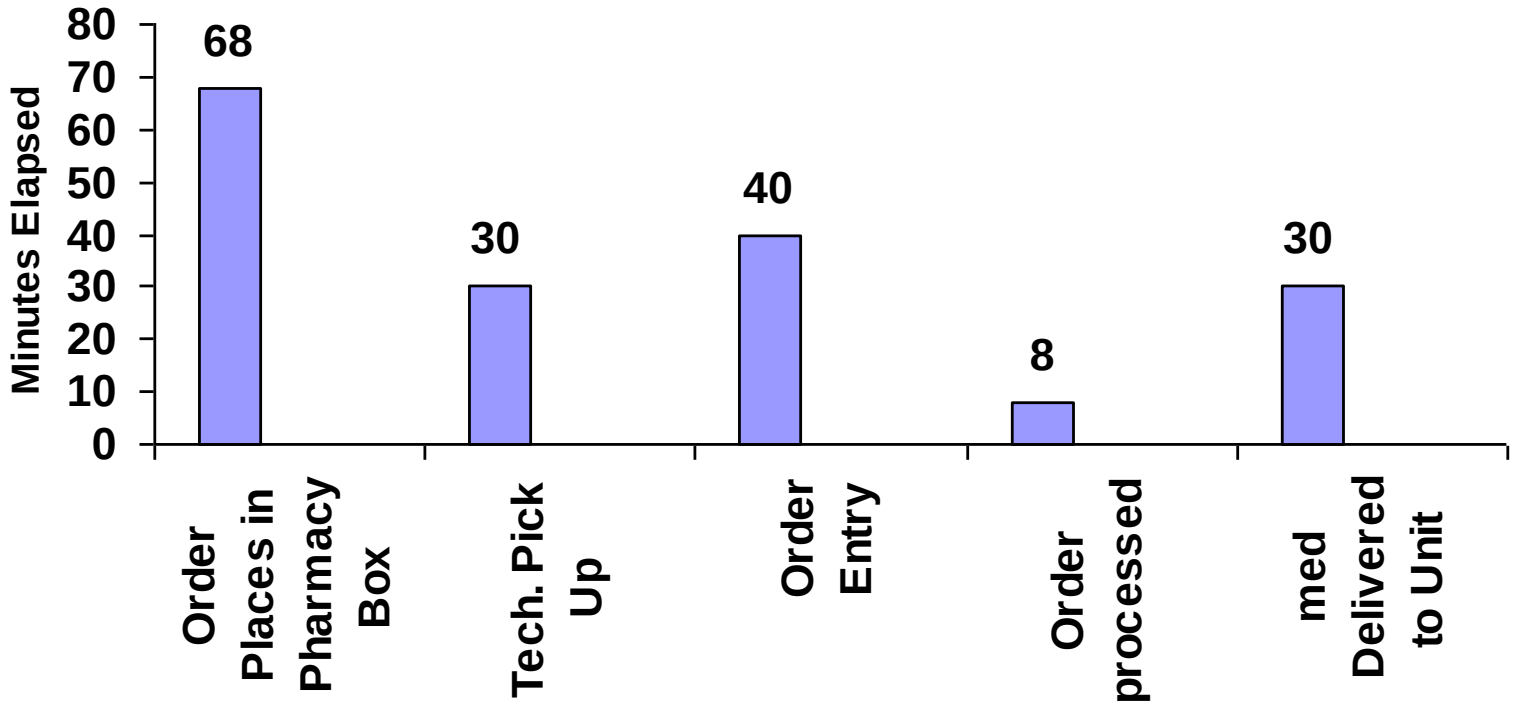
Directions: Please fill in the time that each step is completed
Please check if missing:

| | Time | Time | Signature | Beeper | Pink (PO) |
|---|---|---|---|---|---|
| Order written by physician | | | | | |
| Order placed in Pharmacy box | | | Comments: _____ _____ _____ _____ _____ _____ _____ _____PO_____ _____ _____ | | |
| Order picked up by technician | | | | | |
| Order entry by Pharmacy | | | | | |
| Order label processed | | | | | |
| Order delivered to Med Drawer on unit | | | | | |
| Med Administered to patient | | | | | |

Sec'y or RN

Pharmacy RN

# Median Elapsed Time



# Selecting An Intervention

PLAN:

- Team discussed reasons for delay
- Discovered
  - no standardized system exists from unit to unit for flagging orders
  - Records are located in different places on units
  - charts are taken by medical students, therapy departments and attending physicians
- Team used a brainstorming technique
- Medical Resident suggested the house staff tear aparta two-part form and place in basket on the nursing unit.

# Selecting An Intervention

DO:

- Team devised a pilot project to be limited to several nursing units and only the medicine house staff
- Medical Resident trained the house staff
- Pilot was conducted over two-day period

# Selecting An Intervention

CHECK:

- On first day, almost 100% compliance of test group; time in this step of the process was reduced from up to six hours to zero
- New process eliminated need for secretary to handle orders, thus minimizing opportunity for human error
- Second day a fiasco: Team hadn’t taken into account that the medical service changed and a new batch of house staff arrived unprepared for change in process

# Selecting An Intervention

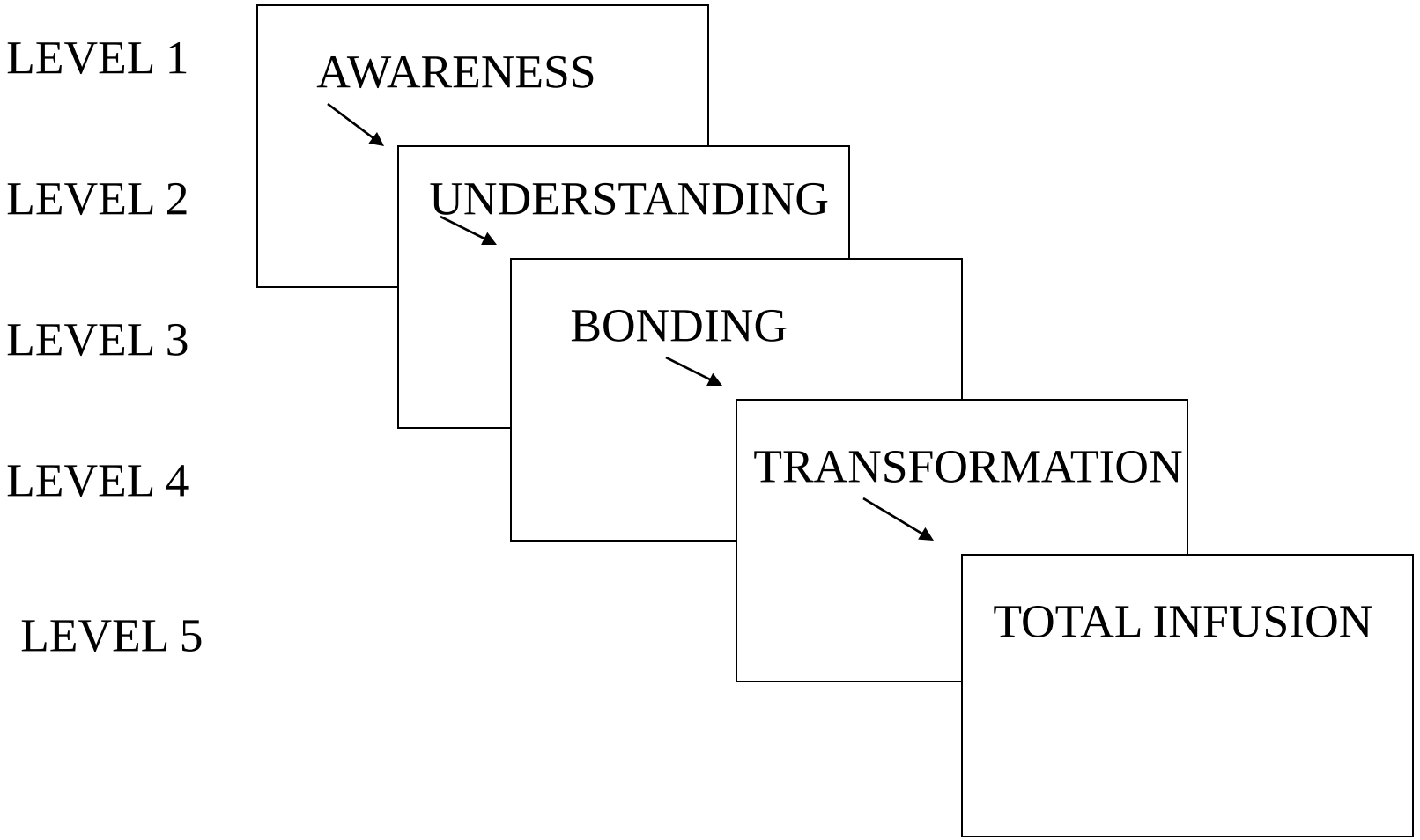
ACT:

- Team was convinced that the process change will result in a major reduction in variation
- Pilot was continued for several weeks and then institutionalized.
- Team turned to additional process improvements, including:
  - Order entry on units by the pharmacists
  - Medication dispensers on units for routine drugs
  - Problems with missed doses immediately post surgery

# What BENEFITS were obtained from the Pharmacy Project?

- The nursing staff and pharmacy held a “cease-fire” since the beginning of the quality improvement team.
- Both groups learned that there are very real system issues driving the people problems.
- The house staff became more sensitized to the need to standardize their behavior in terms of the hospital system.

# Levels of Department Deployment



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# Management Cybernetics 2

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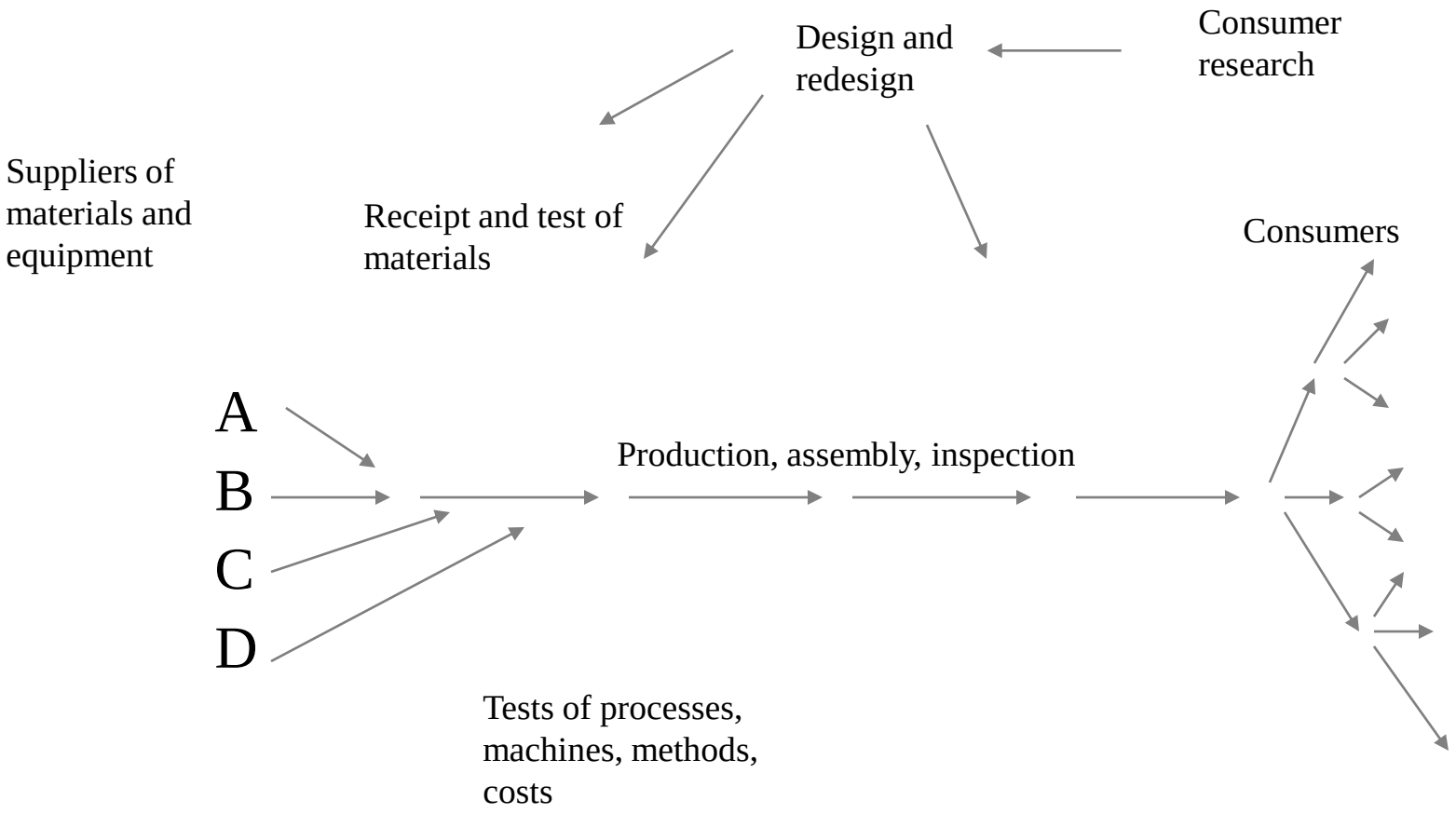
# THE DEMING FLOW DIAGRAM



# Organization Chart

DOES show: reporting relationships

DOES NOT show:

- products/services provided
- customers served
- work flows
- ways in which products/services are delivered

In short, such a chart doesn’t show what an organization does, for whom they do it, or how they do it

# Process

A group of logically related tasks (decisions and activities) that when performed, utilize the resources of the business to produce definitive results.

Processes are independent of organization and have the following characteristics:

- measurable inputs
- value added
- measurable outputs
- repeatable activity

# Limitations of Hierarchical Management

- Artificial goal establishment
- huge coordinating activity to reconcile goals of different units
- managers tend to perceive other functions as enemies
- many issues fall through the cracks
- top level manager is often the only person with authority over low-level problems

# Fast-cycle capability

- If you can do it faster, you'll do it better: not by working faster, but by squeezing the delays out of the process
- Just in time inventory
- Meeting changing customer needs more effectively
- Fewer opportunities for mistakes
- Less work to self-manage
- Less status reporting
- Less chance for Murphy's Law

# Hierarchical vs. Process

- Focus: reporting relationships and flow of authority
- isolated budget requests
- measures are actual vs. budget
- authority and responsibility are divided into functional units or profit-centers
- high-level intervention in low-level issues
- only top manager has big picture

- Focus: converting inputs into outputs
- collective budget requests
- measures begin with the output and track back
- joint authority and responsibility for output of a system
- working level solves low-level issues
- picture expanded throughout

# Stafford Beer's Viable System Model

# Features of the VSM

- Based on the structure of the human nervous system
- Five levels or functions
- The five functions recur at each level of organization

# Features of the VSM

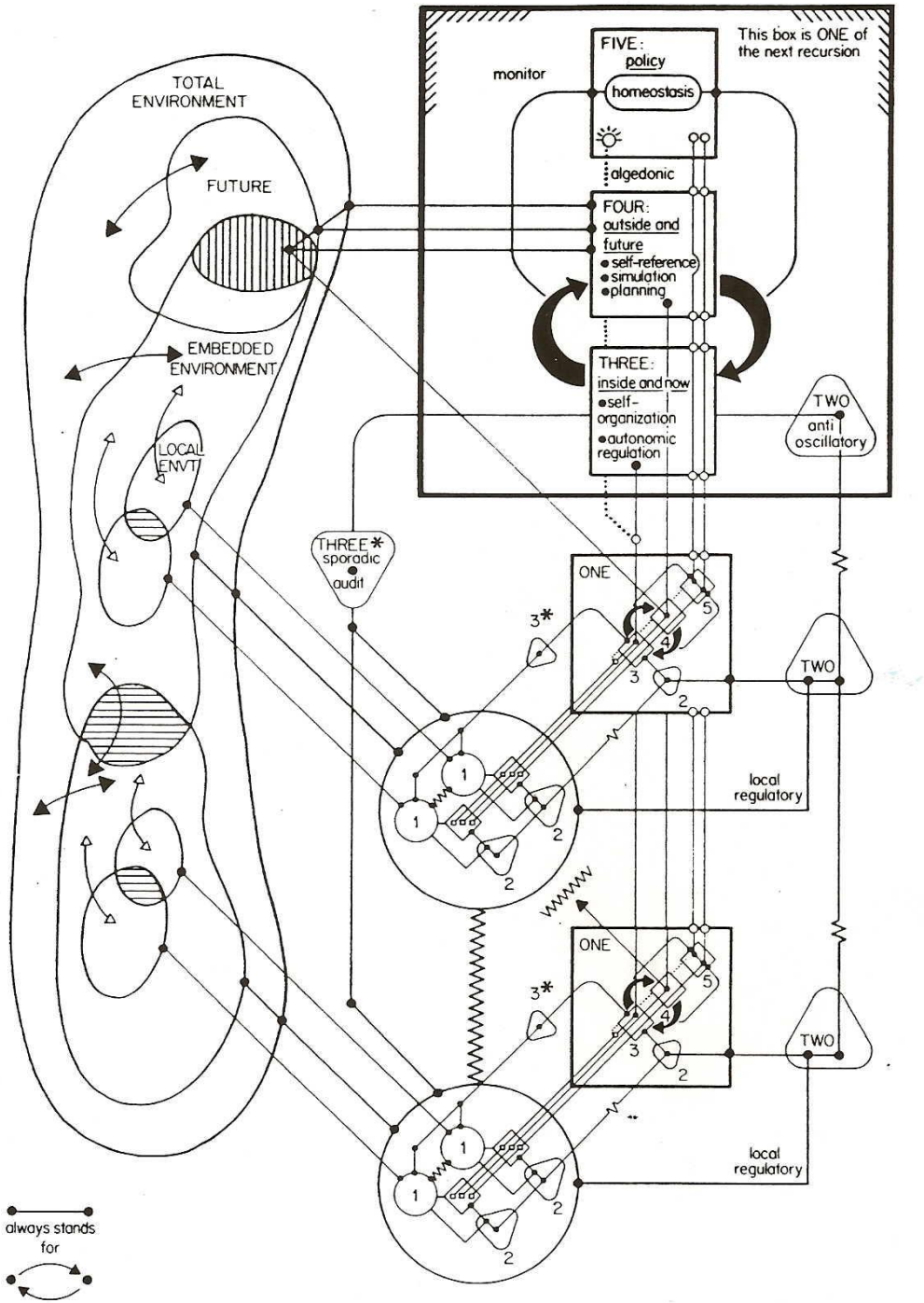
- Maximizes autonomy of units
- Minimizes bureaucracy
- Maintains control of essential activities
- Evaluates results, not methods

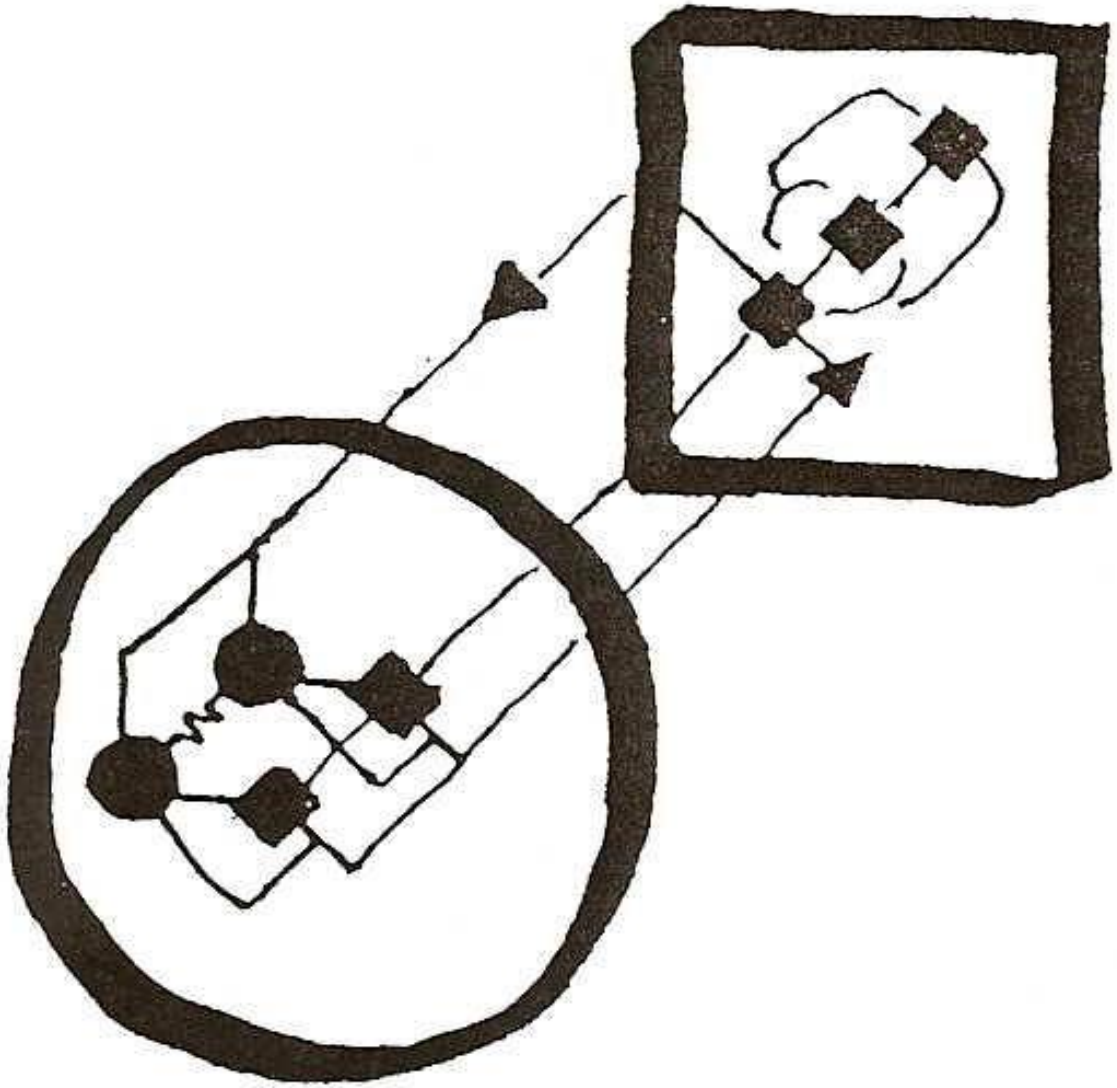
# The five functions

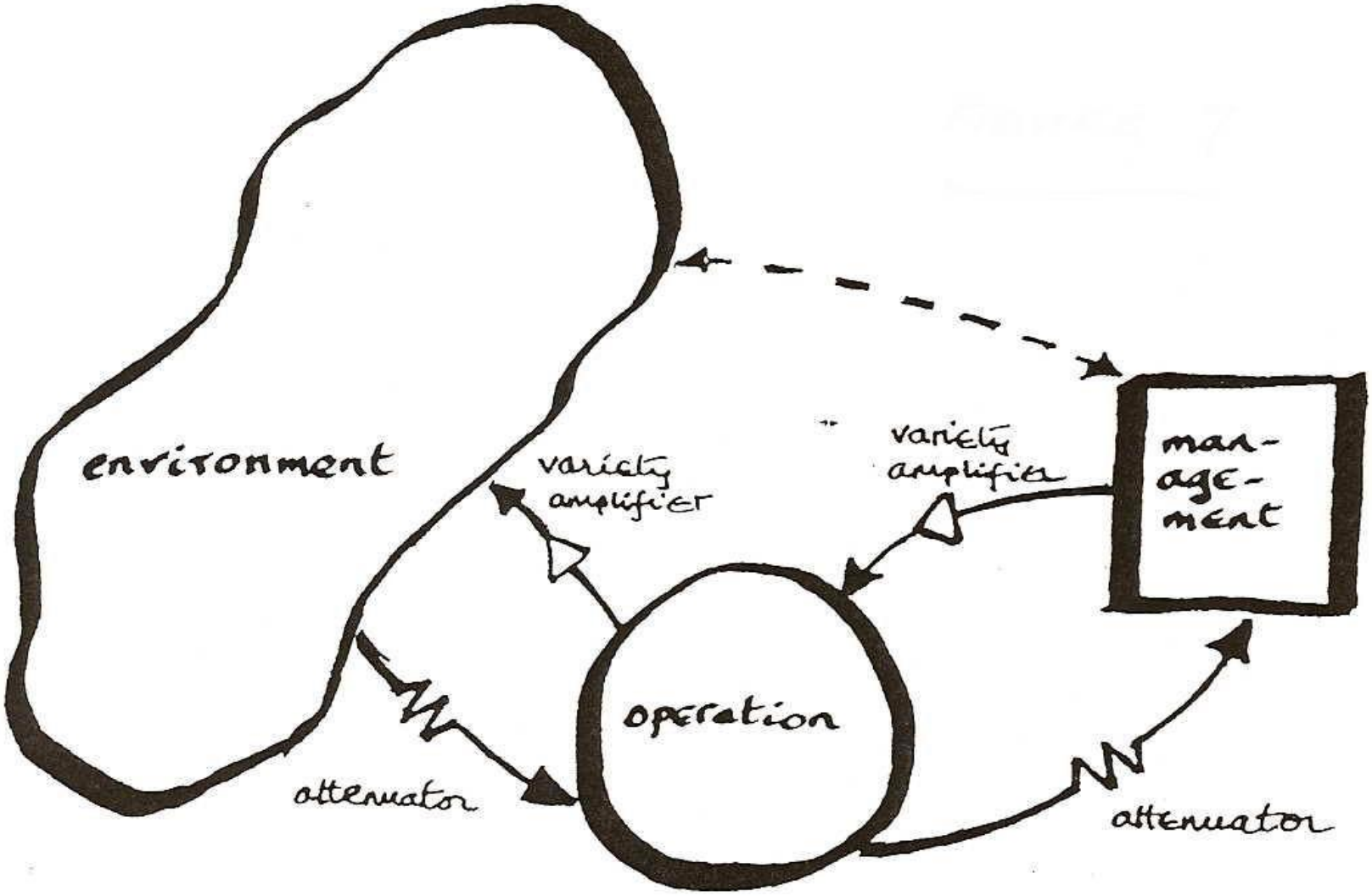
- System five – controls the rate of innovation, defines the organization's values
- System four – does long-range planning, designs the next product or service
- System three – middle management, defines a "resource bargain" with the system ones
- System two – coordinates the producing units
- System one – the producing units

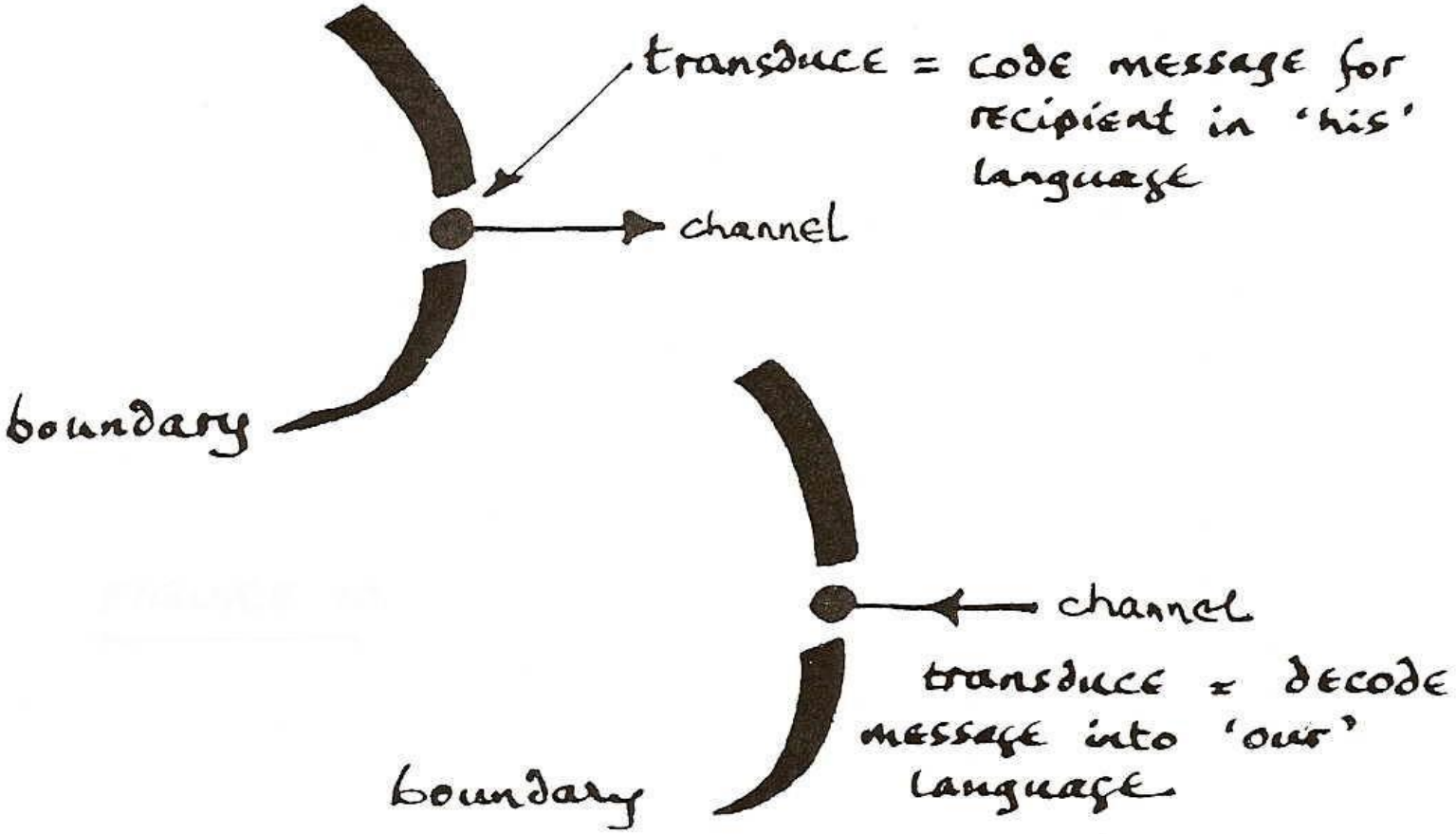
# Concerns of the Viable System Model

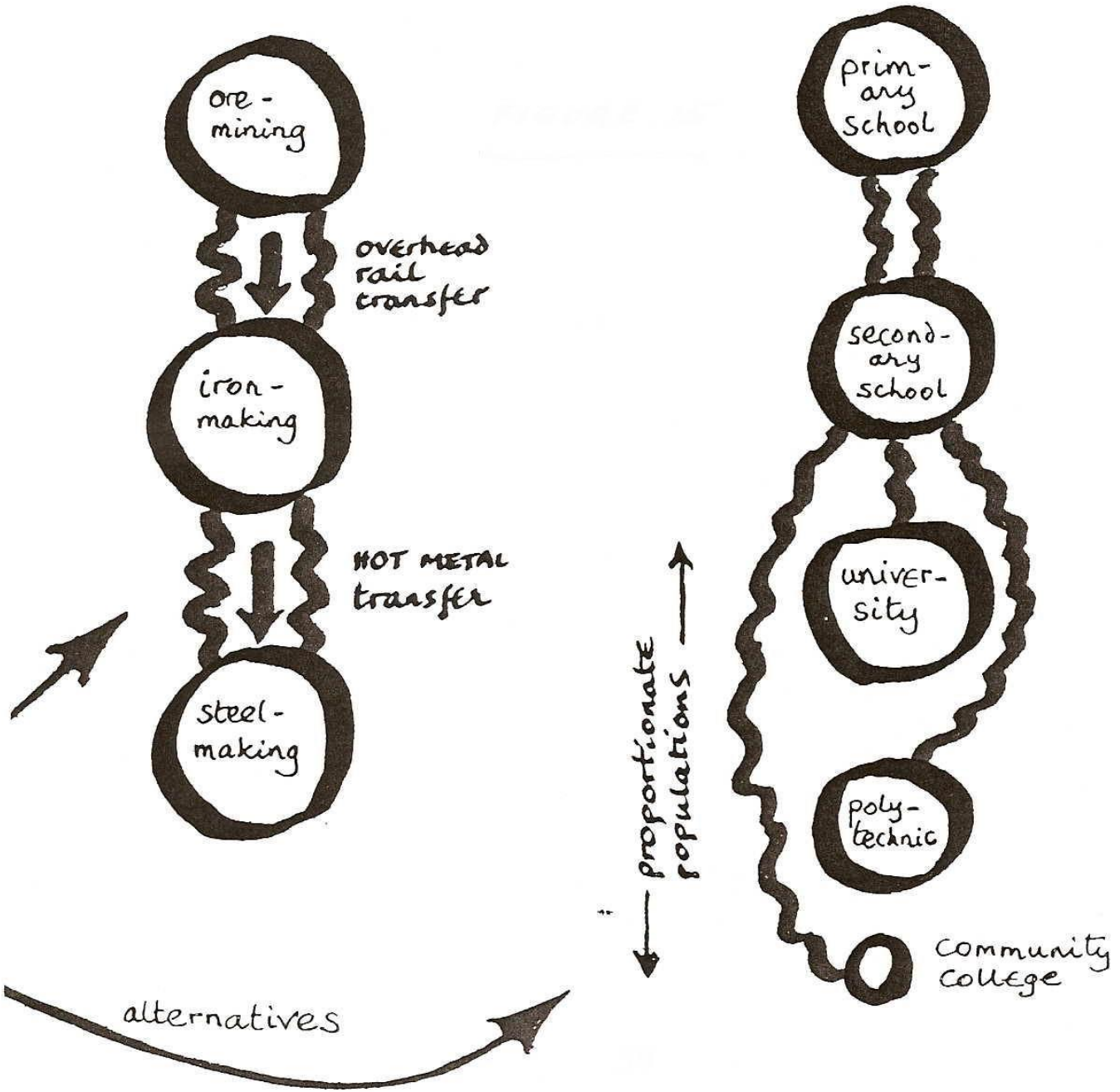
- Make sure that the variety that needs to be controlled is controlled
- Influenced by Ashby's Law of Requisite Variety and Ashby's theory of adaptive behavior

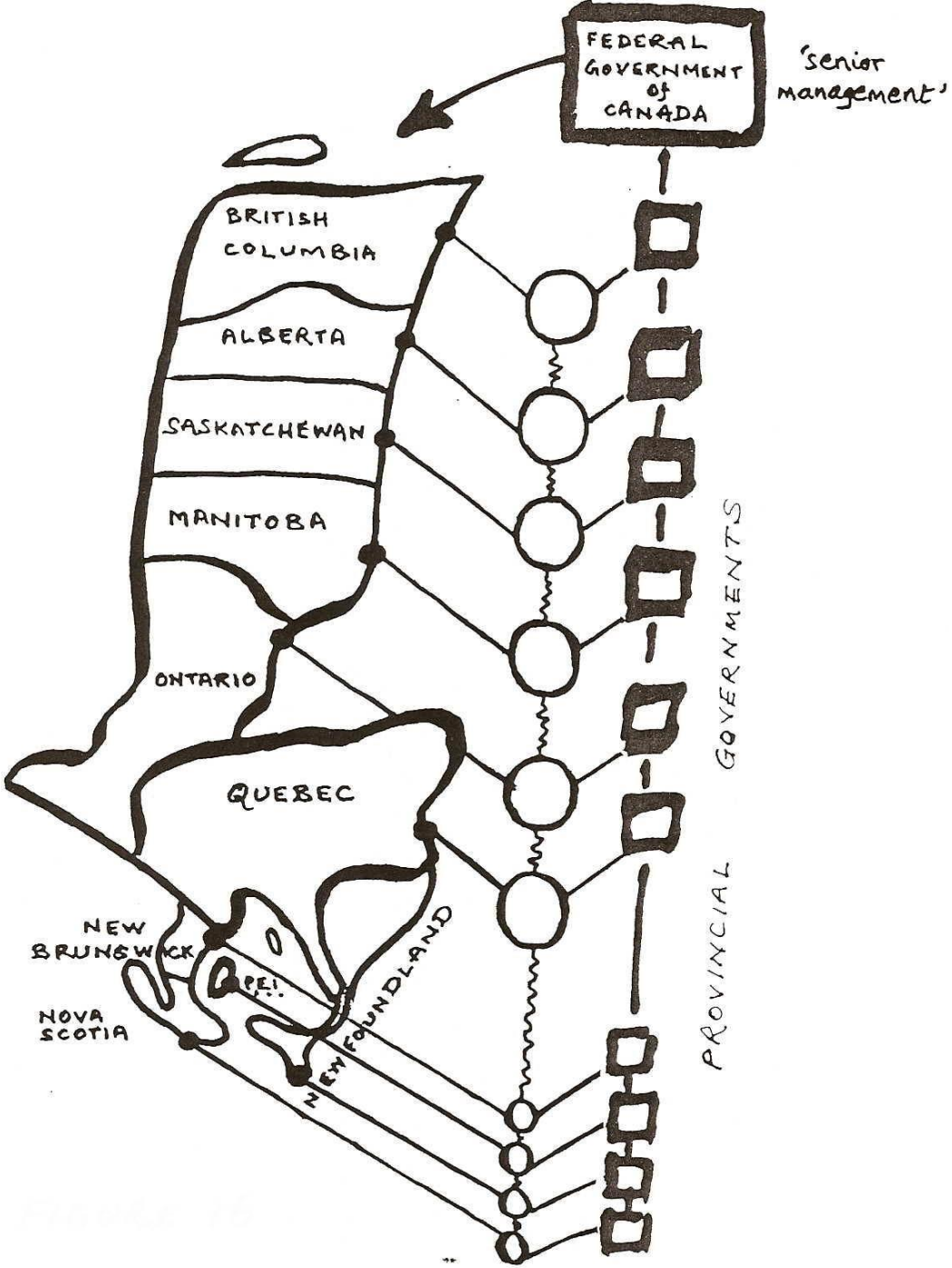

TOTAL ENVIRONMENT
FUTURE
EMBEDDED ENVIRONMENT
LOCAL ENVT
This box is ONE of the next recursion
FIVE: policy
homeostasis
monitor
algedonic
FOUR: outside and future
• self-reference
• simulation
• planning
THREE: inside and now
• self-organization
• autonomic regulation
TWO anti oscillatory
THREE* sporadic audit
ONE
3*
TWO
local regulatory
ONE
3*
TWO
local regulatory
always stands for

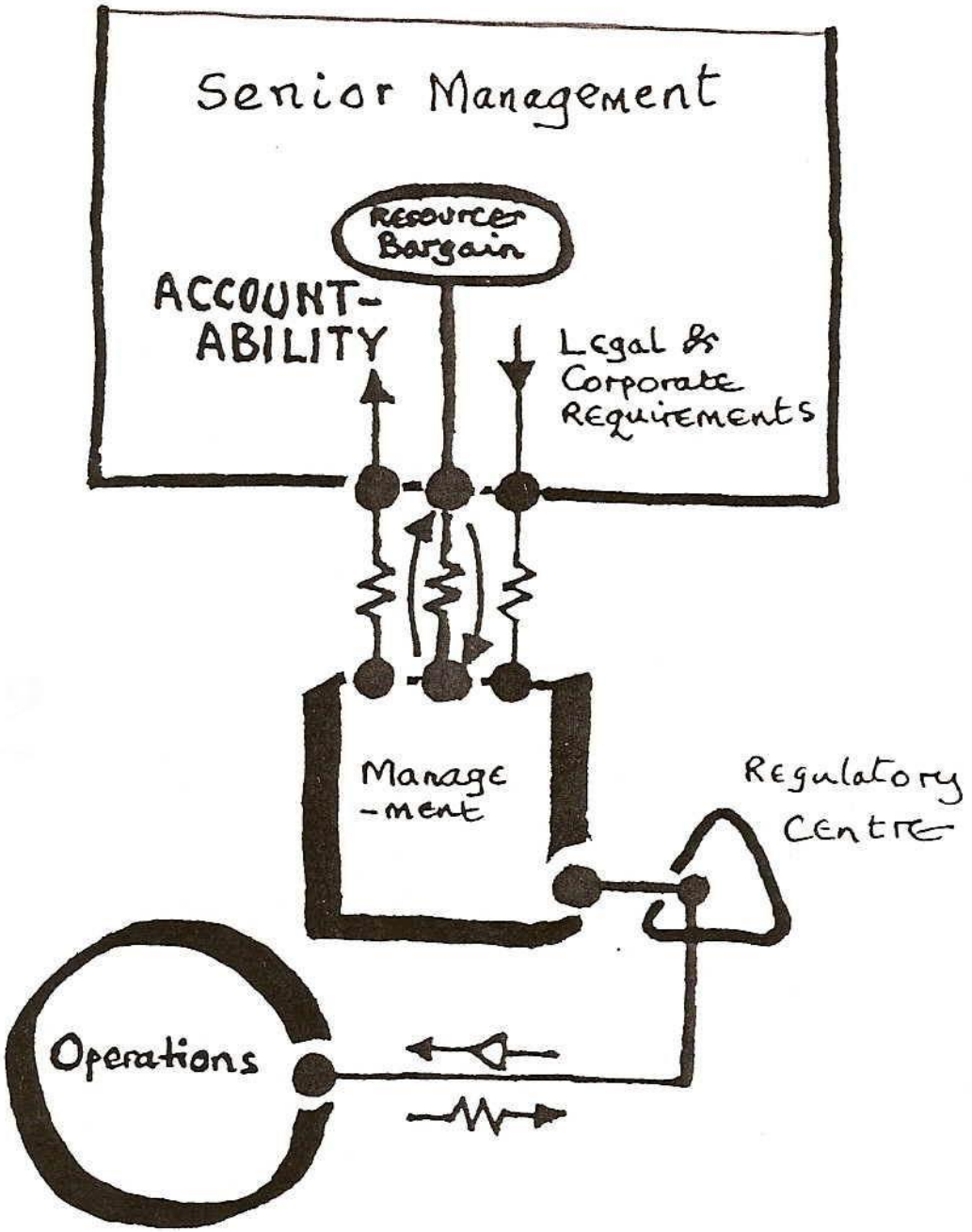


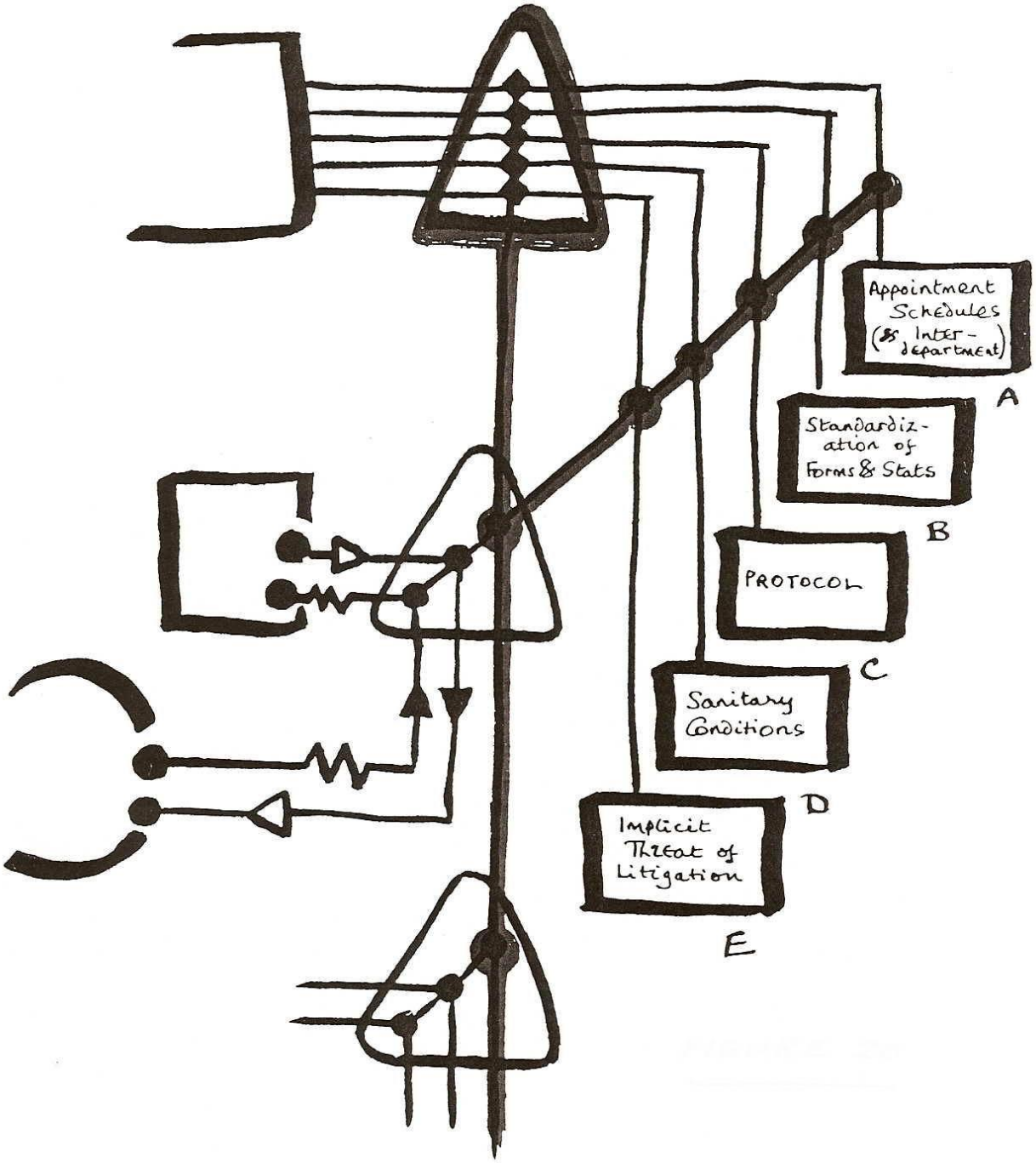

environment
variety amplifier
variety amplifier
man-age-ment
operation
attenuator
attenuator

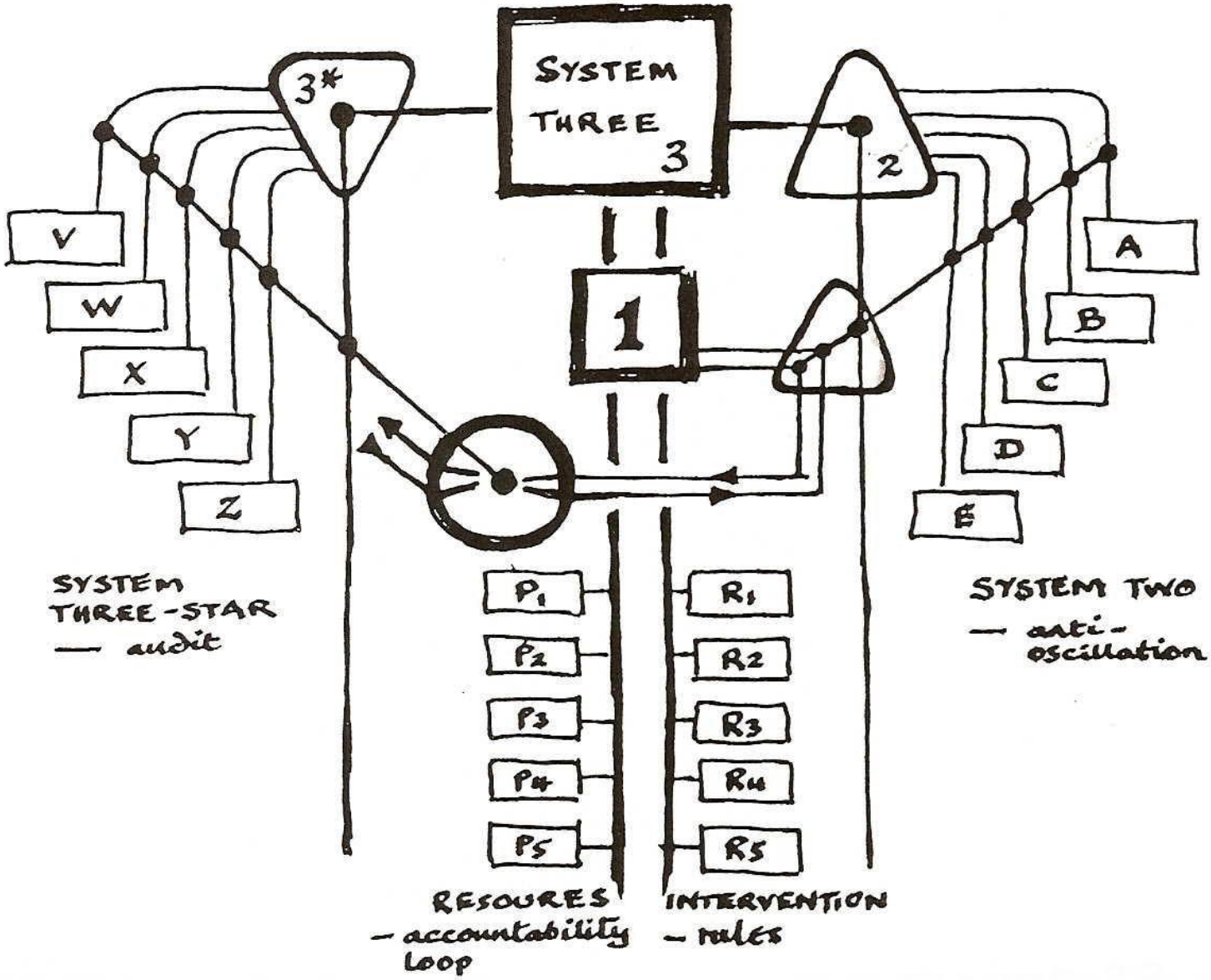

transduce = code message for recipient in 'his' language
channel
boundary
channel
transduce = decode message into 'our' language
boundary

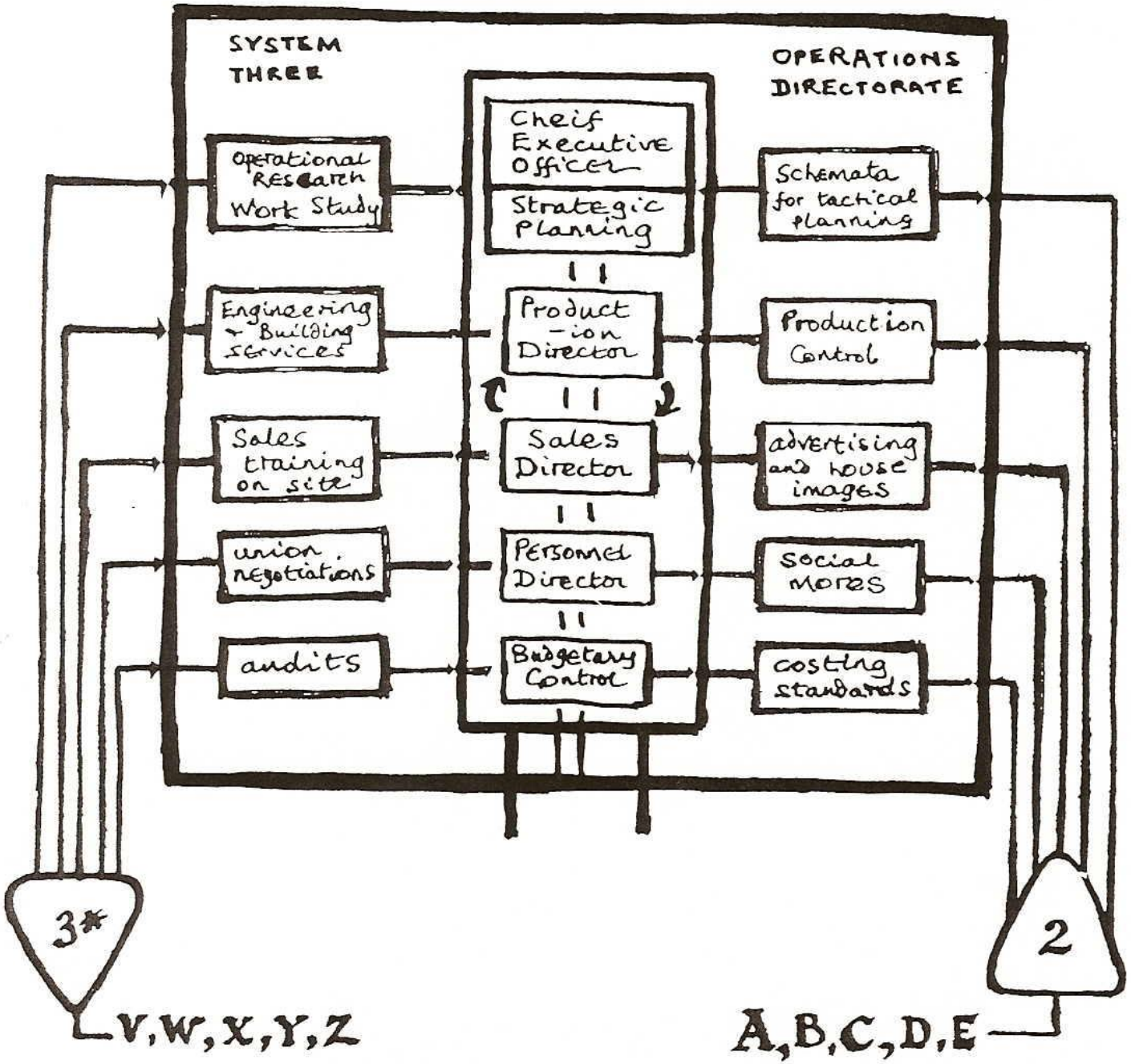

ore - mining
overhead rail transfer
iron - making
HOT METAL transfer
steel - making
alternatives
prim- ary school
second- ary school
univer- sity
poly- technic
community college
proportionate populations

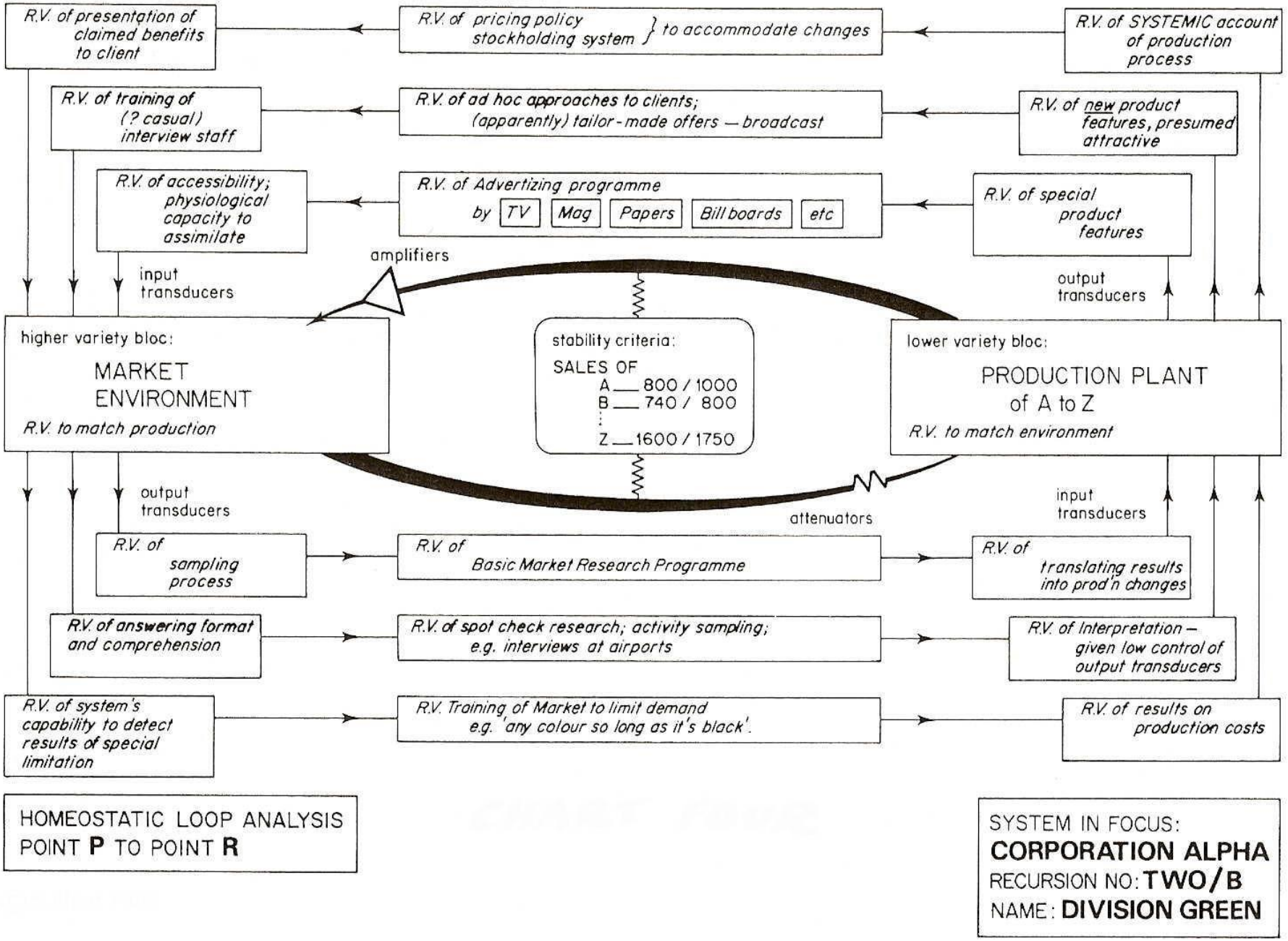

FEDERAL GOVERNMENT OF CANADA
'senior management'
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEW BRUNSWICK
P.E.I.
NOVA SCOTIA
NEWFOUNDLAND
PROVINCIAL GOVERNMENTS


Senior Management
Resource Bargain
ACCOUNT-ABILITY
Legal & Corporate Requirements
Manage-ment
Regulatory Centre
Operations


Appointment Schedules (& Inter-department)
A
Standardiz-ation of Forms & Stats
B
PROTOCOL
C
Sanitary Conditions
D
Implicit Threat of Litigation
E

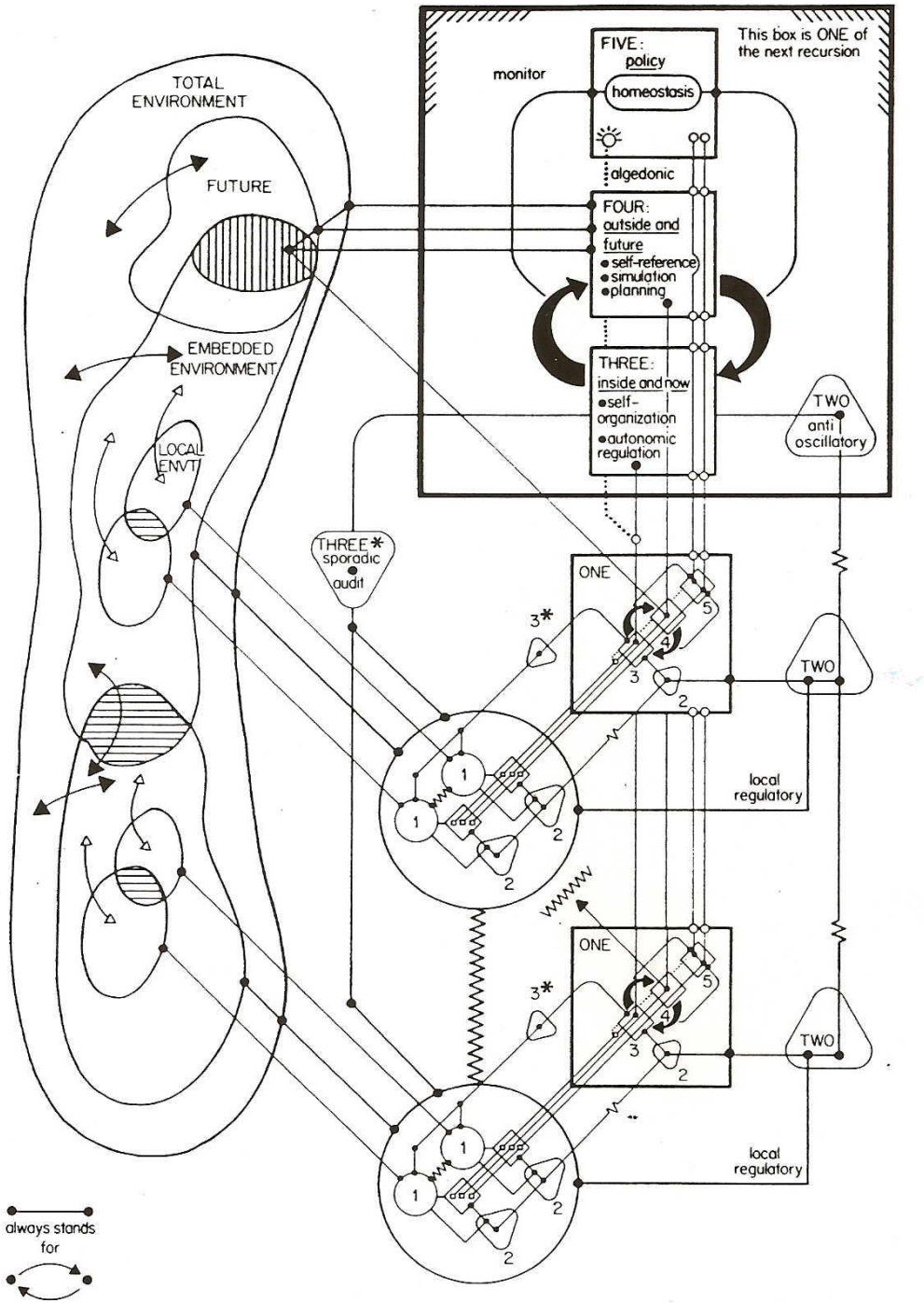

SYSTEM THREE 3
3*
2
1
V
W
X
Y
Z
A
B
C
D
E
P1
P2
P3
P4
P5
R1
R2
R3
R4
R5
SYSTEM THREE-STAR — audit
SYSTEM TWO — anti-oscillation
RESOURES — accountability loop
INTERVENTION — rules


SYSTEM THREE
OPERATIONS DIRECTORATE
Operational Research Work Study
Engineering + Building services
Sales training on site
union negotiations
audits
Cheif Executive Officer
Strategic Planning
Product -ion Director
Sales Director
Personnel Director
Budgetary Control
Schemata for tactical planning
Production Control
advertising and house images
social mores
costing standards
3*
V,W,X,Y,Z
2
A,B,C,D,E




HOMEOSTATIC LOOP ANALYSIS
POINT **P** TO POINT **R**

SYSTEM IN FOCUS:
**CORPORATION ALPHA**
RECURSION NO: **TWO/B**
NAME: **DIVISION GREEN**


TOTAL ENVIRONMENT
FUTURE
EMBEDDED ENVIRONMENT
LOCAL ENVT
This box is ONE of the next recursion
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monitor
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FOUR: outside and future
• self-reference
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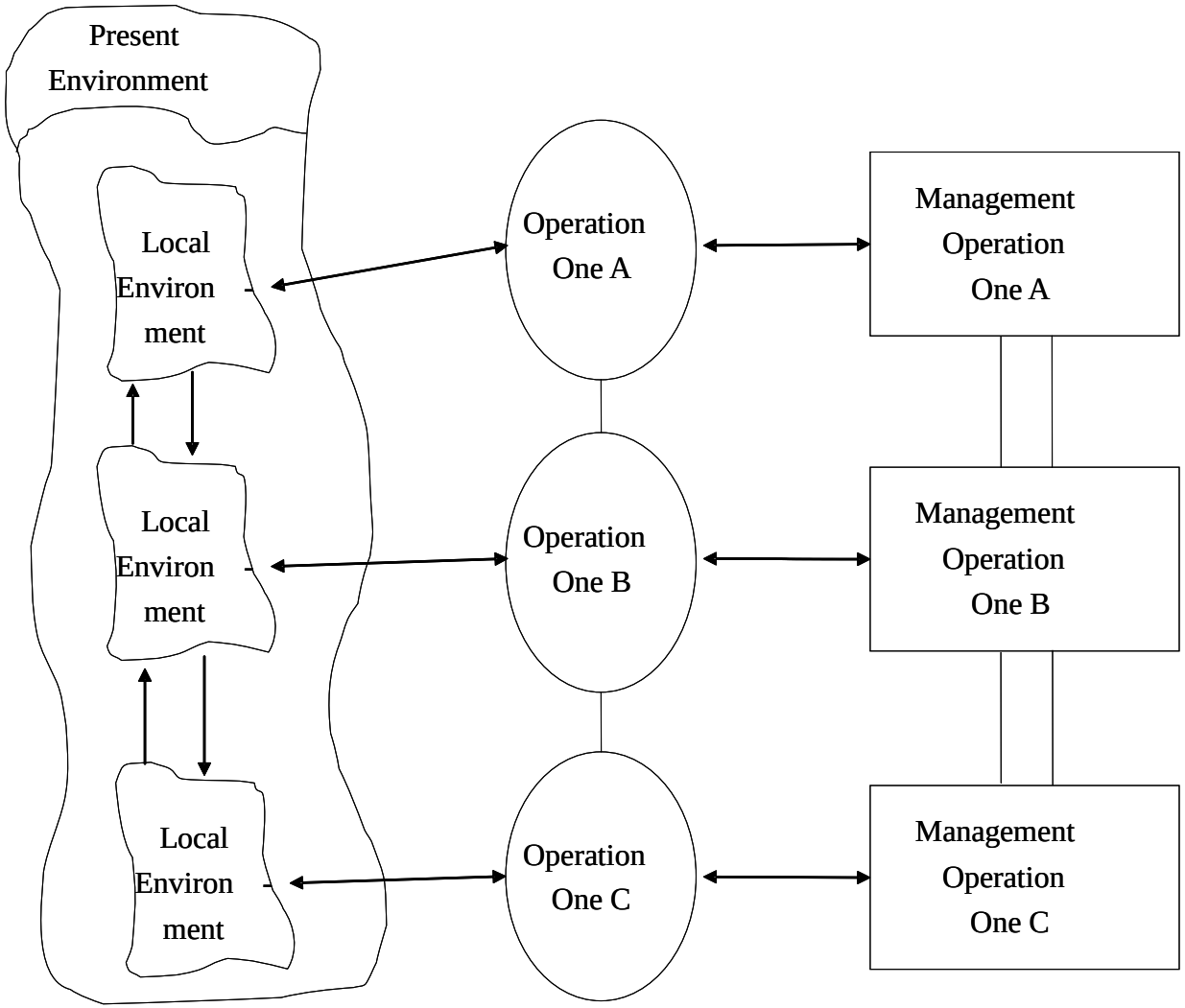
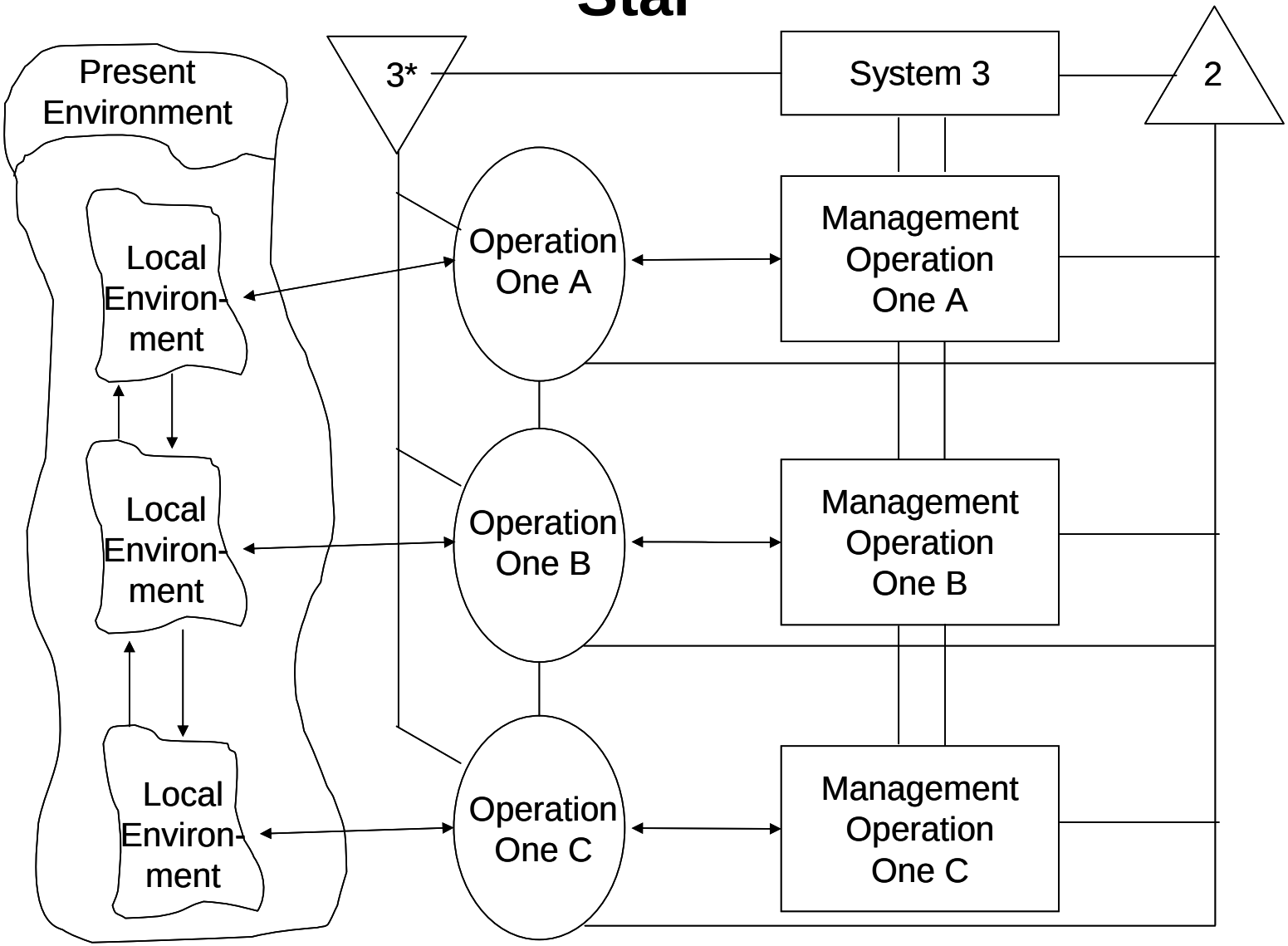
• planning
THREE: inside and now
• self-organization
• autonomic regulation
TWO anti oscillatory
THREE* sporadic audit
ONE
3*
TWO
local regulatory
ONE
3*
TWO
local regulatory
always stands for

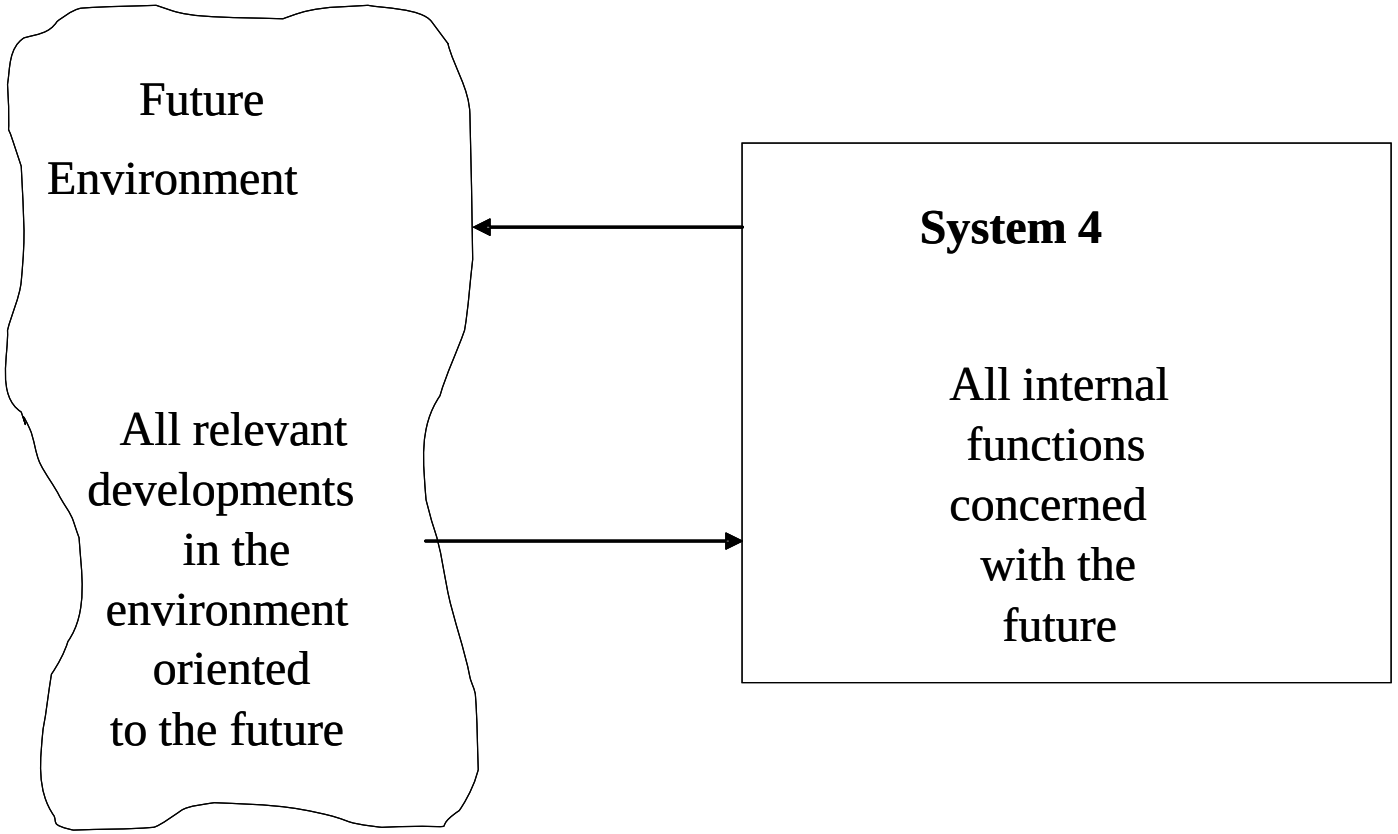
# System One units and their environments



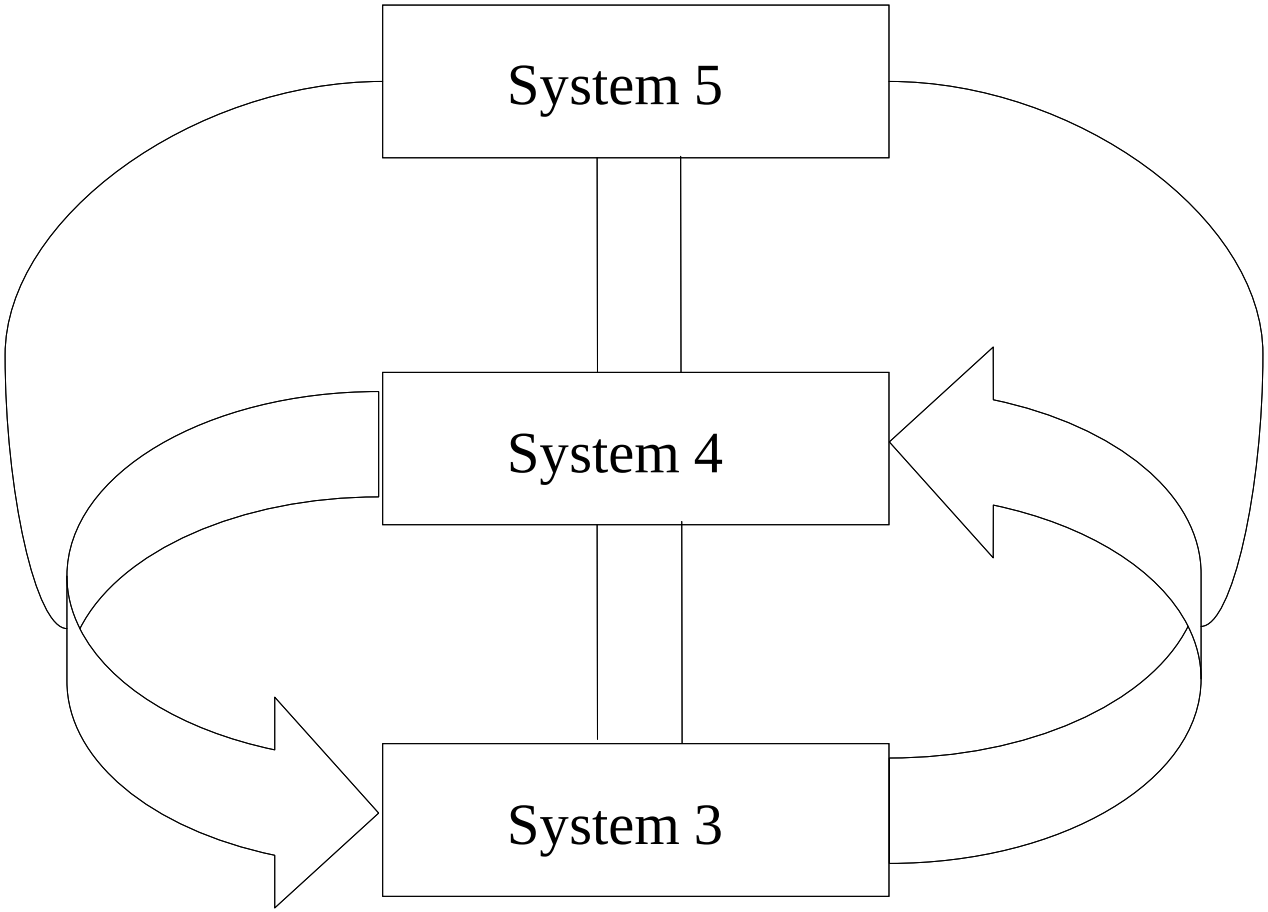
# Repeat of the System One units with the addition of Systems Two, Three, and Three Star

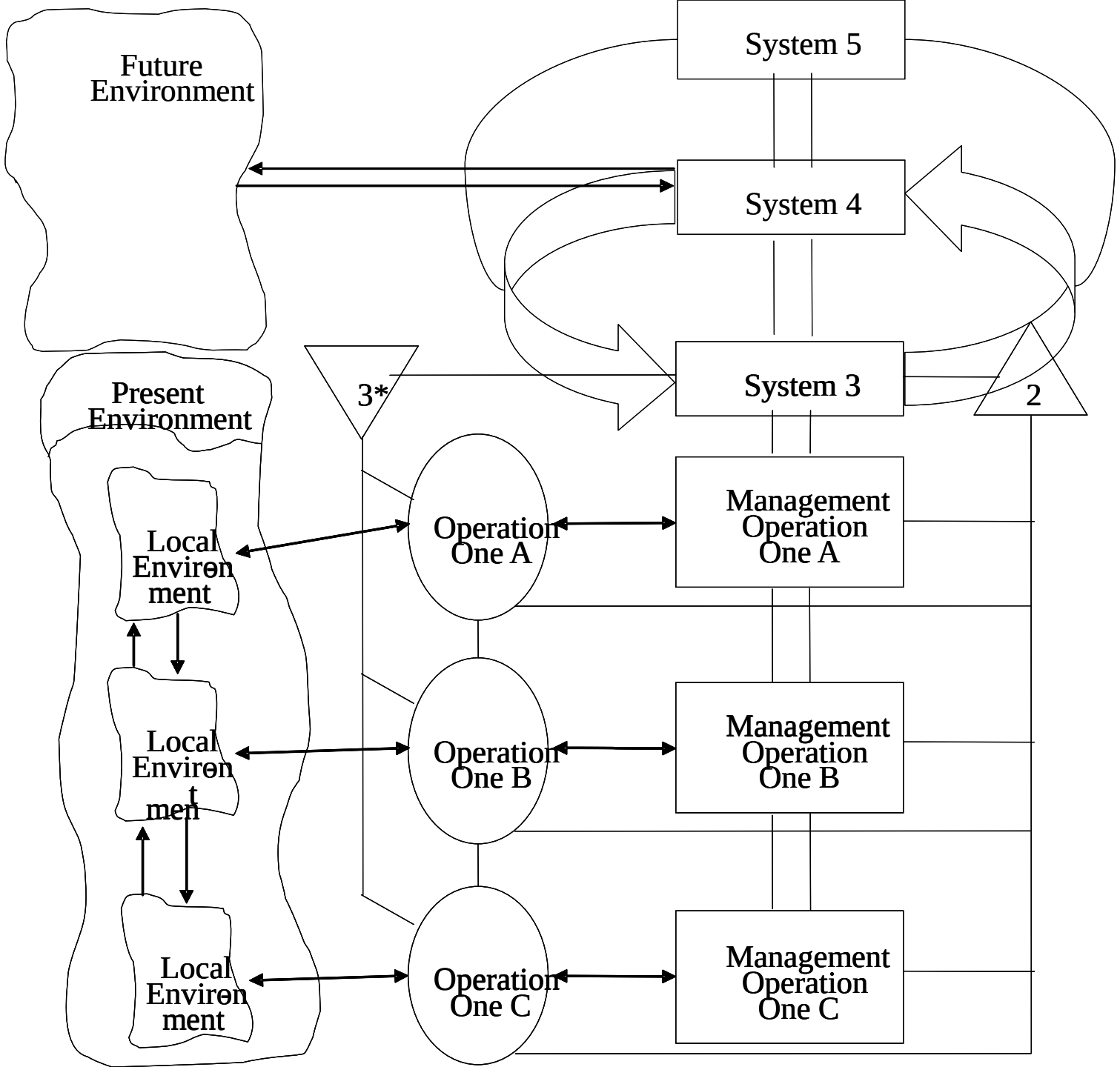


# System Four probing the future environment



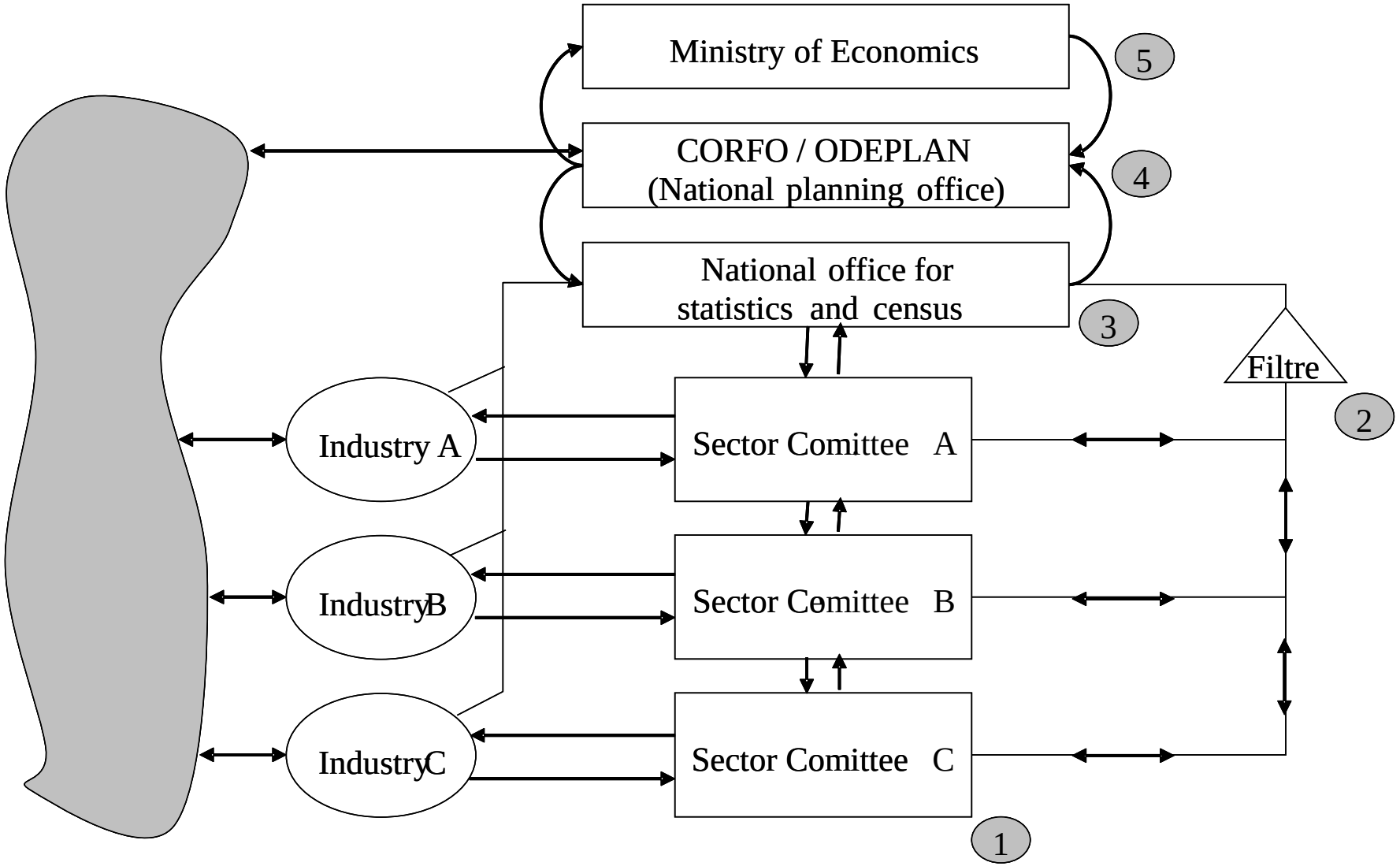
# Relationships among Systems 3, 4, and 5



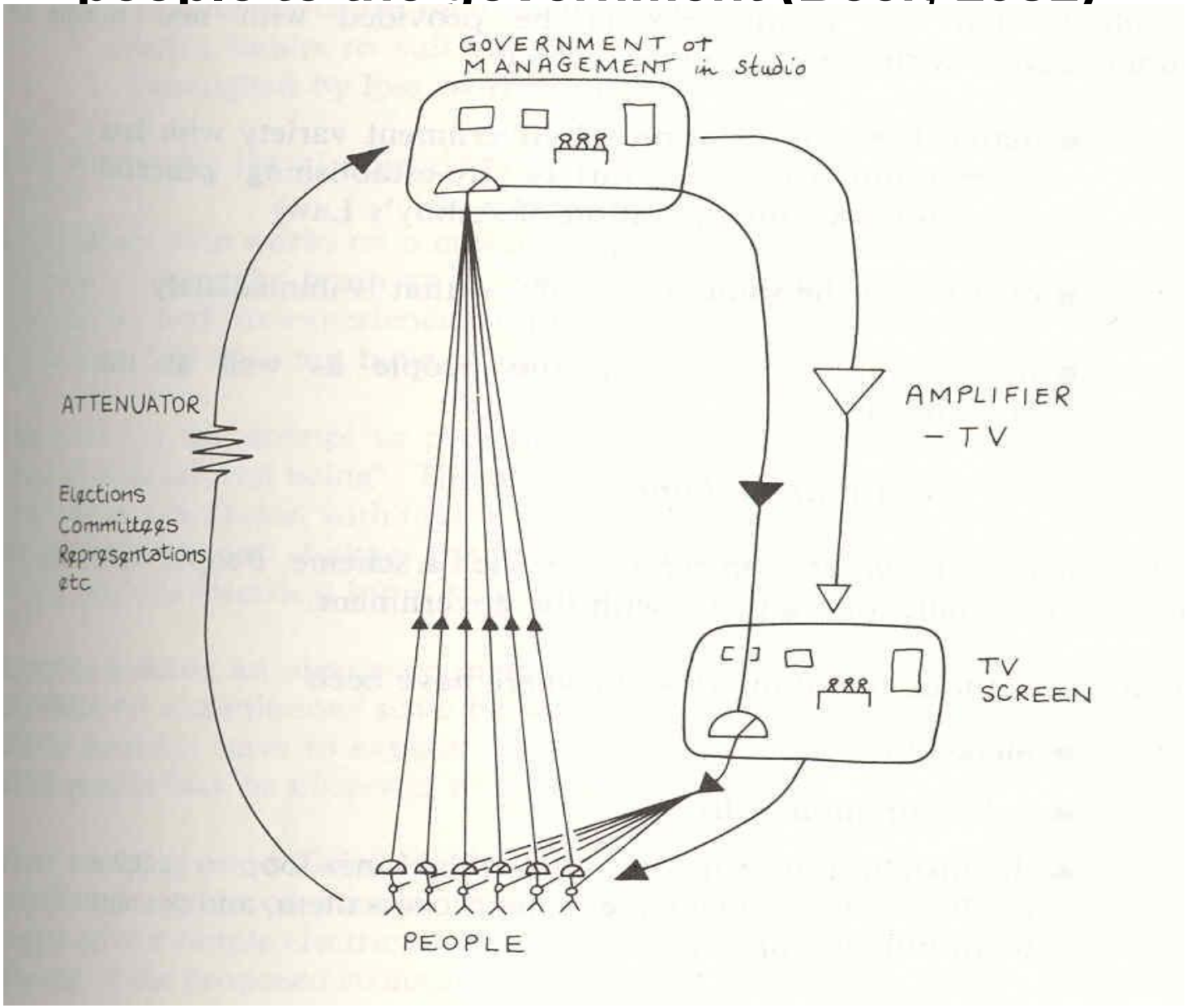



# The Viable System Model

# The VSM applied to the Chilean economy



# Design of the algedonic feedback loop from the people to the government (Beer, 1981)



# Viable System Model

- A diagnostic tool that can aid in understanding any organizational structure – line, staff, or matrix
- Defines the variety that needs to be controlled and the structures to control it
- Shows how both to ensure innovation and to regulate it

# Russell Ackoff's Interactive Planning

# Managerial Situations

- CONTROL - increase control of what can be controlled. Do not have to forecast things you can control
- PREDICT - traditional planning techniques
- ADAPT - if you can respond rapidly and effectively to changes that are uncontrollable and unexpected, you do not have to forecast

# Machine Age - analysis, reductionism, determinism

- universe - machine created by God
- people, made in God's image, should create machine's for their work
- analysis
  - take apart
  - understand parts
  - assemble parts to understand the whole
- reductionism - belief in ultimate elements
- determinism - cause/effect can explain all interactions
- environment - free explanations

# Metaphors of an organization

- Machine – workers are replaceable parts; a good design will work smoothly when set in motion
- Organism – workers are organs of the body; they are not indispensable
- Social system – workers have ideas of their own; the task is to get everyone working in the same direction

# Systems Age - synthesis, expansionism, indeterminism

- appearance of dilemmas
- system
  - behavior of each element affects behavior of whole
  - interdependence
  - can not have independent subgroups
- systems thinking
  - identify a containing whole
  - explain properties of containing whole
  - explain properties in terms of functions within containing whole
- expansionism
- objective teleology - output-oriented, producer-product, the environment matters

# 4 orientations to planning

- **reactive** - past
  - seek to return to a previous state, deals with problems separately
- **inactive** - present
  - satisfied with things as they are, muddling through, committees
- **preactive** - future
  - dominant in US today, change is good, MBO. Predict future and prepare for it
- **interactive** - past, present, and future as different but inseparable aspects of the mess

# How to redesign the future

1. Formulate the mess -- identify how disaster will occur if current behavior continues
2. Ends planning -- create an idealized design
3. Means planning -- select or produce the means to pursue the ends
4. Resource planning -- determine what resources will be required and when
5. Design of implementation and control

# Formulating the mess 1

- Systems analysis – nature of the business, past and present performance, the business environment, organizational structure, management style, rules of the game, personnel policies and practices, operations

# Formulating the mess 2

- Obstruction analysis – External obstructions; Internal obstructions: conflicts between individuals, between individuals and the organization or parts of it, within units, between units at the same level, between units at different levels, within the organization as a whole
- Reference projections – measures of performance and assumptions
- Reference scenario

# Ends planning

- Selecting a mission – the business the organization wants to be in; what effects it wants to have on each class of stakeholders
- Specifying desired properties of the system planned for
- Idealized redesign of that system
- Selecting gaps between this design and the reference scenario which planning will try to close

# Means planning

- Formulate or identify alternative means – selecting relevant controllable variables, controlling uncontrolled variables, relating variables to outcomes
- Evaluate alternative means – the use of models in evaluating means, testing models, the heuristic use of models

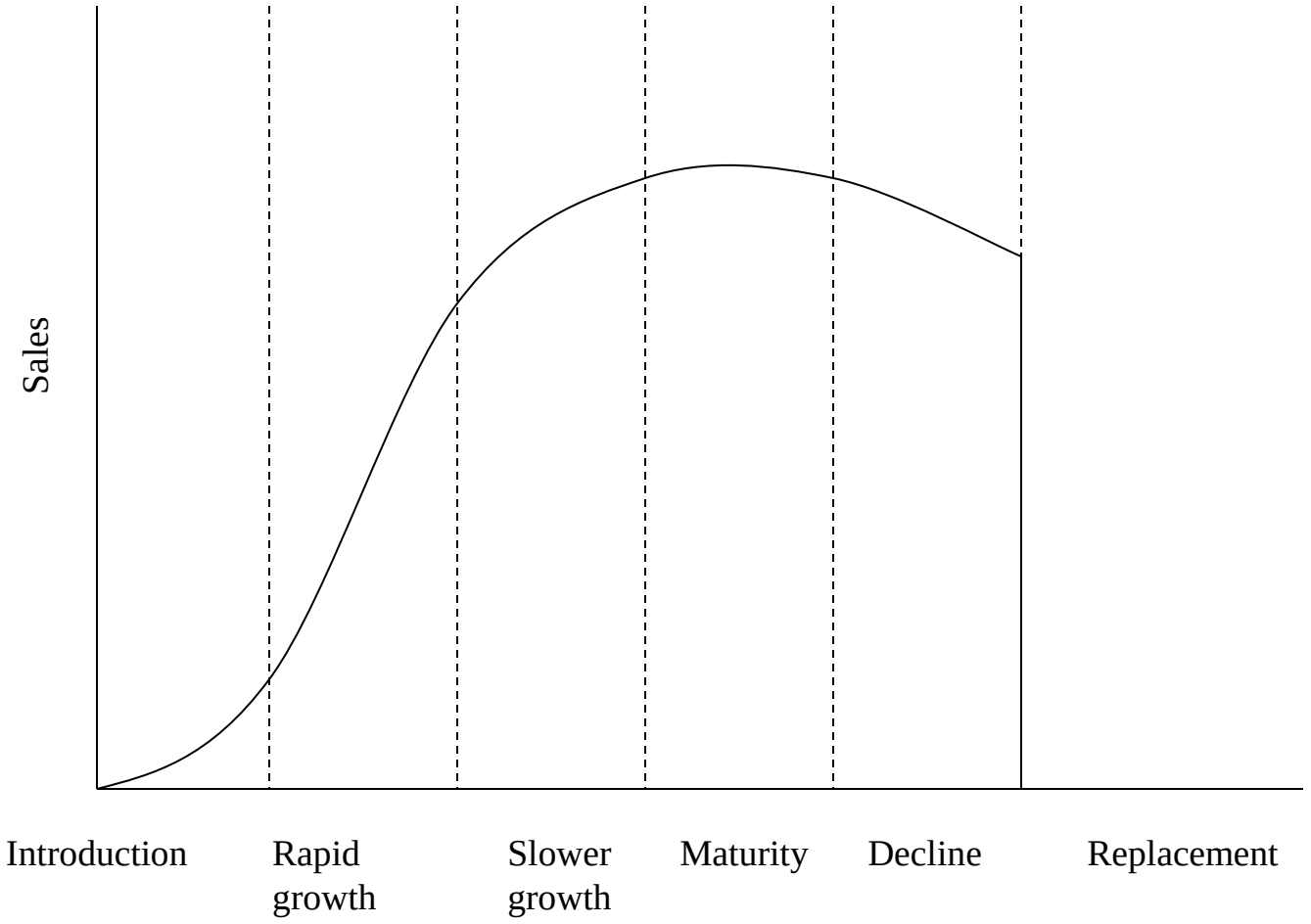
# Resource planning

- Inputs – materials, supplies, energy, and services
- Facilities and equipment
- Personnel
- Information
- Financial planning

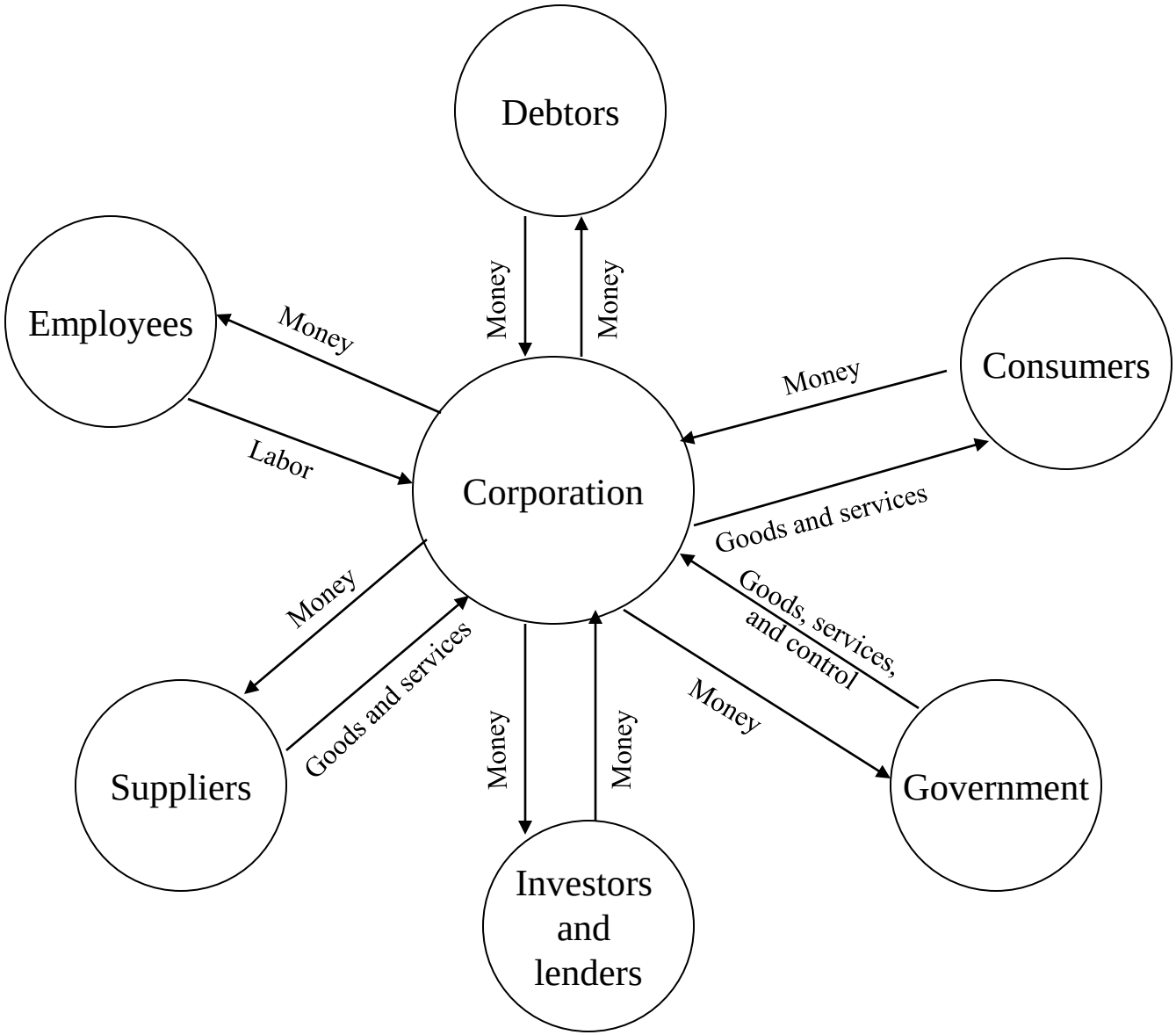
# Implementation and control

Determine who is to do what, when, and where

Decide how the implementation and its consequences are to be controlled




Product life cycle




A stakeholder view of the firm

# Obstruction Analysis: Examples of Discrepancies

| | Preached | Practiced |
|---|---|---|
| | Be a good corporate citizen. | |
| Ends | Equal opportunity employment | Do as little for the community as you can get away with. |
| | Diversify through product innovation. | Make no effort to recruit minorities but give those that apply equal treatment. |
| Means | Care about employees. | Diversify through acquisition or imitation. |
| | Long-range strategic planning. | Minimize employment. |
| Management | Get the best people available. | Crisis management. |
| Resources | Keep plants up-to-date and in top condition. | Maintain salaries at the industry's average. |
| | A commitment to quality. | Maintain and replace equipment only when absolutely necessary. |
| Environment | Concern and respect for consumers. | Sacrifice quality when necessary to make price attractive. |
| | | Advertise to them as though they were simple-minded. |

# In a strategic conversation

1. Share perceptions
2. Identify areas of similarity and difference
3. Resolve differences by conducting experiments
4. Forecasting vs. planning

# Comments on Interactive Planning

- Interactive planning was created by working with corporations
- Corporations are well-organized, successful, and sometimes complacent
- Hence, it is useful to begin by creating a sense of urgency
- Only when people are convinced that change is necessary will they work on redesign

# The Institute of Cultural Affairs' Participatory Strategic Planning

# Background on the Technology of Participation

- The Technology of Participation was created by working with poor communities
- Poor communities are usually not well-organized and are characterized by feelings of hopelessness and mistrust
- Hence, it is helpful to begin by identifying a shared vision of the future to show people what they have in common

# Steps in The Process

1. Operating vision
2. Obstacles or contradictions
3. Strategies
4. Actions
5. Implementation timeline

# The Workshop Method

- Defining the context
- Brainstorming
- Clustering the ideas
- Naming the clusters
- Exploring implications

# Advantages of the Technology of Participation

- An easy method to learn and to use
- Does not require advanced technology
- Can be used with groups of varying size
- Can lead to a consulting practice for academics
- Could be the basis for a bottom-up development strategy

# John Warfield's Interactive Management

# Origin of Interactive Management

- Work as an engineer for Batelle Memorial Institute in Columbus, Ohio
- Concerned with the management of complex systems
- Studied the modeling of complex systems in the history of mathematics
- Like Peter Checkland he gradually moved toward the social sciences

# Elements of Interactive Management

- When designing very complex systems, such as a computer, an automobile, or an airplane, a group of specialists must work together
- They need a comfortable, well-equipped room to work in
- And a computer program to help them keep track of the interactions they must consider

# Assumptions underlying Interactive Management

- No matter how sophisticated a model may be, human judgment cannot be excluded
- The human beings who must decide must be involved in the planning, so they will know why certain actions need to be taken
- The most complicated application was redesigning the Defense Acquisitions System

A tutorial presented at the

World Multi-Conference on Systemics, Cybernetics, and Informatics

Orlando, Florida

July 8, 2007

# Management Cybernetics 3

Stuart A. Umpleby
The George Washington University
Washington, DC
www.gwu.edu/~umpleby

# The context of organizations

- The “global problematique” – population – environment balance
- World population is increasing about 80 million people per year
- Per capita income, and hence consumption, is increasing in most countries
- Non-renewable resources are being consumed

# Shortages can be expected

- The “petroleum peak”
- Competition for water
- Over fishing
- Soil erosion
- Climate change may displace populations
- Coastal land may be lost

# Challenges and capabilities

- Although we are entering a period of unprecedented challenges
- We also have unprecedented capabilities – the internet, air travel, the global network of universities
- Several forecasts predict a change in the relationship of human beings to the planet about 2025

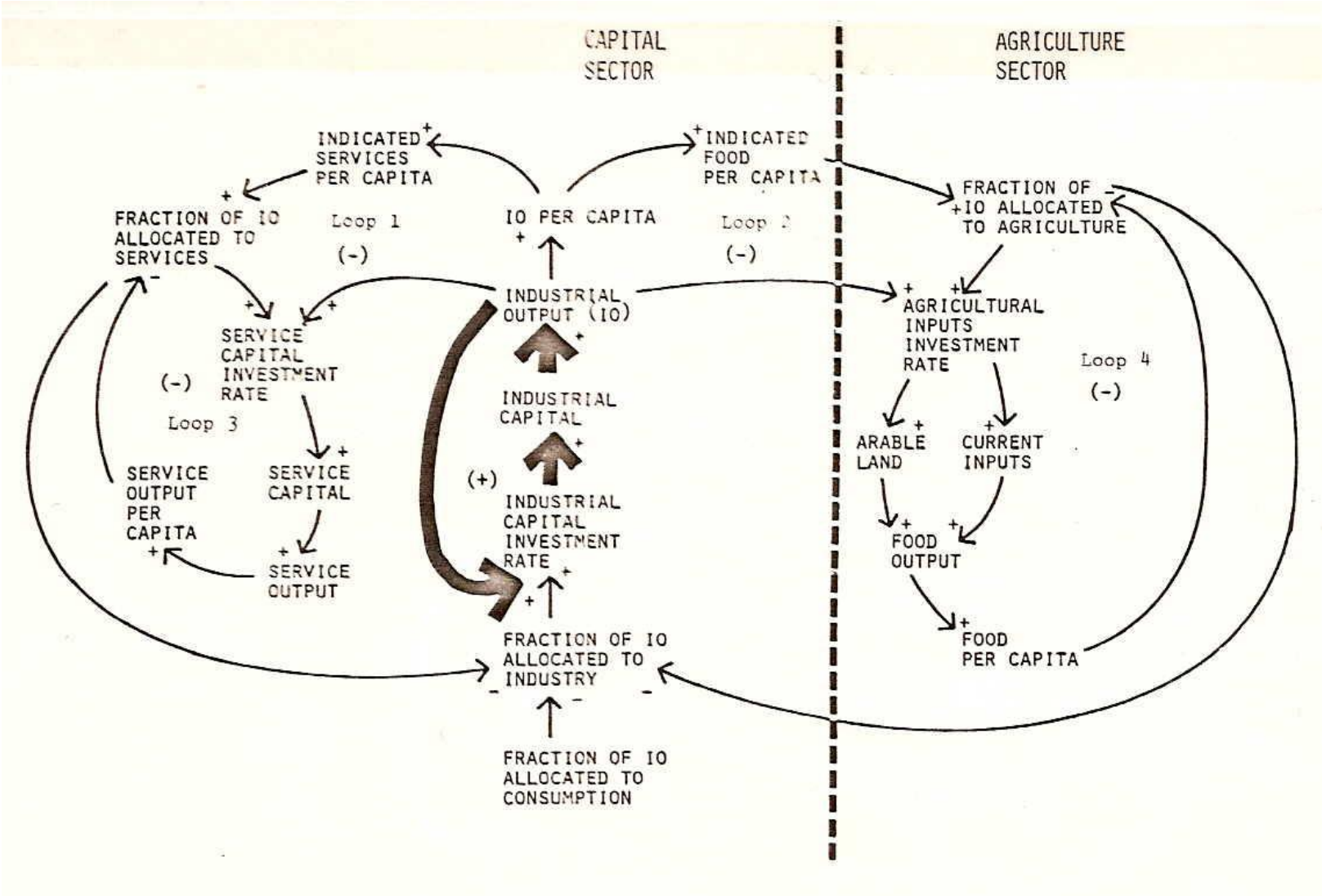
# The Club of Rome

- 1972 *The Limits to Growth*
- 1982 *Groping in the Dark*
- 1992 *Beyond the Limits*
- Current work

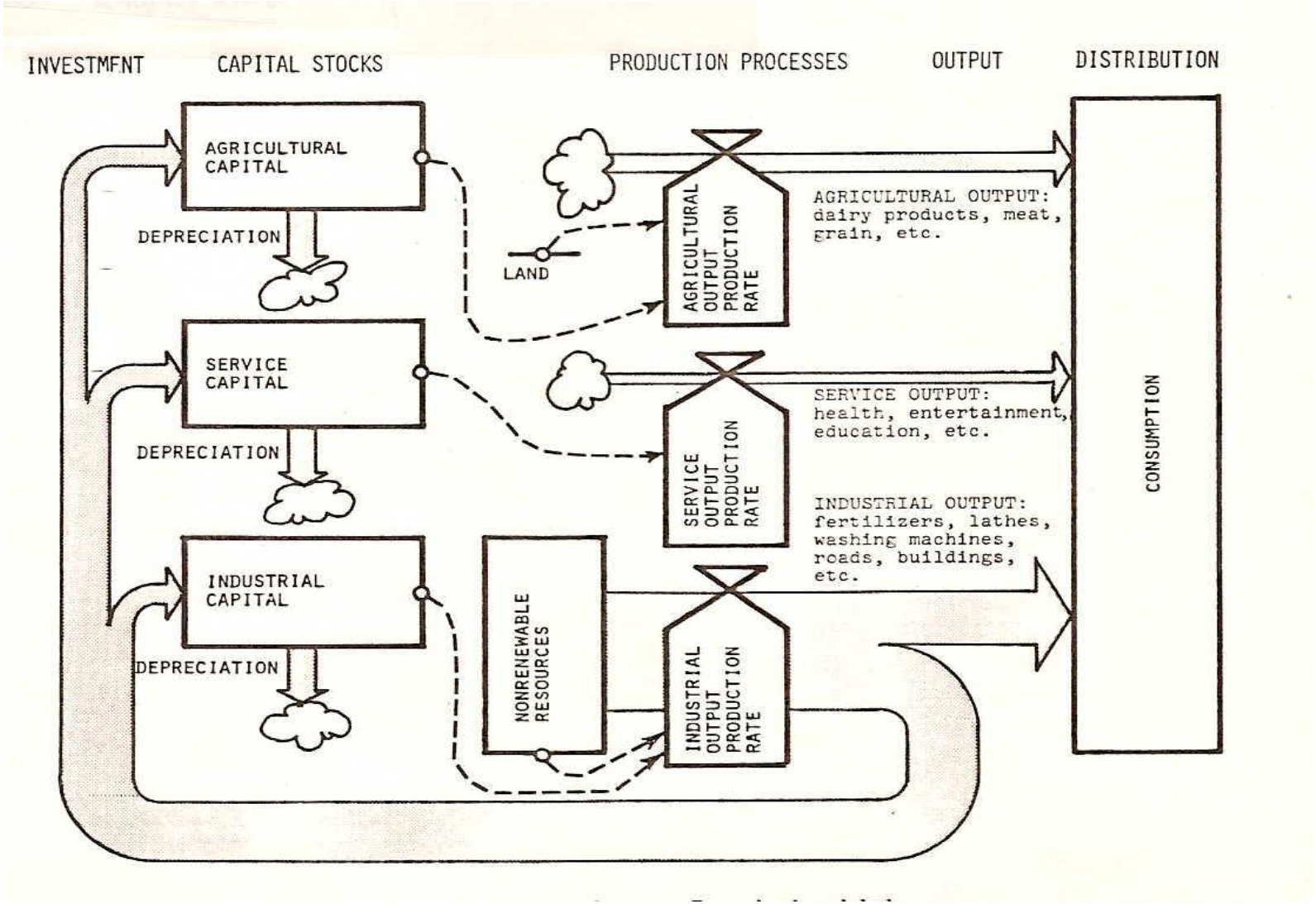
# 1972 *The Limits to Growth*

- From extrapolating independent trends to a model of how trends affect each other
- Assumptions about relationships were clearly stated
- Alternative assumptions about amount of resources and effectiveness of recycling were tested

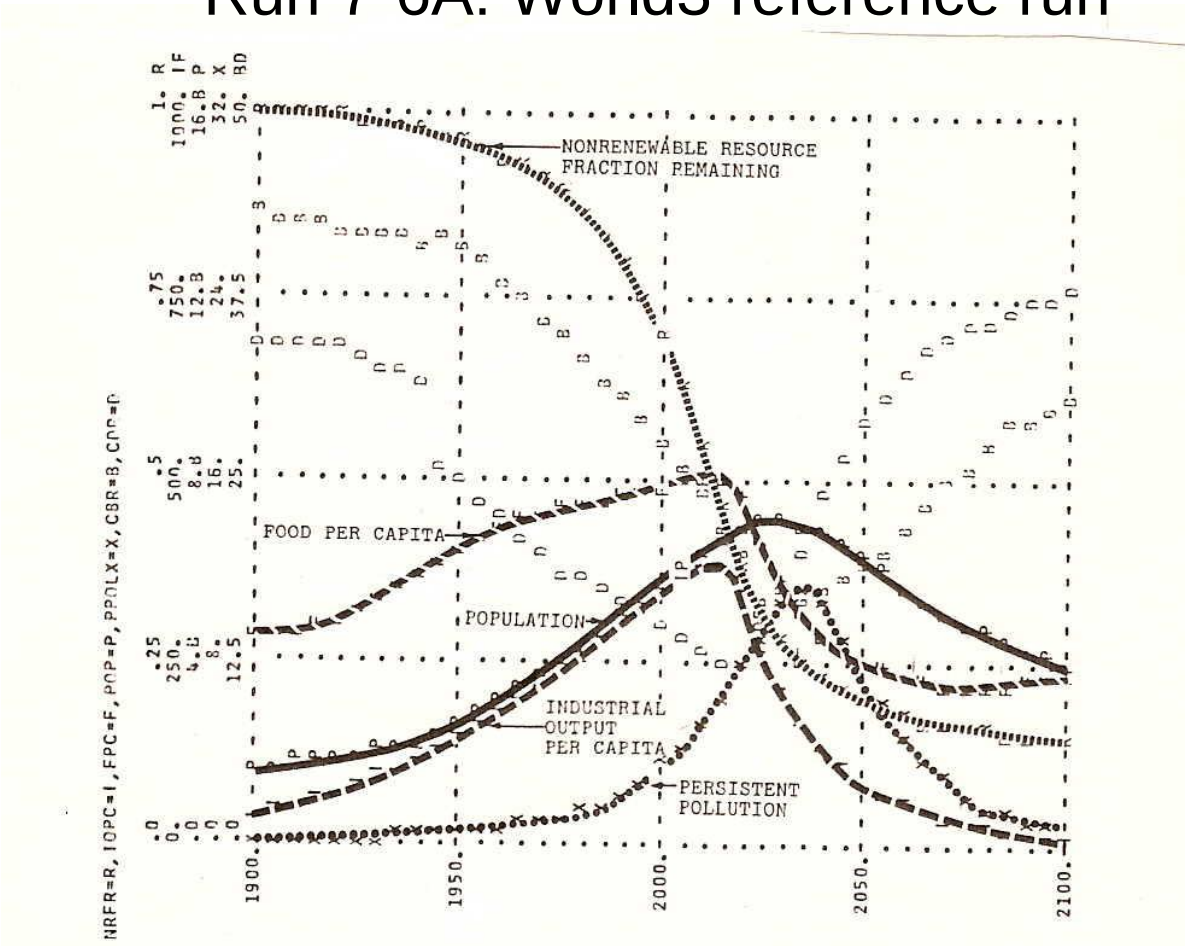
# The casual relationships that can produce any specified development patterns



# Capital stocks and output flows in the global economy

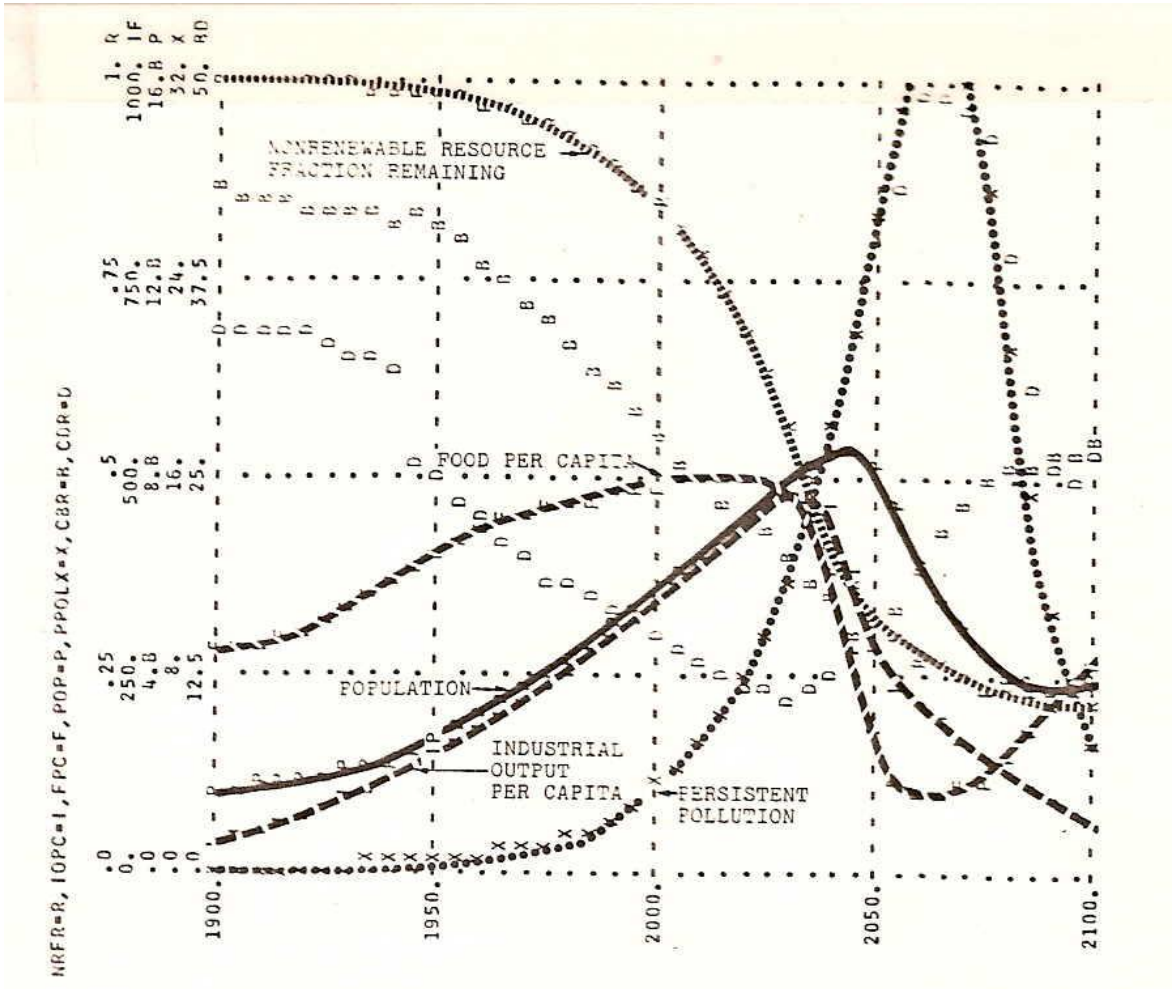


# Run 7-6A: World3 reference run



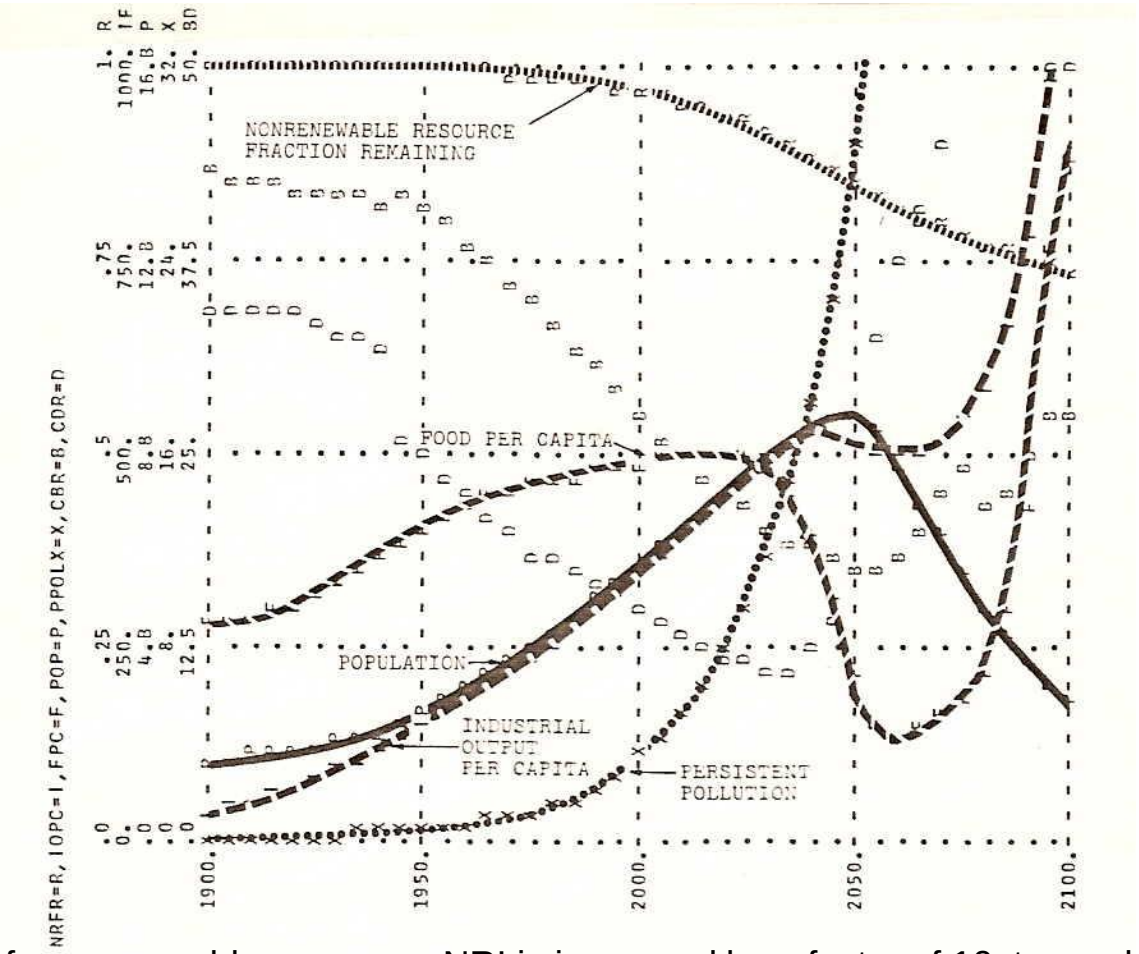

This is the World3 reference run, to be compared with the sensitivity and policy tests that follow. Both population POP and industrial output per capita IOPC grow beyond sustainable levels and subsequently decline. The cause of their decline is traceable to the depletion of nonrenewable resources. Runs 7-6B and 7-6C illustrate the mechanisms that force population POP and industrial output per capita IOPC to decline.

# Run 7-7: sensitivity of the initial value of nonrenewable resources to a doubling of NRI



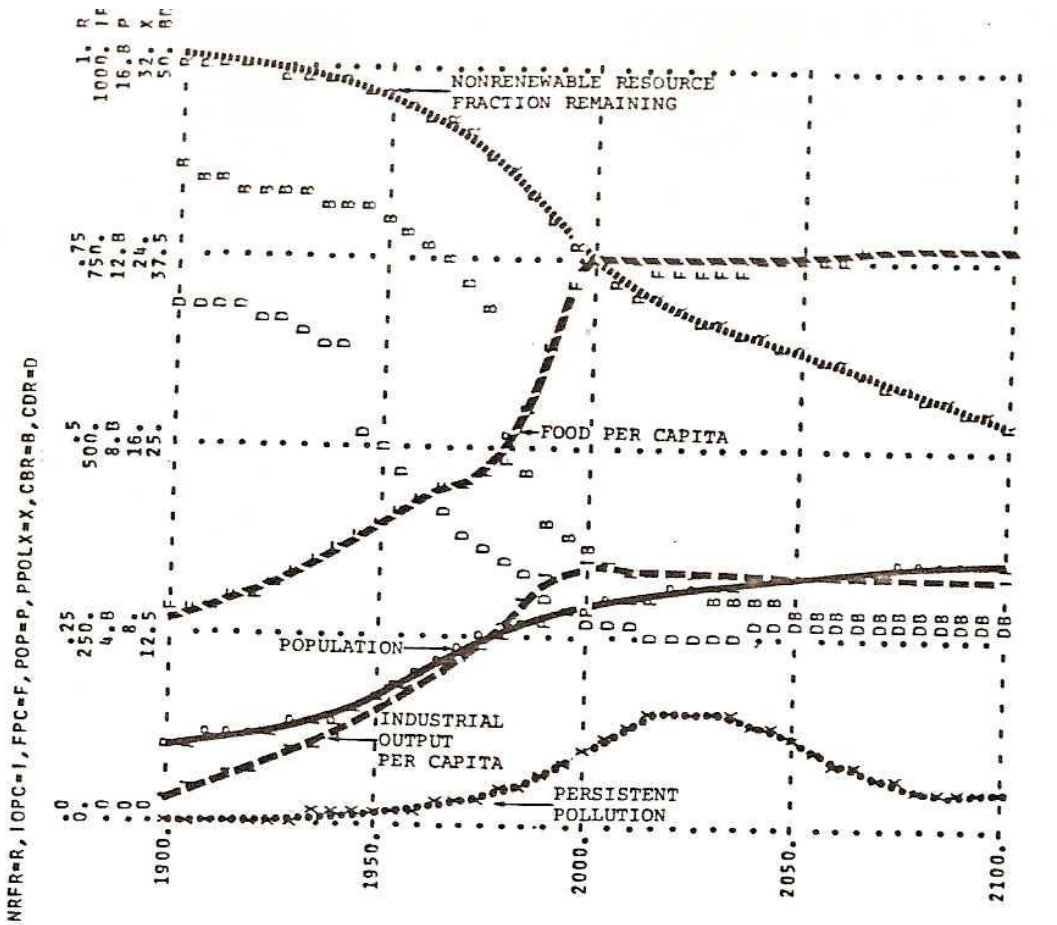

To test the sensitivity of the reference run to an error in the estimate of initial nonrenewable resources, NRI is doubled. As a result, industrialization continues for an additional 15 years until growth is again halted by the effects of resource depletion.

# Run 7-8: sensitivity of the initial value of nonrenewable resources to a tenfold increase in NRI



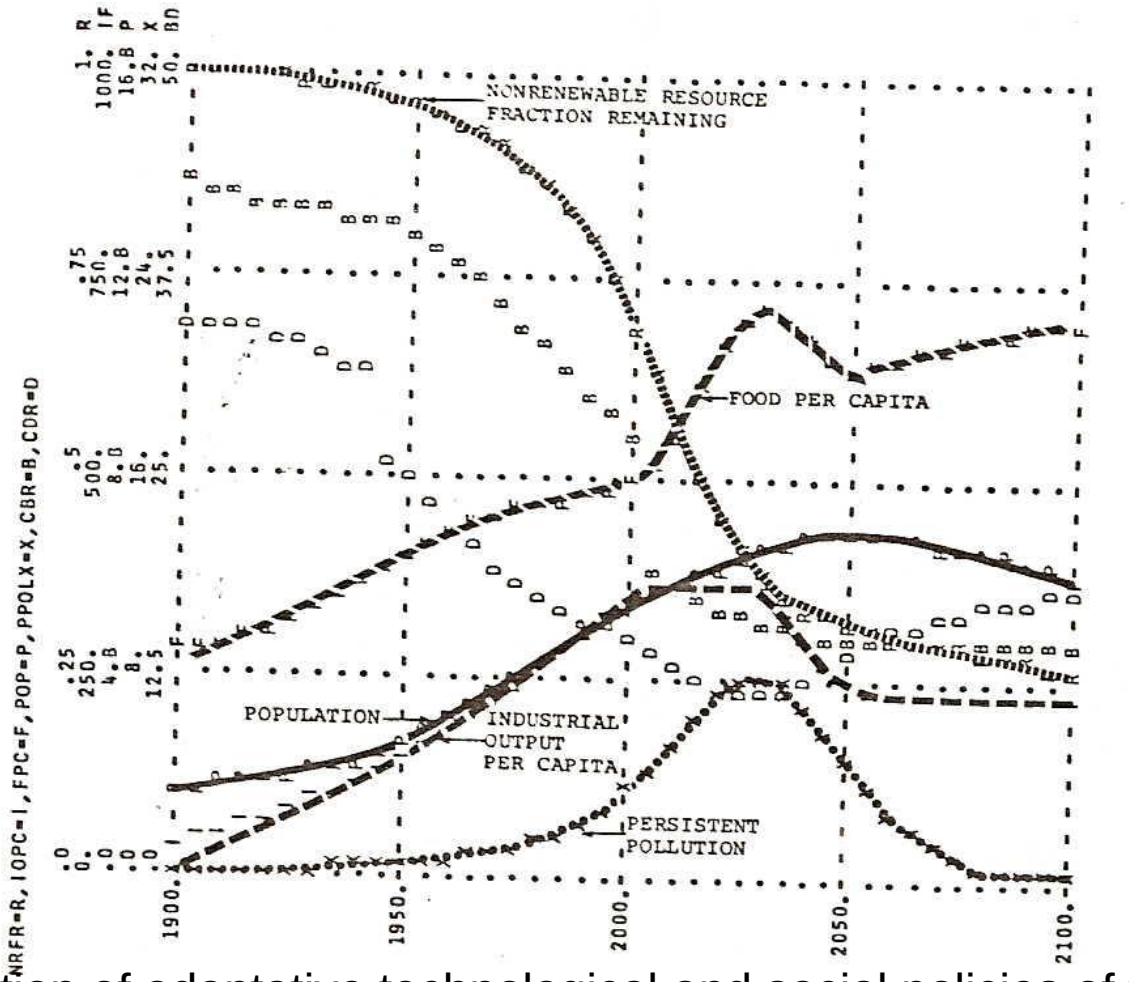

The initial value of nonrenewable resources NRI is increased by a factor of 10, to a value well outside its most likely range. Under this optimistic assumption, the effects of nonrenewable resource depletion are no longer a constraint to growth. Note that there is no dynamic difference in this run between setting resources at 10 times their reference value or assuming an infinite value of resources. However, population and capital continue to grow until constrained by the level of pollution.

# Run 7-29: equilibrium through adaptative policies




Adaptative technological policies that increase resource recycling, reduce persistent pollution generation, and increase land yields are combined with social policies that stabilize population POP and industrial output per capita IOPC. The technological advances in recycling, pollution control and land yields are assumed to be effective only after a delay and to require capital for their development and implementation. As in the adaptative technological runs, additional technologies are assumed to be implemented in 1975. The policies lower resource costs, decrease the effects of air pollution, and reduce land erosion. The resulting model behavior reaches equilibrium because the stable population and capital reduce the need for new technologies. Thus the newly implemented technologies are less costly, and the delays in their development and implementation are less critical to their effectiveness.

# Run 7-30: stabilization policies introduced in the year 2000




The combination of adaptative technological and social policies of the previous run are not introduced until the year 2000. The continuation of growth for an additional 25 years further erodes the carrying capacity of World 3; therefore, the policies that led to equilibrium 25 years earlier are no longer effective.

# 1982 *Groping in the Dark*

- Summarized the results of seven global models created in the 10 years following *The Limits to Growth*
- The models were made by people in different countries using different methods
- All agreed that growth could not continue indefinitely on a finite planet

# *Groping in the Dark* conclusions 1

- Basic needs can be met into the foreseeable future
- Basic needs are not being met now due to social and political structures, values and norms, not physical scarcities
- We do not have complete information on the degree to which the environment can absorb further growth in human population

# *Groping in the Dark* conclusions 2

- Continuing present policies will not lead to a desirable future
- The world socio-economic system will be in a period of transition to something different
- Policy changes made soon will have more impact with less effort than the same changes made later

# *Groping in the Dark* conclusions 3

- No set of purely technical changes was sufficient to bring about a desirable future
- Interdependencies about people and nations are greater than commonly imagined
- Decisions should be made within the broadest possible context
- Many plans and programs are based on assumptions that are impossible

# 1992 *Beyond the Limits*

- Whereas the assumption in 1972 was that resources would limit growth, in 1992 the emphasis shifted to the earth's ability to absorb the products of industrial production
- Rising levels of CO2 in the atmosphere would be one example

# System dynamics

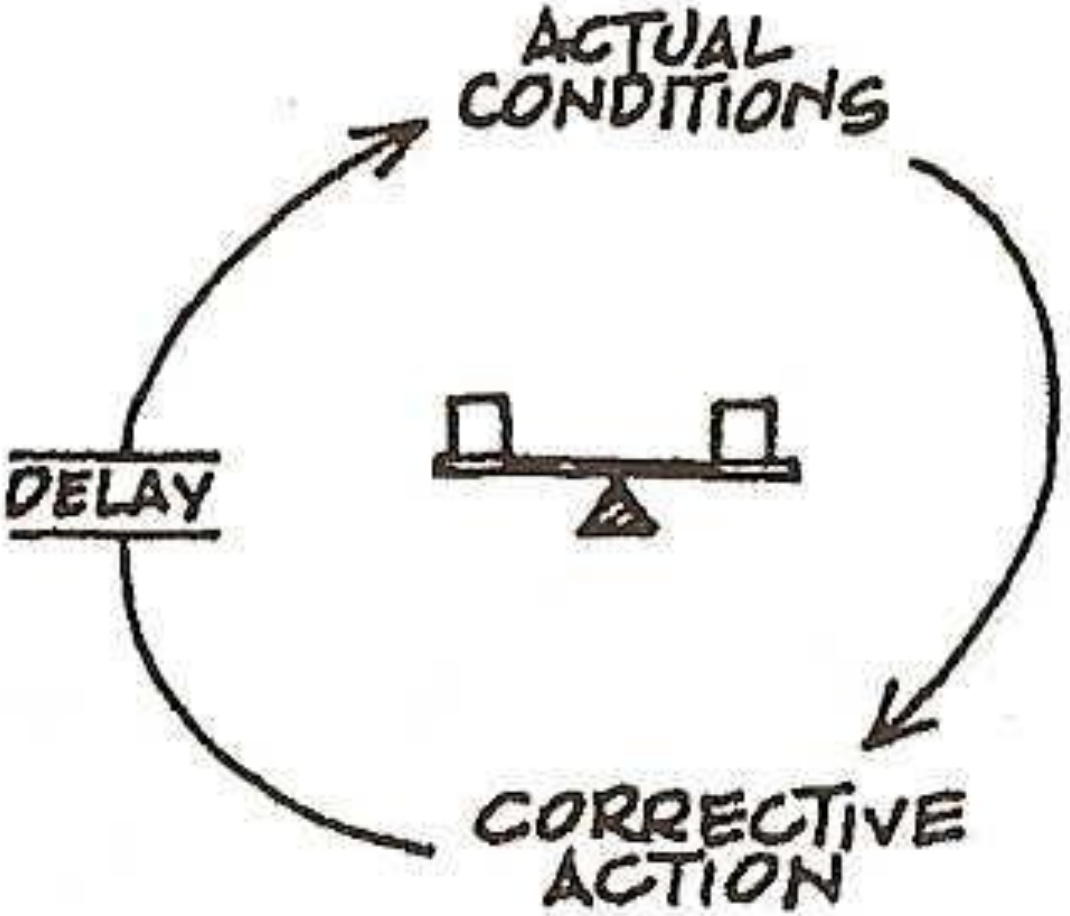
- Analyses an organization in terms of positive and negative feedback loops
- Claims that feedback processes are often counter-intuitive
- Hence, a system dynamics analysis of an organization or a problem in an organization can be helpful in producing improved results

# Peter Senge's
# *The Fifth Discipline*

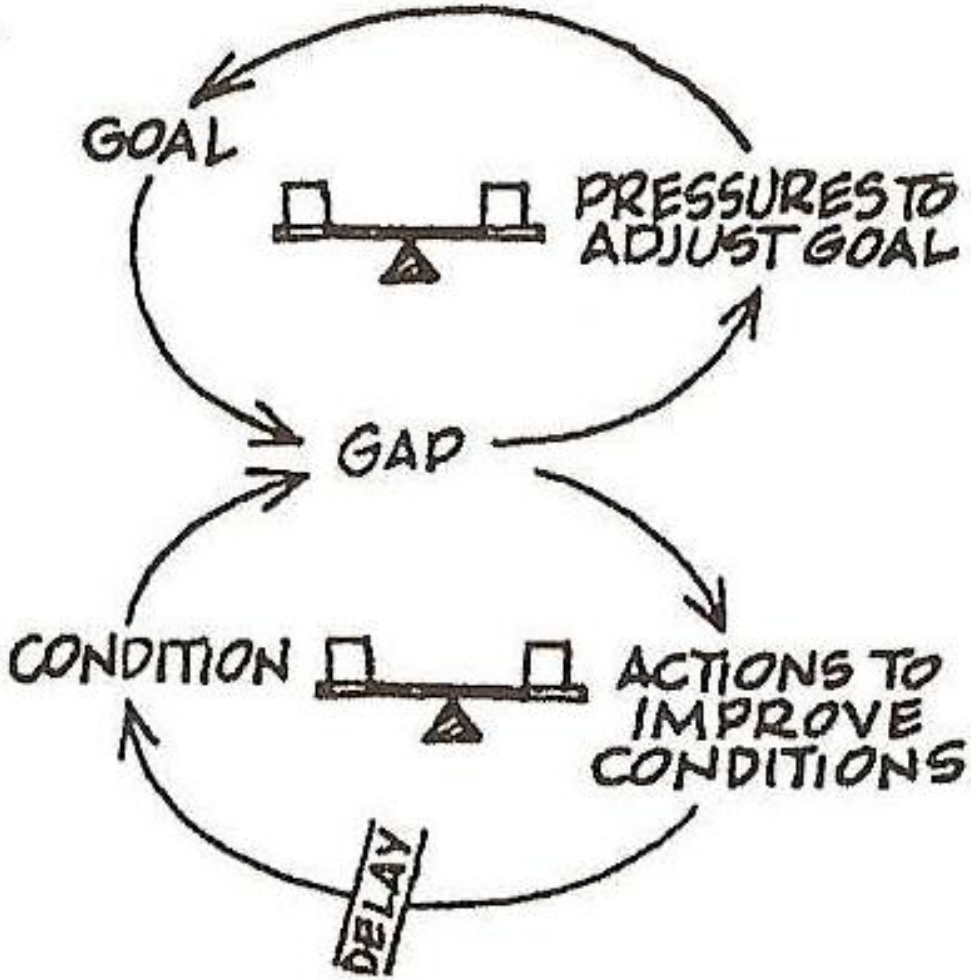
# The five “disciplines”

- Personal mastery
- Mental models
- Shared vision
- Team learning
- Systems thinking

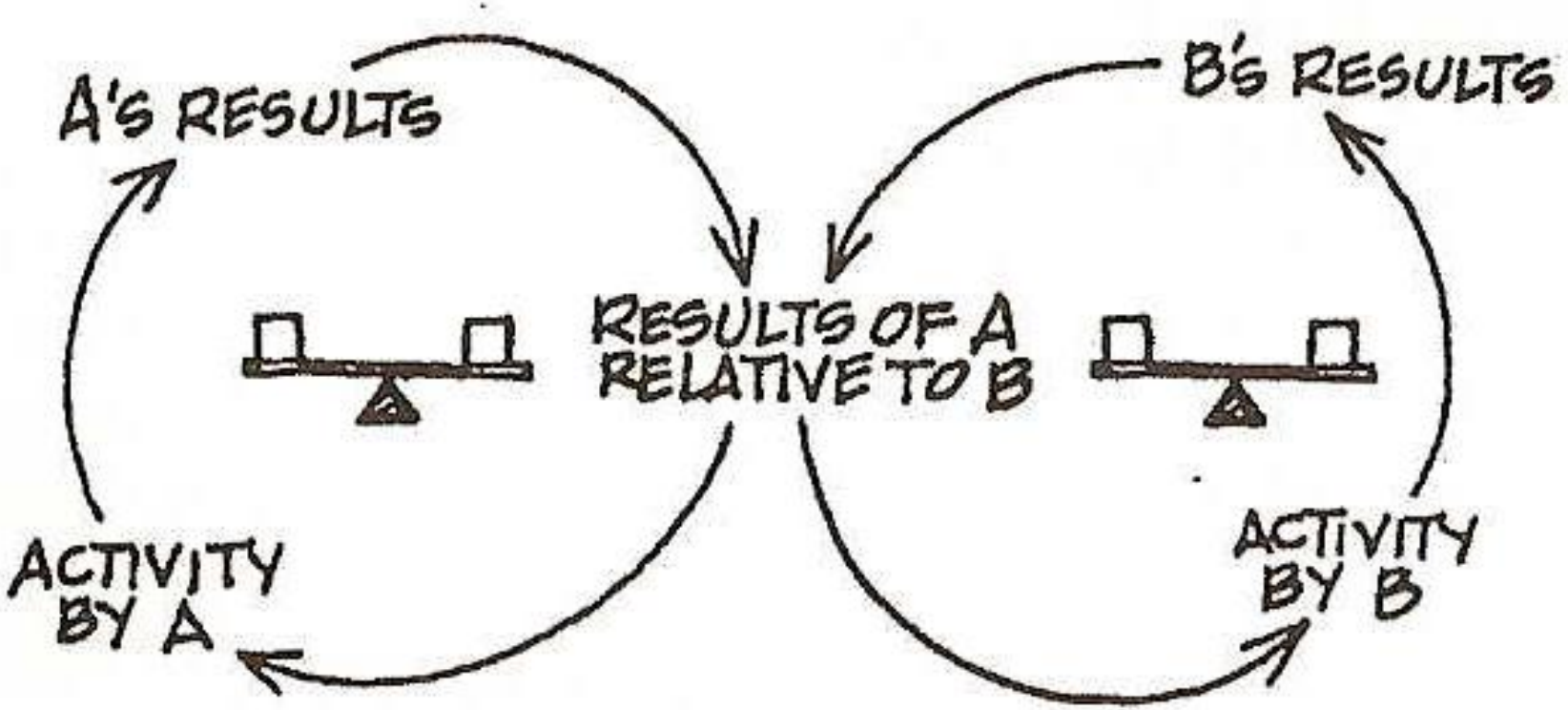
# Balancing Process with Delay



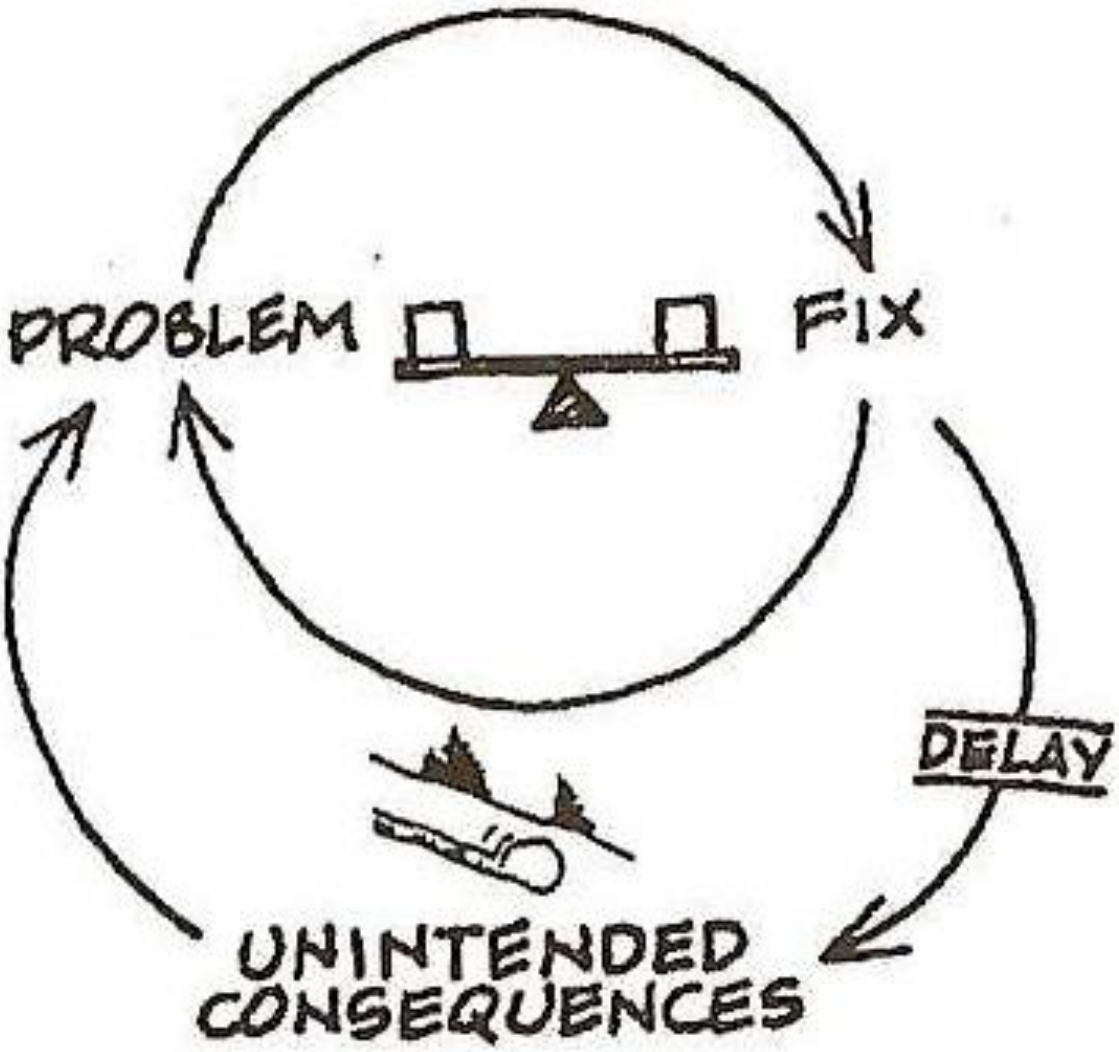
# Eroding Goals



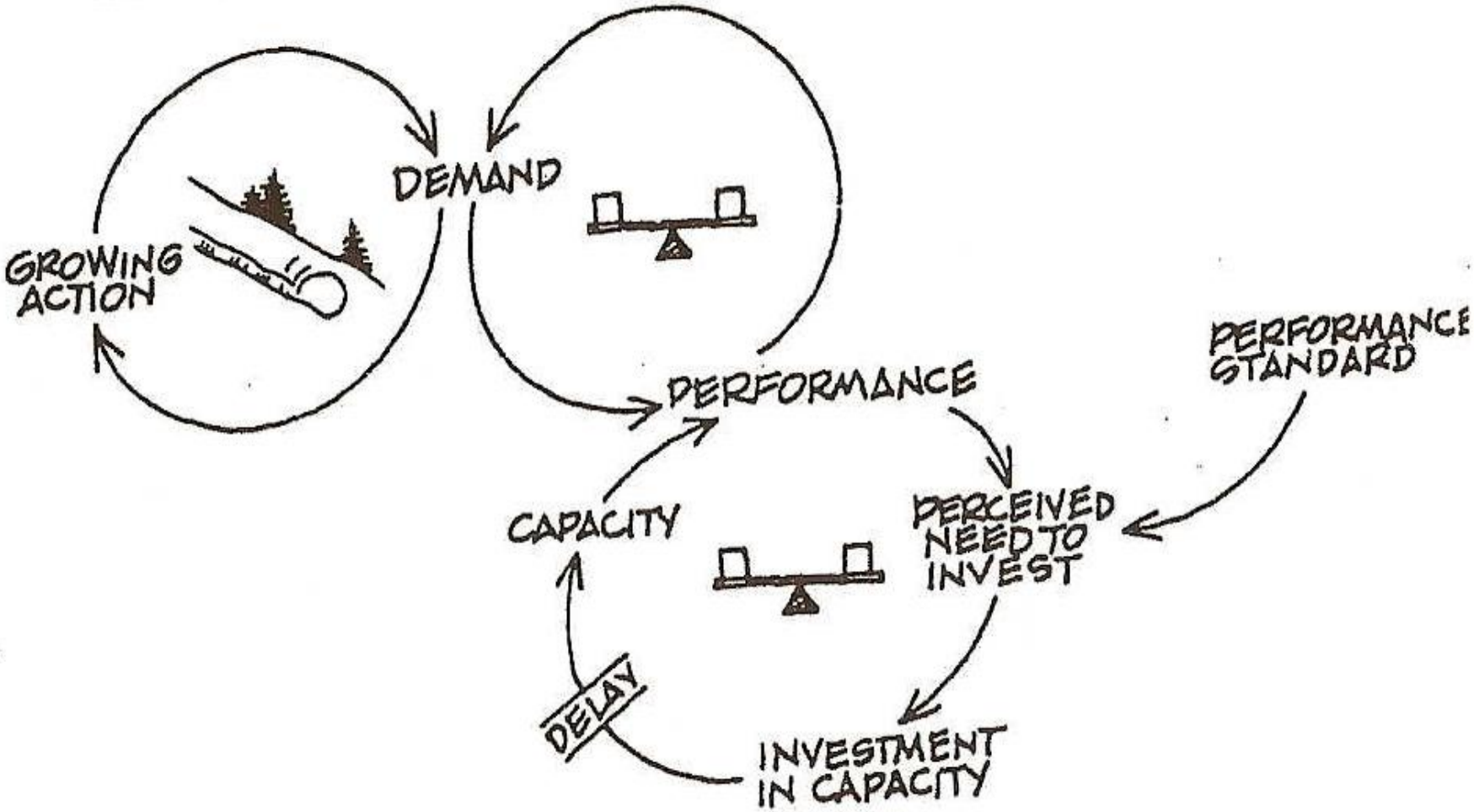
# Escalation


A'S RESULTS
B'S RESULTS
RESULTS OF A RELATIVE TO B
ACTIVITY BY A
ACTIVITY BY B

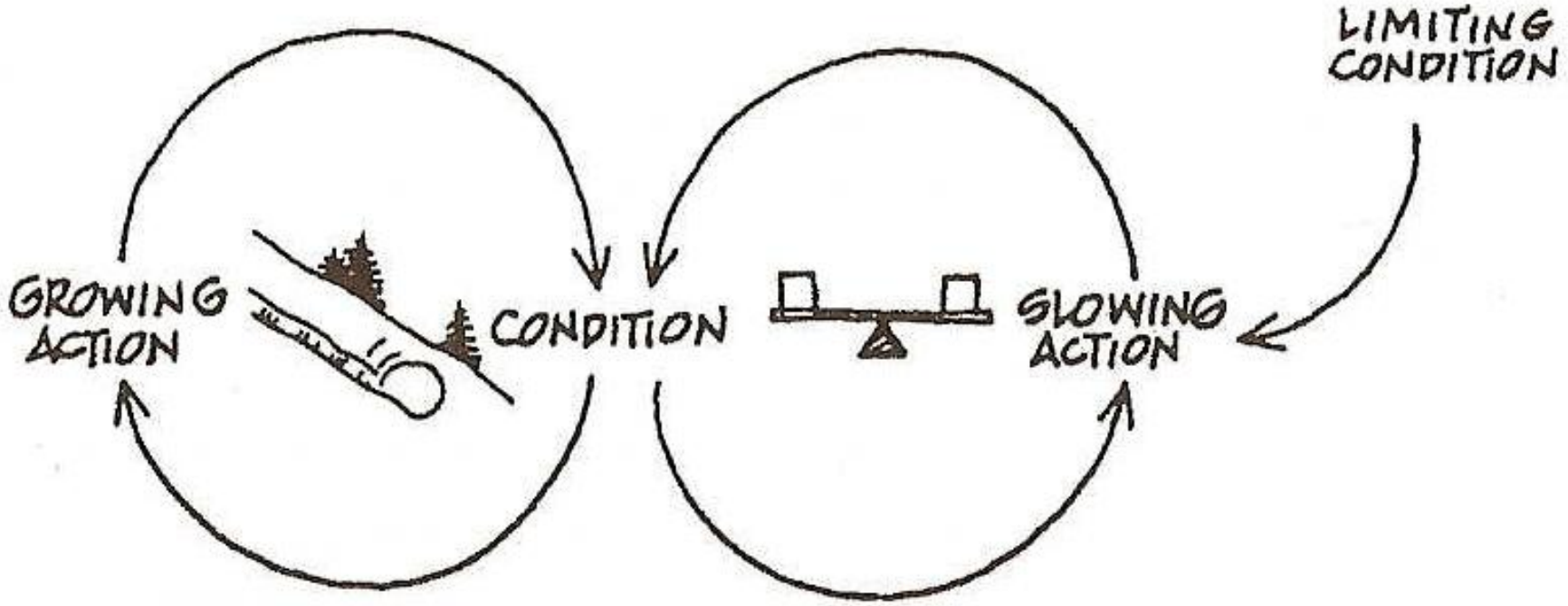
# Fixes that Fail



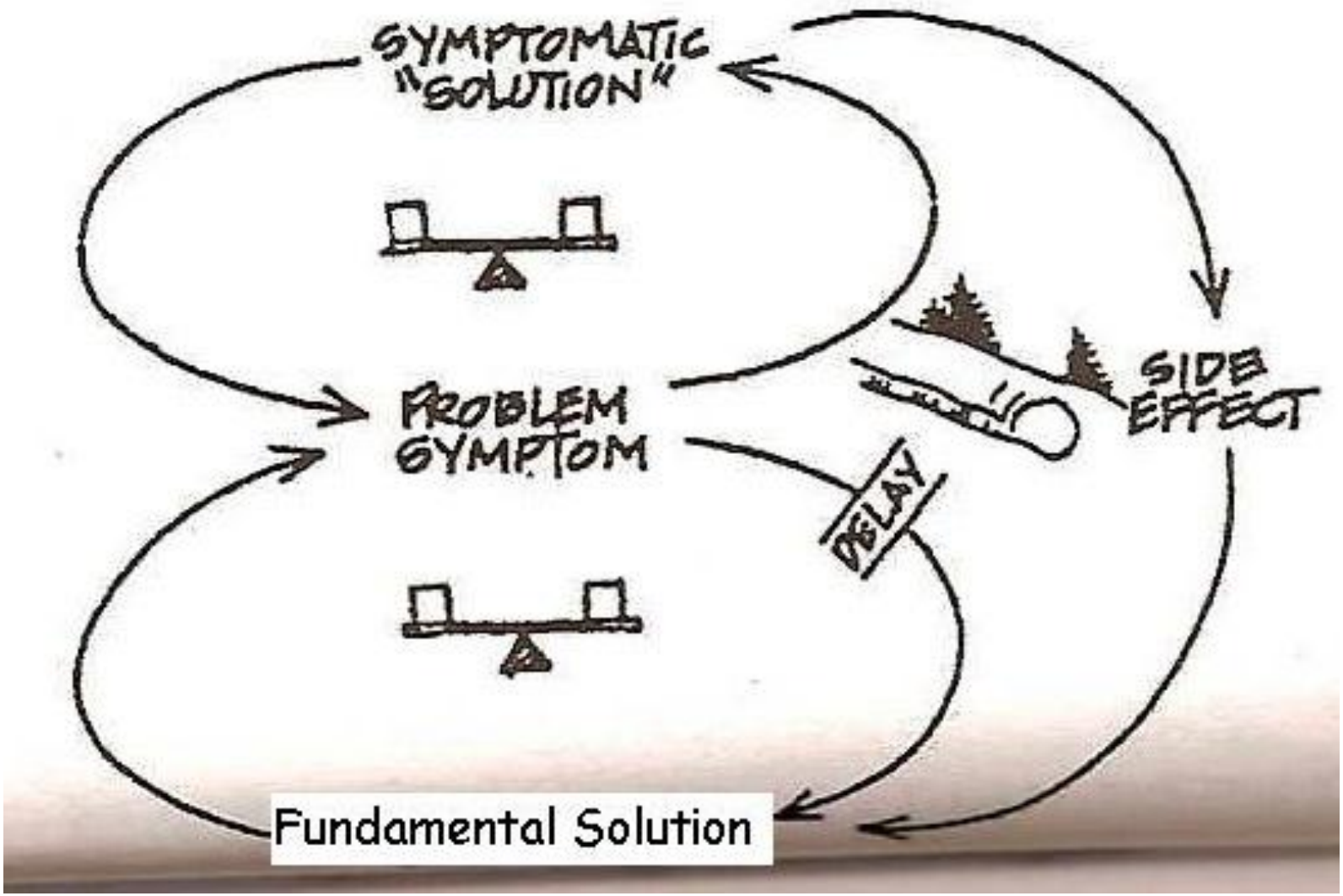
# Growth and Underinvestment



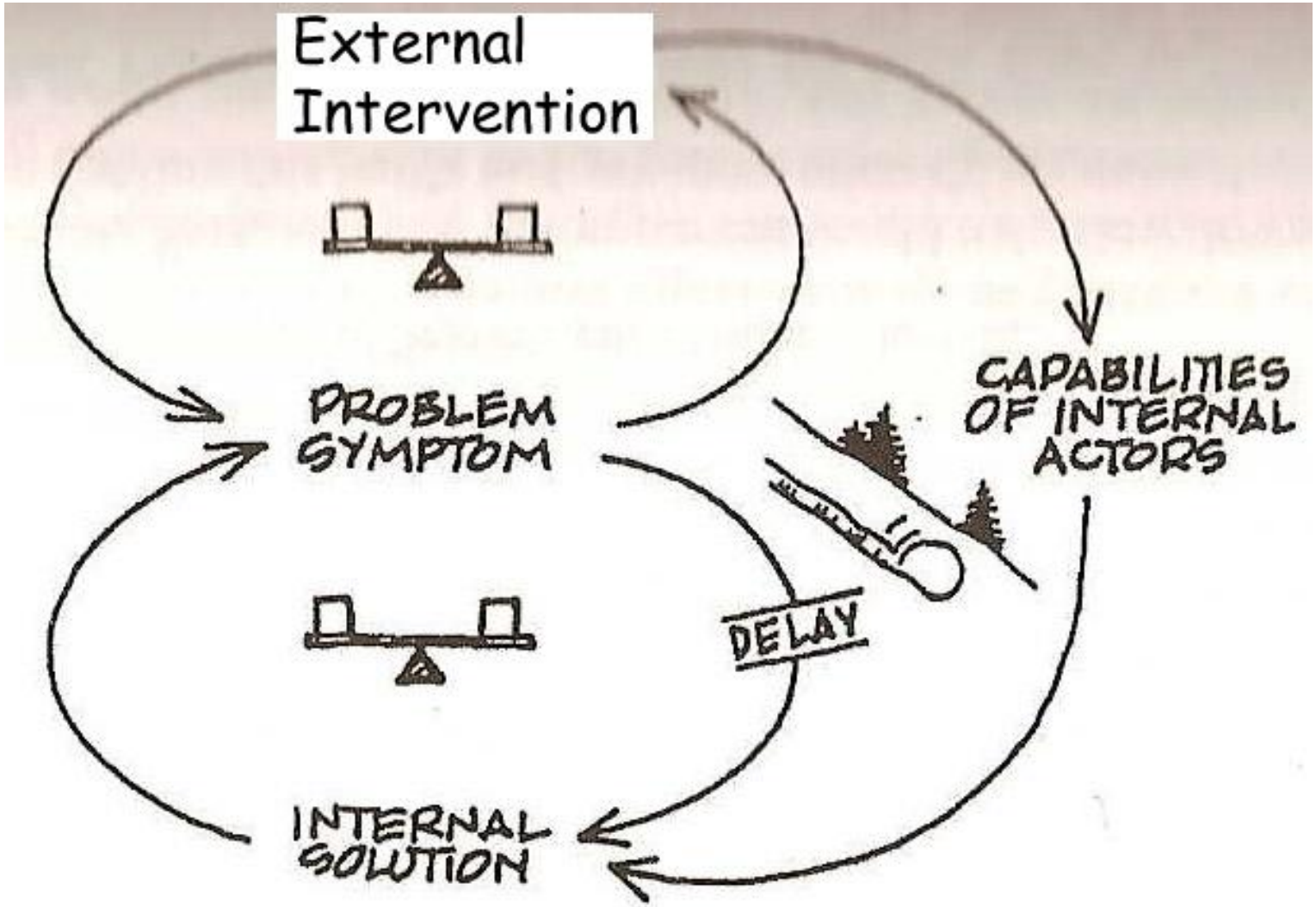
# Limits to Growth



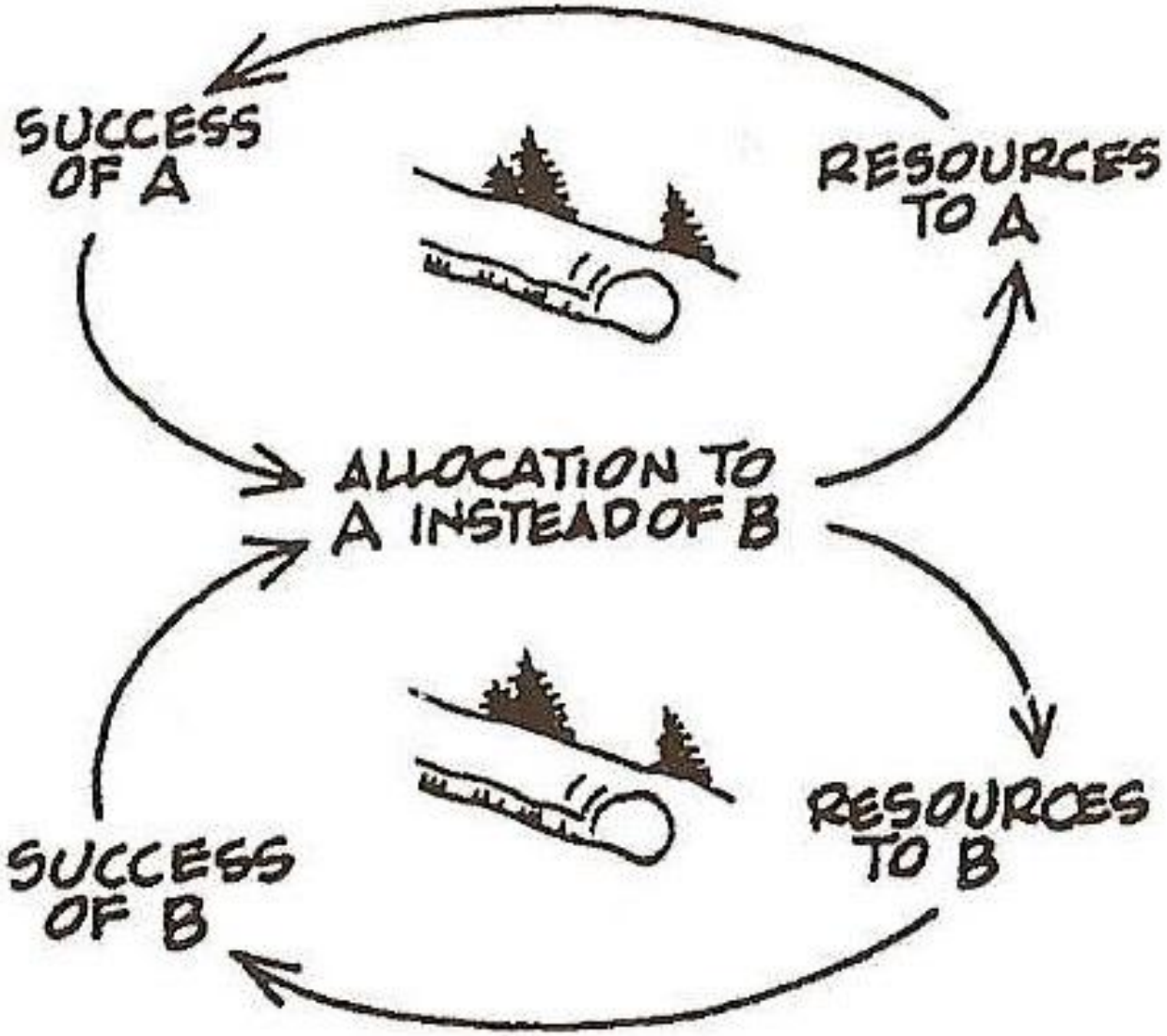
# Shifting the Burden



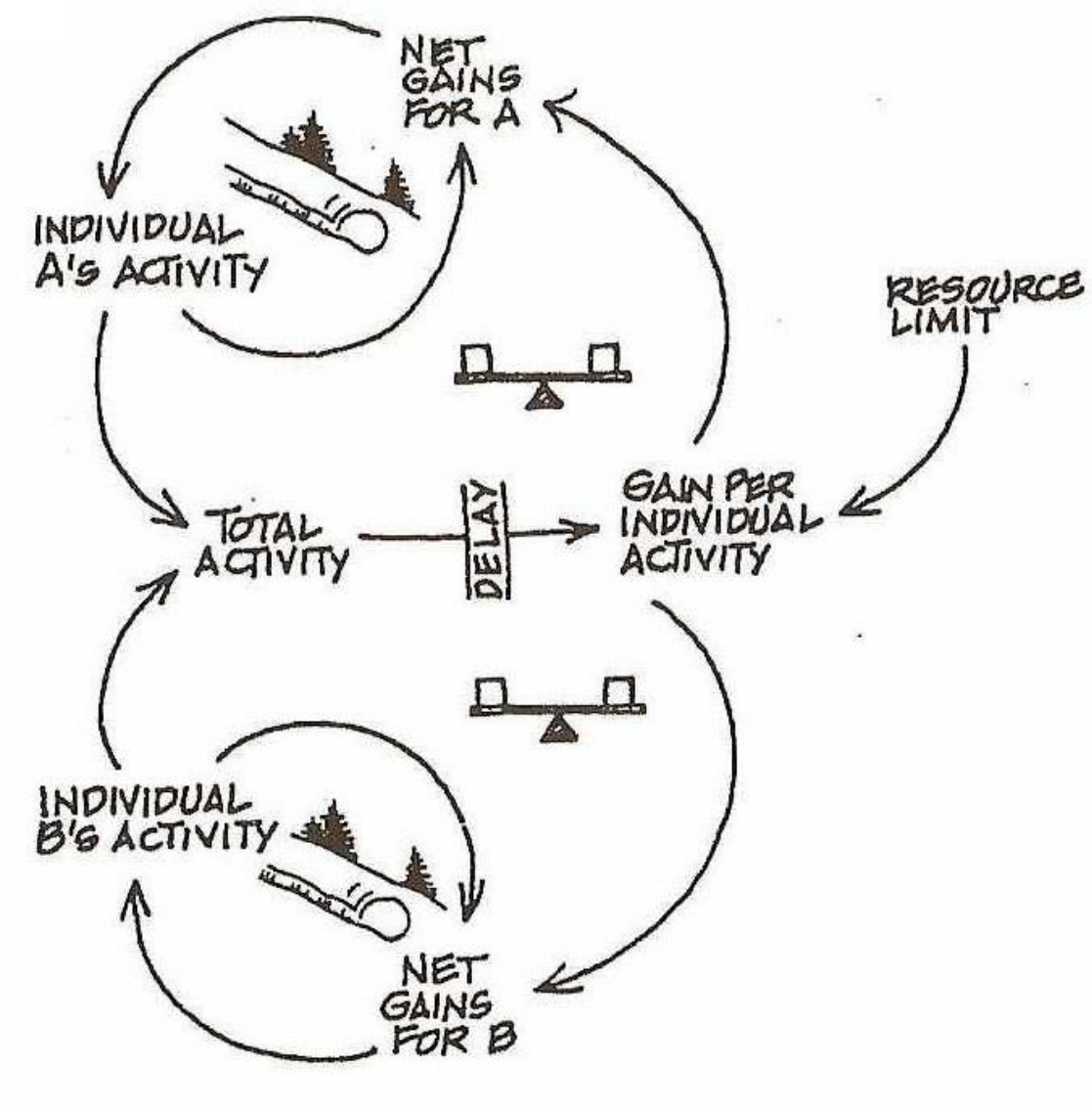
# Special Case: Shifting the Burden to the Interventor



# Success to the Successful



# Tragedy of the Commons



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# Management Cybernetics 4

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# Elliott Jaques's Theory of Cognitive Functioning

- Parallel processing – developing a combination of the two sets of units
- Extrapolating – working out the implications of the new set of units
- Reflecting – considering an alternative set of units
- Shaping – operating with well-defined units

# Task complexity hierarchy

- Ideology and society – 100 years to 5000 years, language for societal and theoretical systems
- Corporate world – 5 years to 100 years, language as a tool for complex systems
- Ordinary world – 1 week to 5 years, language as a tool for classes of things
- Dependent here-and-now childhood world – 2 min. to 1 week, words refer to things and events

# Stratified Systems Theory

**Level of task complexity**

- Construct complex sys.
- Oversee complex systems
- Judge consequences
- Parallel process paths
- Create alternative paths
- Diagnostic accumulation
- Practical judgment, overcome obstacles

**Organizational strata**

- CEO and COO
- Exec. Vice President
- Business Unit President
- General Manager
- Unit manager
- Line manager
- Shop and office floor

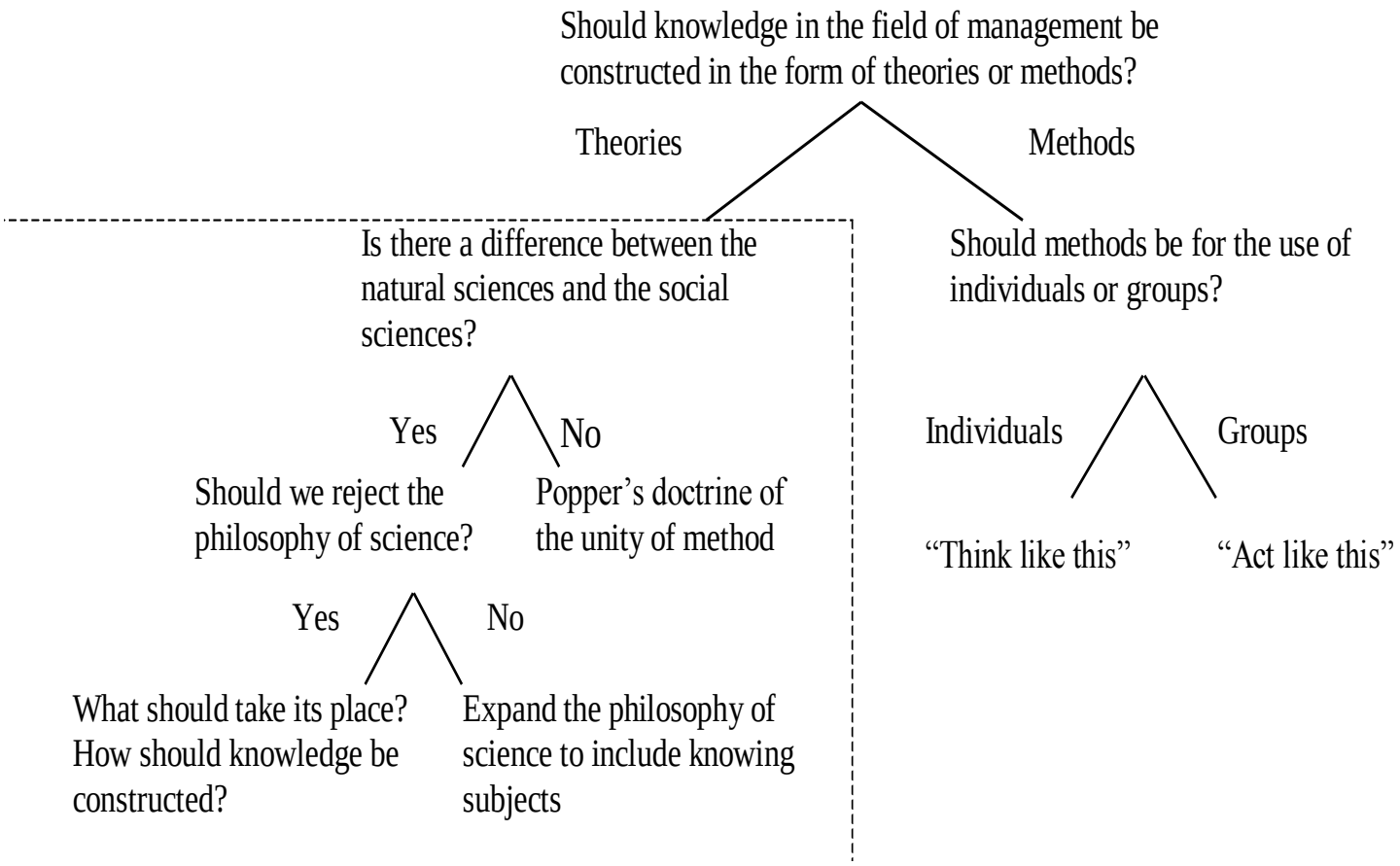
# Gerard Endenburg's Sociocracy

- Gerard Endenburg is a Dutch businessman and management theorist
- The problem he faced was that employees were not passing on needed information
- He wanted to increase their sense of responsibility not only for their job but for the success of the firm as a whole

# Sociocracy

- Endenburg invented the concept of sociocracy
- The key idea is consent, not to be confused with consensus
- Everyone is invited to comment on and contribute to the discussion of a decision
- Consent means that one does not object to or have reservations about a decision

# The nature of knowledge of management


Should knowledge in the field of management be constructed in the form of theories or methods?
Theories
Methods
Is there a difference between the natural sciences and the social sciences?
Yes
No
Should we reject the philosophy of science?
Popper's doctrine of the unity of method
Yes
No
What should take its place? How should knowledge be constructed?
Expand the philosophy of science to include knowing subjects
Should methods be for the use of individuals or groups?
Individuals
Groups
"Think like this"
"Act like this"

# Two conceptions of how to structure knowledge

- Most philosophers of science
- Cause and effect
- If, then
- Analysis
- Reductionism
- Theory

- E.A. Singer, Jr., Churchman, Ackoff
- Producer - product
- Necessary conditions
- Synthesis
- Expansionism
- Method

# Science one vs. science two

- Observation
- Description
- Test knowledge
- Extrapolate/ forecast
- Reproduce experiments
- Accuracy/ precision

- Participation
- Prescription
- Solve problems
- Create/ design
- Achieve agreement or acceptance
- Usefulness

# Why methods tend to lead to integration

- Unlike academics managers are more likely to be generalists than specialists
- Managers focus on getting things done rather than developing ideas
- Ideas used in management need to be shared with subordinates

# A comparison of science and management

# Science

- Scientists are highly educated.  They have special training
- Knowledge is codified in the form of theories
- The purpose is to describe how the world works
- Knowledge is preserved in scientific literature and taught in science courses

# Science (continued)

- Theories are steps in an endless search for better explanations
- Theories change through testing, experimentation, and invention
- Theories are accepted tentatively as the best available explanation of observations

# Management

- Managers sometimes have education in management.  They need leadership skills
- Knowledge is embodied in the form of methods
- Knowledge is developed through experience and consulting practice
- The purpose is to help people work together to achieve common goals

# Management (continued)

- Methods are learned and passed on by using them
- Methods aid coordination, production of goods, and conflict resolution
- Methods change through imitation, experimentation, and innovation
- Methods are accepted as a means to improve group performance

# The New Production of Knowledge

Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott, Martin Trow

# Mode 1 and Mode 2

- Single discipline-based
- Problem formulation governed by interests of specific community
- Problems set and solved in (largely) academic context

- Trans-disciplinary, involving a diverse range of specialists
- Problem formulation governed by interests of actors involved with practical problems
- Problems set and solved in application-based context

# Mode 1 and Mode 2

- Newtonian model of science specific to a field of enquiry
- Research practice conforms to norms of discipline's definition of "scientific"
- Quasi-permanent, institutionally-based teams

- Emergent theoretical / conceptual framework not reducible to single discipline
- Research practice reflexive and socially accountable
- Short-lived, problem-defined, non-institutional teams

# Mode 1 and Mode 2

- Hierarchical and conservative team organization
- Normative, rule-based, “scientific” knowledge produced
- “Innovation” seen as production of “new” knowledge

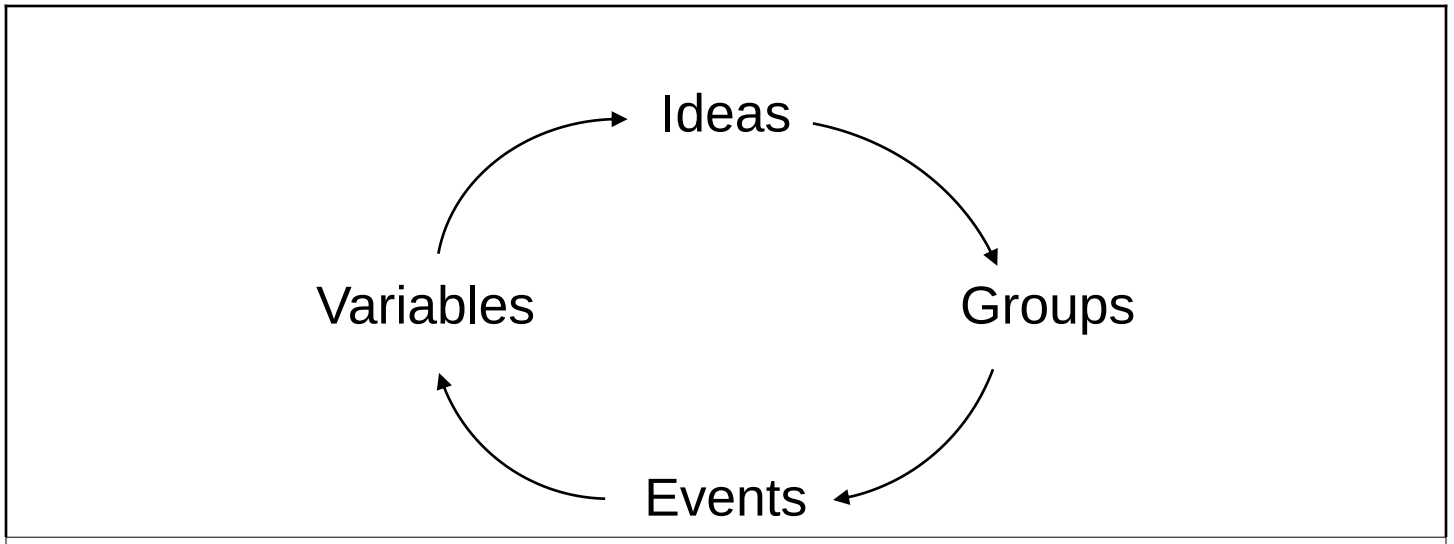
- Non-hierarchical and transient teams
- Consensual, continuously negotiated, knowledge
- “Innovation” also seen as reconfiguration of existing knowledge for new contexts

# Mode 1 and Mode 2

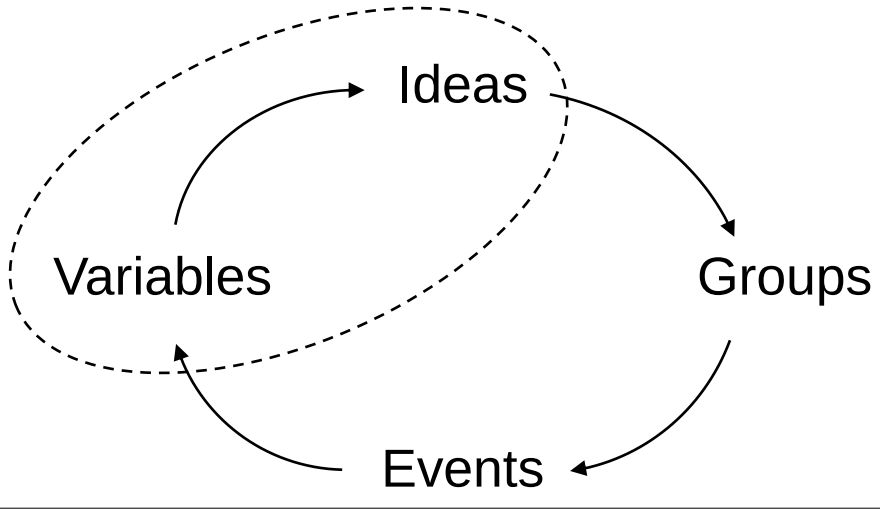
- Separate knowledge production and application
- Dissemination is discipline-based through institutional channels
- Research practice should be “good science”

- Integrated knowledge production and application
- Dissemination is through collaborating partners and social networks
- Dynamic research practice characterized by on the move problem-solving

Whereas scientists describe, managers act within social systems




**A model of social change using four methods for describing systems**




**A reflexive theory operates at two levels**

The Interaction Between Ideas and Society

| Ideas | Events |
|---|---|
| | 1096 First Crusade |
| Interest in trade and in ancient learning | |
| | Marco Polo's trip to China |
| Science and technology stimulated by desire to improve trade | |
| | Traders accumulate wealth, nation–states develop and protect trade routes |
| The idea of progress, people strive to produce more than mere subsistence | |
| | Industrial Revolution in England |
| Adam Smith's *The Wealth of Nations*, 1776 | |
| | Capital accumulation, urbanization, growing gap between rich and poor |
| Marx and Engles, *The Communist Manifesto*, 1848 | |
| | Revolutions in Europe, demands for more equal distribution of wealth |
| Social reform movements in industrializing countries | |
| | World War I and the Great Depression |
| Keynes's theory justifying government intervention in the economy | |
| | World War II, World Bank and IMF established, decolonialization of the Third World |
| Friedman's monetary policy | |
| | Oil crisis in 1973 leads to abandonment of gold standard and fluctuating exchange rates |
| Environmental movement and futures research movement, many conferences on the "world problematique" | |
| | Economic progress in Asia, liberalization of communist regimes |

## Society

Military need for many rifles

Labor intensive production of textiles

High cost of automobiles

Efforts to improve production efficiency

Logistics during World War II

Labor-management misunderstandings

Desire to improve product quality

New information technology (ERP)

Avoid problems due to loss of key people

Need for faster adaptation

## Ideas

Replaceable parts

Jaquard loom

Assembly line

Human relations movement

Operations research

Management by objectives

Process improvement methods

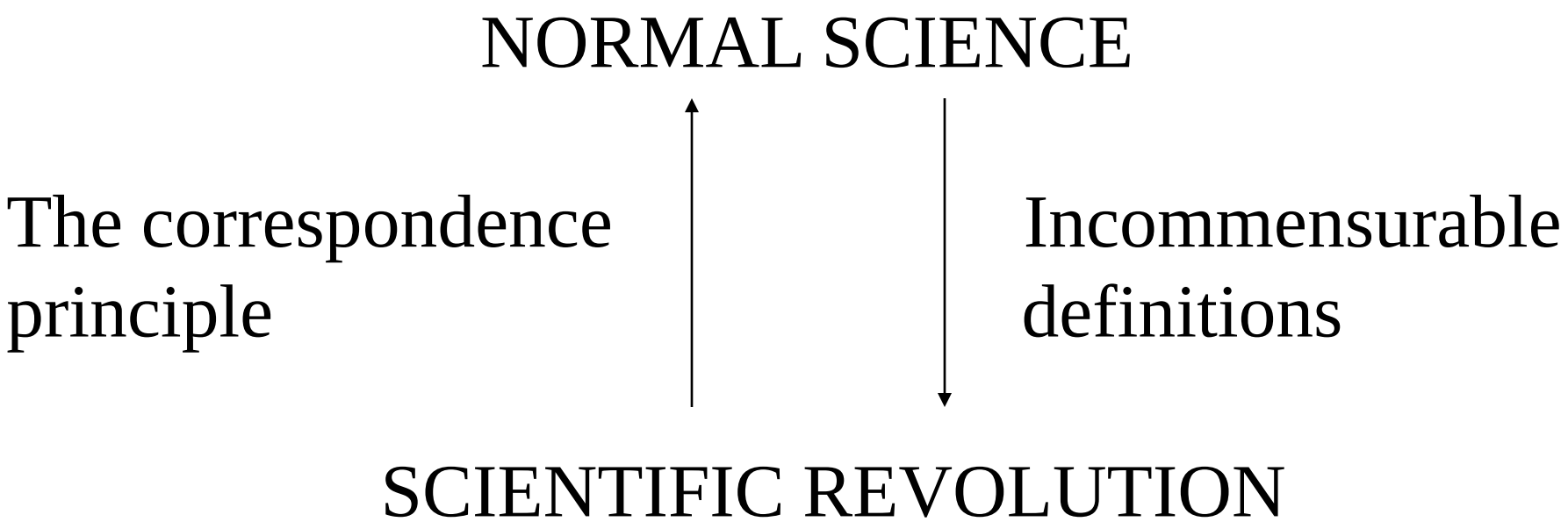
Reengineering

Knowledge management

Learning organization

# Creating an epistemology for management

# How science advances

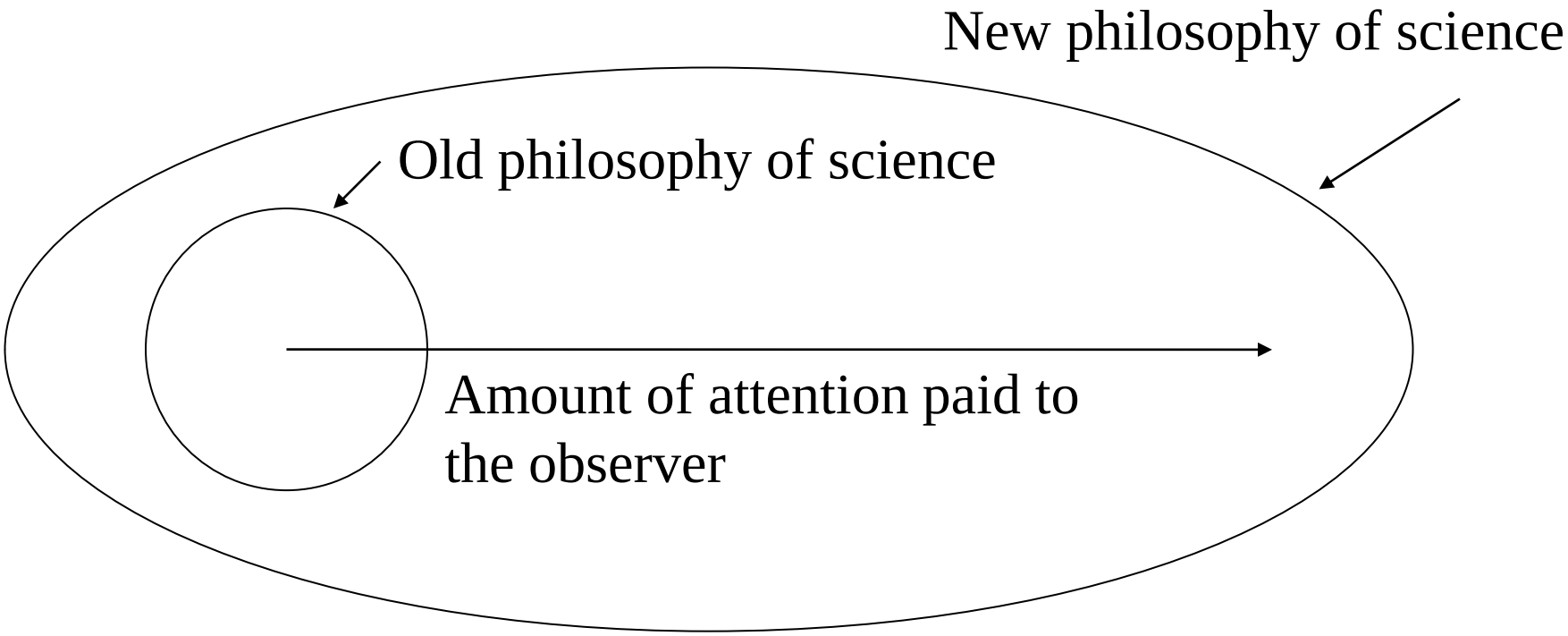


| Author | First Order Cybernetics | Second Order Cybernetics |
|---|---|---|
| Von Foerster | The cybernetics of observed systems | The cybernetics of observing systems |
| Pask | The purpose of a model | The purpose of a modeler |
| Varela | Controlled systems | Autonomous systems |
| Umpleby | Interaction among the variables in a system | Interaction between observer and observed |
| Umpleby | Theories of social systems | Theories of the interaction between ideas and society |

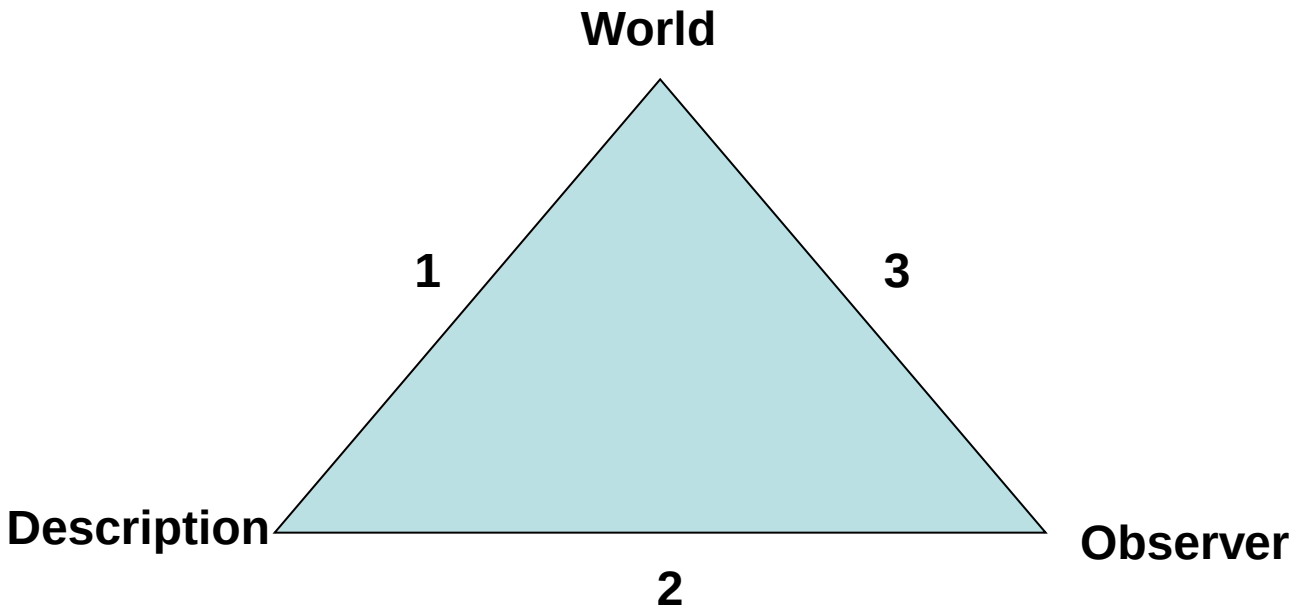
**Definitions of First and Second Order Cybernetics**

# The Correspondence Principle

- Proposed by Niels Bohr when developing the quantum theory
- Any new theory should reduce to the old theory to which it corresponds for those cases in which the old theory is known to hold
- A new dimension is required




**An Application of the Correspondence Principle**


World
1
3
Description
Observer
2

# Popper's three "worlds"

- "World" can be thought of as Popper's "world one"
- "The observer" is what Popper meant by "world two"
- "Description" can be thought of as Popper's "world three"

| | Engineering Cybernetics | Biological Cybernetics | Social Cybernetics |
|---|---|---|---|
| The view of epistemology | A realist view of epistemology: knowledge is a "picture" of reality | A biological view of epistemology: how the brain functions | A pragmatic view of epistemology: knowledge is constructed to achieve human purposes |
| A key distinction | Reality vs. scientific theories | Realism vs. Constructivism | The biology of cognition vs. the observer as a social participant |
| The puzzle to be solved | Construct theories which explain observed phenomena | Include the observer within the domain of science | Explain the relationship between the natural and the social sciences |
| What must be explained | How the world works | How an individual constructs a "reality" | How people create, maintain, and change social systems through language and ideas |
| A key assumption | Natural processes can be explained by scientific theories | Ideas about knowledge should be rooted in neurophysiology. | Ideas are accepted if they serve the observer's purposes as a social participant |
| An important consequence | Scientific knowledge can be used to modify natural processes to benefit people | If people accept constructivism, they will be more tolerant | By transforming conceptual systems (through persuasion, not coercion), we can change society |

**Three Versions of Cybernetics**

# Conclusion

- The key to managing complexity is to realize that the observer defines the system
- Kolmogorov – complexity is measured by the length of the description
- We have considered several interpretations of an organization

# Authors and interpretations

- Deming – an organization is a set of processes; each can be improved
- Beer – the structures and functions of an organization can be understood using the viable system model
- Ackoff – an organization is a social system; interactive planning can help people work together to redesign the organization
- Forrester's system dynamics modeling

# Conclusions

- Different descriptions of organizations lead to different ways of making improvements
- Just as there is no one best description of an organization, so also there is no one best set of consulting recommendations
- Any suggestions or decisions that move an organization forward can be helpful

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