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

Suppliers of materials and equipment

A
B
C
D

Receipt and test of materials

Tests of processes, machines, methods, costs

Production, assembly, inspection

Design and redesign

Consumer research

Consumers
Worksheet

Customer Model

<table>
<thead>
<tr>
<th>My customers</th>
<th>What I provide them</th>
<th>Is there a quality gap between what I provide them and what they want?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Worksheet

Supplier Model

Your Suppliers

Your Process

Your Customers

Requirements & Feedback

Input

Outputs

Requirements & Feedback

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

<table>
<thead>
<tr>
<th>My suppliers:</th>
<th>What they provide me:</th>
<th>Is there a quality gap between what I get and what I want?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

My suppliers: What they provide me: Is there a quality gap between what I get and what I want?
The Deming Chain Reaction

- Improve Quality
- Costs decrease because of less rework, fewer mistakes, fewer delays, snags
- Productivity improves
- Capture the market with better quality and lower price
- Stay in business
- Provide jobs and more jobs
Elements of Quality Management

- Total Employee Involvement/Team Work
- Leadership
- Customer Focus
- Supplier Partnership
- Constancy of Purpose/Long-Term Commitment
- Focus on Process
- Quantitative Methods
- Continuous Improvement
- Training
- TQM
The Old Way

1. Design it

2. Make it

3. Sell it
The Shewhart Cycle

1. Design it
2. Make it
3. Market it
4. Test it in Service
5. Redesign

Act

Plan

Study

Do
## What’s Different?

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

### PROBLEM
- Motivate People
- Who is wrong?
- Define: responsibility
- Watch bottom line
- Measure people
- Define job
- Fix deviations
- “Do your job”
- “Obey orders”

### PROCESS
- Remove barriers
- What is wrong?
- Define: procedure
- Watch quality
- Measure systems
- Define customer
- Reduce variability
- “Can I help you?”
- “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.
A common language:
“What is the level of quality?”

Open Honest Two-Way Communication
Getting Better Faster

![Graph showing performance improvement over time for Company A and Company B.](attachment:graph.png)
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

* To hold gain
- To continue improvement

- Data for process Improvement:
  - Customer view
  - Worker view
  - Lessons learned

- Improvement
- Data collection
- Data analysis
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
“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.
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)
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

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ave. Imp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Health care benefits</td>
<td>8.72</td>
</tr>
<tr>
<td>2. Computer software</td>
<td>8.65</td>
</tr>
<tr>
<td>3. Classroom facilities</td>
<td>8.65</td>
</tr>
<tr>
<td>4. A supportive climate in the dept.</td>
<td>8.60</td>
</tr>
<tr>
<td>5. Salaries</td>
<td>8.58</td>
</tr>
<tr>
<td>6. Projection equipment</td>
<td>8.48</td>
</tr>
<tr>
<td>7. Computer labs</td>
<td>8.47</td>
</tr>
</tbody>
</table>
The most stable low importance features (always in the last 15) from 2001 to 2005

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ave. Imp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recreational activities</td>
<td>4.19</td>
</tr>
<tr>
<td>2. Social activities</td>
<td>4.94</td>
</tr>
<tr>
<td>3. Faculty annual reports</td>
<td>5.31</td>
</tr>
<tr>
<td>4. SBPM working papers series</td>
<td>5.92</td>
</tr>
<tr>
<td>5. Faculty websites</td>
<td>5.94</td>
</tr>
<tr>
<td>6. Annual retreat</td>
<td>6.11</td>
</tr>
</tbody>
</table>
The most stable low Performance features (always in the last 15) from 2001 to 2005

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ave. Perf.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help with writing research proposals</td>
<td>3.34</td>
</tr>
<tr>
<td>Dept. organization to implement its strategic plan</td>
<td>3.54</td>
</tr>
<tr>
<td>Use of continuous improvement methods in the Dept.</td>
<td>3.74</td>
</tr>
<tr>
<td>Conference room and other space</td>
<td>3.81</td>
</tr>
<tr>
<td>Dept. strategic plan</td>
<td>3.89</td>
</tr>
<tr>
<td>Building/physical environment</td>
<td>3.94</td>
</tr>
<tr>
<td>Recreational activities</td>
<td>4.06</td>
</tr>
</tbody>
</table>
The most stable high Performance features (always in the first 15) from 2001 to 2005

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ave. Perf.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dept. head protects faculty from admin. interference</td>
<td>7.76</td>
</tr>
<tr>
<td>Computer hardware</td>
<td>7.00</td>
</tr>
<tr>
<td>A supportive climate in the dept.</td>
<td>6.93</td>
</tr>
<tr>
<td>Interlibrary loan</td>
<td>6.85</td>
</tr>
<tr>
<td>Computer software</td>
<td>6.84</td>
</tr>
<tr>
<td>Copiers</td>
<td>6.72</td>
</tr>
<tr>
<td>Fax machines</td>
<td>6.62</td>
</tr>
<tr>
<td>Course catalogue</td>
<td>6.39</td>
</tr>
<tr>
<td>Campus grounds</td>
<td>6.17</td>
</tr>
</tbody>
</table>
The features always in the SE quadrant from 2001 to 2005

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

MATERIAL
- Scrap
- Excess Inventory
- Inspection Equipment
- Test Equipment
- Poor Machine Utilization
- Energy
- Lost or Misplaced Material
- Over and Under Specifications
- Excessive Equipment

PEOPLE’S TIME
- Rework
- Inspection
- Checking
- Clarifying
- Producing Waste or Poor Quality
- Inefficient Meetings

LOST SALES
- Poor Quality Products/Services
- Not Responsive to Customers Needs
- Poor Customer Service
- Poor Engineering

CUMULATIVE

CAPITAL
- Investments
- Warranty Cost
- Liability Cost
- Idle Equipment
- Depreciation

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

= $18.8M or approximately $3.21 for every $1.00 spent to date
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
• 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

Order written

Chart available?

yes

Wait

no

Order reviewed, Is it correct?

yes

Pull yellow copy and place in pharmacy box (Station Secretary)

no

Pharmacy Pick-Up?

yes

Order delivered in Pharmacy

no

Reasons for Order Errors:
- Illegible
- No Signature
- No Co-signature
- Non-conforming (Id)
- Nursing Judgment
- Multi-Service order
- Patient Allergy
- Incorrect Stamp
- Restricted Drug

Reasons for Delay of Pick-Up:
- Elevators
- Volume too large
- Names on drawers
- Patient discharged
- Off schedule

Order reviewed, Is it correct?

yes

Order entered in computer

no

Order checked, Is it OK?

yes

Order Filled

no

See Reasons for Order Errors (above).

Order Delivered to Unit

Medication administered to patient
Directions: Please fill in the time that each step is completed
Please check if missing:

<table>
<thead>
<tr>
<th>Step</th>
<th>Time</th>
<th>Time</th>
<th>Signature</th>
<th>Beeper</th>
<th>Pink (PO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order written by physician</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order placed in Pharmacy box</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order picked up by technician</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order entry by Pharmacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order label processed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order delivered to Med Drawer on unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PO</td>
</tr>
<tr>
<td>Med Administered to patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Median Elapsed Time

- Order Places in Pharmacy Box: 68 minutes
- Tech. Pick Up: 30 minutes
- Order Entry: 40 minutes
- Order Processed: 8 minutes
- med Delivered to Unit: 30 minutes
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 apart a 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

LEVEL 1

LEVEL 2

LEVEL 3

LEVEL 4

LEVEL 5

Awareness

Understanding

Bonding

Transformation

Total Infusion
A tutorial presented at the

World Multi-Conference on Systemics, Cybernetics, and Informatics

Orlando, Florida
July 8, 2007
Management Cybernetics 2

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

Suppliers of materials and equipment

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Receipt and test of materials

Tests of processes, machines, methods, costs

Production, assembly, inspection

Design and redesign

Consumer research

Consumers
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
boundary

channel

transduce = code message for recipient in 'his' language

channel

transduce = decode message into 'our' language
System One units and their environments

Present Environment

Local Environment

Local Environment

Operation One A

Operation One B

Operation One C

Management Operation One A

Management Operation One B

Management Operation One C
Repeat of the System One units with the addition of Systems Two, Three, and Three Star

Present Environment

Local Environment

Operation One A

Operation One B

Operation One C

Management Operation One A

Management Operation One B

Management Operation One C

System 3

2
System Four probing the future environment

Future Environment
All relevant developments in the environment oriented to the future

System 4
All internal functions concerned with the future
Relationships among Systems 3, 4, and 5
The Viable System Model

Future Environment

Present Environment

Local Environment

Local Environment

Local Environment

System 5

System 4

System 3

Operation One A

Management Operation One A

Operation One B

Management Operation One B

Operation One C

Management Operation One C

3*

2

The Viable System Model
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, 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
Sales

Introduction | Rapid growth | Slower growth | Maturity | Decline | Replacement

Product life cycle
A stakeholder view of the firm
## Obstruction Analysis: Examples of Discrepancies

<table>
<thead>
<tr>
<th>Ends</th>
<th>Practiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be a good corporate citizen.</td>
<td>Do as little for the community as you can get away with.</td>
</tr>
<tr>
<td>Equal opportunity employment</td>
<td>Make no effort to recruit minorities but give those that apply equal treatment.</td>
</tr>
<tr>
<td>Diversify through product innovation.</td>
<td>Diversify through acquisition or imitation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Means</th>
<th>Practiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care about employees.</td>
<td>Minimize employment.</td>
</tr>
<tr>
<td>Long-range strategic planning.</td>
<td>Crisis management.</td>
</tr>
<tr>
<td>Get the best people available.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resources</th>
<th>Practiced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep plants up-to-date and in top condition.</td>
<td>Maintain salaries at the industry’s average.</td>
</tr>
<tr>
<td>A commitment to quality.</td>
<td>Maintain and replace equipment only when absolutely necessary.</td>
</tr>
<tr>
<td>Concern and respect for consumers.</td>
<td>Sacrifice quality when necessary to make price attractive.</td>
</tr>
<tr>
<td></td>
<td>Advertise to them as though they were simple-minded.</td>
</tr>
</tbody>
</table>
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
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.
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

Diagram:
- Goal
- Gap
- Condition
- Pressures to adjust goal
- Actions to improve conditions
- Delay
Escalation

A's Results → RESULTS OF A RELATIVE TO B → B's Results

Activity by A  Activity by B
Fixes that Fail

Diagram:
- Problem
- Fix
- Unintended Consequences
- Delay
Growth and Underinvestment
Limits to Growth
Shifting the Burden

Fundamental Solution
Special Case: Shifting the Burden to the Interventor

Diagram:
- External Intervention
- Problem Symptom
- Internal Solution
- Delay
- Capabilities of Internal Actors
Success to the Successful

SUCCESS OF A

ALLOCATION TO A INSTEAD OF B

SUCCESS OF B

RESOURCES TO A

RESOURCES TO B
Tragedy of the Commons
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July 8, 2007
Management Cybernetics 4

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

Is there a difference between the natural sciences and the social sciences?

- Yes: Should we reject the philosophy of science?
- No: Popper’s doctrine of the unity of method

What should take its place? How should knowledge be constructed?

**Methods**

Should methods be for the use of individuals or groups?

- Individuals: “Think like this”
- Groups: “Act like this”

Yes  No
Two conceptions of how to structure knowledge

- Most philosophers of science
- Cause and effect
- Analysis
- Reductionism

- E.A. Singer, Jr., Churchman, Ackoff
- Producer - product
- Necessary conditions
- Synthesis
- Expansionism
- Method
Science one vs. science two

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

NORMAL SCIENCE

The correspondence principle

SCIENTIFIC REVOLUTION

Incommensurable definitions
<table>
<thead>
<tr>
<th>Author</th>
<th>First Order Cybernetics</th>
<th>Second Order Cybernetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Von Foerster</td>
<td>The cybernetics of observed systems</td>
<td>The cybernetics of observing systems</td>
</tr>
<tr>
<td></td>
<td>The purpose of a model</td>
<td>The purpose of a modeler</td>
</tr>
<tr>
<td></td>
<td>Controlled systems</td>
<td>Autonomous systems</td>
</tr>
<tr>
<td></td>
<td>Interaction among the variables in a system</td>
<td>Interaction between observer and observed</td>
</tr>
<tr>
<td></td>
<td>Theories of social systems</td>
<td>Theories of the interaction between ideas and society</td>
</tr>
<tr>
<td>Pask</td>
<td></td>
<td></td>
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<tr>
<td>Varela</td>
<td></td>
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<tr>
<td>Umpleby</td>
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</tr>
</tbody>
</table>

**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

Old philosophy of science

Amount of attention paid to the observer

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

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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