World Resources Institute

Sustainable Enterprise Program
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AT&T ENVIRONMENT AND SAFETY
Teaching Note

This case describes a project in which "classic" total quality management techniques are used to eliminate an environmental hazard. I have used this case in three settings:

- In an MBA elective course on Total Quality, near the end as a special topic;
- In executive education programs as a "stand-alone" case on environmental management issues, or paired with another session on TQM problem-solving techniques;
- In a Ph.D. course entitled Manufacturing Performance Measurement, again as a special topic with heavier emphasis on measurement issues.

This case also could be used in an introductory session of an environmental management course, to lay out a variety of issues for future consideration, or as a closing summary case to review concepts and apply them in a specific context.

I have assigned the following articles to be read with the case; they are short, and their presence in prominent business publications adds to their legitimacy. Complete citations appear in the reference at the end of this note.

- Smith, Emily T., "Doing It For Mother Earth," **Business Week**, Special Issue on Quality, October 1991.
- Spencer, Leslie, "Designated Inmates," **Forbes**, October 26, 1992.
- Rice, Faye. "Who Scores Best on the Environment?" **Fortune**, July 26, 1993.
- Carpenter, George D., "The Evolution of Total Quality Environmental Management," **Corporate Quality Environmental Management II Conference Proceedings**, Global Environmental Management Initiative, 1992, pp. 1-2. (This can be handed out in class.)

I have passed out or shown other items during the class session, depending on the audience and session length:

- International Chamber of Commerce Sustainable Development Charter (summarized in Figure 3)
- Environmental Self-Assessment Program of the Global Environmental Management Initiative (excerpts or representative slides; see Figure 9)
- TQEM Primer and Self-Assessment Matrix of the Council of Great Lakes Industries (excerpts or representative slides; see Figure 10)
- AT&T Environmental and Safety Report, 1992 or 1993, and/or other firms' annual environmental reports (excerpts or representative slides)

I assign two questions for students to prepare for this class:

1. Sketch a process flow diagram that would help you identify all the points at which AT&T is either "at risk" with respect to 1,1,1 trichloroethane (TCA) or in a position to reduce that risk. Your diagram should indicate where costs are likely to be incurred, and where actions could be taken to reduce those costs.

2. How should AT&T measure its progress toward total quality environmental management at the Columbus Works?

When I use this case as a single environmental session embedded in a course or executive program, my teaching objectives are embodied in the assignment questions. Constructing the process flow diagram allows class members to collectively expand their view of the potential consequences of using hazardous substances in a production process. Most students find that the final class-session diagram contains many more entries than their own, and that the full range of potential effects and costs is far greater than their initial impression. Many of the effects are far downstream from the design stage, and some of the measurements of effects are tenuous. As a result, insufficient information is "fed back" to product designers and process engineers. The final process diagram should be sufficiently general to be applicable in a wide variety of situations.

The discussion of measurement techniques illustrates the differences between measuring outcomes and assessing the capability of processes to produce outcomes. This is an important issue in quality management, within which one can discuss:

- Standard quality techniques (Pareto diagrams, process flow diagrams, fishbone charts, barriers and aids analysis)
- Using Baldrige Award criteria for measuring environmental quality
- ISO 14000 criteria (the environmental counterpart of ISO 9000)

Finally, this case can set the stage for subsequent sessions on:

- Environmental costing systems
- Environmental auditing and estimation of liabilities
- Environmental regulation, international accords (e.g., Montreal Protocol)
- The economic theory of externalities
- Green product design
- Green marketing and community relations

Background on Industry Activity

I begin with overhead slides of the three lists in the Fortune article: "Best Companies, Worst Companies, and Most Improved Companies." Pages 116-117 of this article refer to the AT&T projects described in the case. I then mention the President's Commission on Environmental Quality, which published **Total Quality Management: A Framework for Pollution Prevention** in January, 1993. As described in the case, AT&T was a member of the Quality Environmental Management task force of PCEQ, within which eleven companies each volunteered to undertake a demonstration project on total quality environmental management at one of its facilities. Figure 1 contains a list of the project sites.

Two of the participating firms, AT&T and Dow Chemical, appear on Fortune Magazine's Ten Best list; the 3M Company is among the Ten Most Improved. Unfortunately, participation in the demonstration projects was not insurance against unfavorable publicity, as three of the firms (DuPont, General Electric, and International Paper) appear on Fortune's Ten Worst list. Unfortunately for this program, the "President" in its title was George Bush, who lost his bid for re-election in November, 1992.

GEMI, the Global Environmental Management Initiative is mentioned on page 6 of the case, and Figure 2 is a slide of its twenty members. GEMI was founded in 1990, and its first conference in January 1991 was on Corporate Quality and Environmental Management; GEMI may have coined the term TQEM. The assigned readings include the introduction to the second conference, Corporate Quality - Environmental Management II: Measurements and Communication, March 1992. This article mentions both a technical journal on the topic (entitled Total Quality Environmental Management) and the Business Charter for Sustainable Development of the International Chamber of Commerce. Figure 3 is a summary of the sixteen principles of the Charter, and one can see the influence of TQEM thought in several elements. We return to the ICC charter later in the discussion of measurement issues.

The Business Week article is taken from a special issue devoted entirely to Quality that appeared in December, 1991. It emphasizes both the usefulness of TQM methods and the measurement difficulties to be

expected in environmental contexts. AT&T is highlighted on the third page of this article.

Finally, I pass out a flyer for British Standards Institution BS 7750. BSI is the British national organization that works with the International Standards Organization to develop and administer the (voluntary) corporate certification process known as ISO 9000. BSI was a leader in developing an environmental counterpart to ISO certification, and at the time of this writing, ISO is working on an international environmental certification process. The proposed environmental standards currently are referred to as ISO 14000. An exposure draft is expected in January, 1995, and the target date for completion is January, 1996.

What Are the Issues at AT&T Columbus Works?

The focus here is on ozone-depleting chemicals: Chlorofluorocarbons (CFC's), Methyl Chloroform, and Halons. For scientific background, one can consult the brochure published by the Electric Power Research Institute listed in the references. The two substances at issue here are Perchloroethylene (referred to both as PCE and PERC) and 1,1,1 Trichloroethane (TCA). Both are covered by the Montreal Protocol on Substances that Deplete the Ozone Layer, which took effect on January 1, 1989, and whose goals were tightened by the London Revisions of 1990. One can launch a more extensive discussion of The Montreal Protocol here, and should see the WRI briefing on the Montreal Protocol for more information.

A second major consideration is SARA Title III: the Superfund Amendments and Reauthorization Act (1986). This legislation requires manufacturing companies to report the amounts of toxic chemicals in inventory and released to the environment; this is the Toxic Release Inventory (TRI) requirement.

A third consideration is the federally mandated product labeling rules, set to begin on May 15, 1993. These rules state that all products containing or made using CFC's must bear a warning label (see Figure 4). The rules require firms to label products if ozone-depleting substances have been used in the firms' direct manufacturing process, and to "pass-through" labels applied by suppliers to components that contain these substances.

In addition, AT&T and Northern Telecom were leaders of the Industry Cooperative for Ozone Layer Protection (ICOLP). This voluntary association included fifteen members from the U.S., Canada, Japan, and the United Kingdom. David Chittick, who became Environmental and Safety Engineering Vice President of AT&T in December 1986, was the Chairman of the Board and President of ICOLP. AT&T also became a member of the United Nations Environment Programme, a 12-member committee of experts that addresses CFC alternatives in developing and industrialized nations. Chittick joined a U.N. Mission to the Peoples' Republic of China, the former U.S.S.R., and Hungary to exchange technical information regarding CFC replacement.

Another notable issue was the public announcement of AT&T's Environmental Goals by AT&T's Chairman Bob Allen at the 1990 Shareholders' Meeting. These are presented in Figure 5, including the progress made by 1992 and accompanying modifications to some targets. The first two goals are relevant here:

1. Eliminate chlorofluorocarbon usage by end of 1994
    - 1986 CFC emissions = 2,500,000 pounds
    - Usage was reduced by 86% in 1992
    - Usage was eliminated by May 15, 1993

2. Reduce reportable toxic air emissions by 95% by end of 1995
    - 1987 toxic air emissions = 11,500,000 pounds

- Emissions were reduced by 81% in 1992

While these concerns affect AT&T as a corporation, one can identify two special considerations at the Columbus Works. The first is the local newspaper article that identifies AT&T as the second-biggest air polluter in Ohio in 1987. The article may be something of a mis-statement, as the numbers refer to "single-emission" polluters, and refer only to PERC emissions at the Columbus Works.

Second, Tom Davis, AT&T's Director of Environmental and Safety Affairs, was AT&T's representative on the QEM task force of the President's Commission on Environmental Quality (1992), and he agreed to undertake a demonstration project on TQM and the environment. Largely because of their success in using TQM methods to eliminate the use of PERC, the Columbus Works was asked to select another toxic air emission to attack.

Constructing the Process Flow Diagram for TCA (Figure 6)

After covering this background material, eliciting the process flow diagram from the class can consume 20 to 30 minutes or more, and will cover two standard-sized boards. The diagram, shown in Figure 5, has four main blocks. Student responses typically begin in the middle, work downstream, and then fill in the upstream portion. During this part of the class, I use a videotape obtained from AT&T to add more items for consideration. A typical progression would be:

1. Usage Data from Table 1 on page 11
    - Tool Room/Machine Maintenance
    - Switching Assembly
    - Circuit-Pack Assembly
    - Circuit Pack Repairs
    - Wire-Spring Relay
    - Equipment Testing

2. Exit Media
    - To customer in product
    - To customer in packaging
    - In scrap parts
    - In scrap supplies (cleaning rags, etc.)
    - In spent materials disposed of as waste
    - In air
    - In water
    - In soil
    - On/in biota

- On/in employees
- On/in activists/terrorists
- Community reputation
- On labels

3. Downstream Elements
    - Recovery and recycling
    - Emission controls
    - Hazardous waste disposal
    - Continual monitoring
    - Public perception

4. Break to show video, which brings out cost items in the production process
    - Space used for vats, equipment, etc.
    - Throughput time
    - Defects introduced by cleaning process
    - Monitoring
    - Emergency preparedness

5. Upstream elements
    - Product & process design
    - Substance approval
    - Supplier
    - Shipment
    - Receiving
    - Storage
    - Dispense
    - Transport into use

Discussion of Selected Elements of the Process Flow Diagram

A. Usage Data from Table 1

On the diagram in Figure 6, we show a total of 11,562 lb. of TCA entering the production process, of which 5,846 lb. (51%) have been designated as "emitted." What processes are occurring in each location? What exit media are carrying the TCA? Do the data seem trustworthy?

Tool Room/Machine Maintenance (4750 lb. in, 650 lb. emitted). General cleaning and degreasing of equipment. Where are the remaining 4100 lb.?

- Switching Assembly (2446 lb. in, 1991 lb. emitted). Cleaning ink stamps and rollers used to mark

circuit boards.

- Circuit-Pack Assembly (960 lb. in, 960 lb. emitted). Cleaning gold fingers on circuit boards.

- Circuit Pack Repairs (2440 lb. in, 1279 lb. emitted). Cleaning reworked products.

- Wire-Spring Relay (686 lb. in, 686 lb. emitted). Removing flux, cleaning and degreasing assemblies.

- Equipment Testing (280 lb. in, 280 lb. emitted). General cleaning and degreasing. This use sounds identical to Tool Room/Machine Maintenance, but here we find that 100% is classified as emitted.

One can ask the general question of how much value we add to our product by using TCA as a solvent. For example, consider the flux removed in the wire-spring relay department. Flux is a cleaning agent that removes oxides from metal surfaces to ensure good metal-to-metal contact in soldering. Here we are using TCA as a cleaning agent to remove another cleaning agent that we, ourselves, have applied to our circuit boards.

B. Exit Media

I use this segment simply to list all the possible ways that TCA can leave AT&T's control. Not all the items are mentioned in the case, and not all may be immediately applicable at the Columbus Works. The emphasis here is on developing a comprehensive checklist that will be useful in a broad range of situations. In addition to the standard air, water, and soil media, one can discuss the following points:

- Even if no TCA is transmitted to customers in the product or packaging, various regulations are being proposed (especially in European Union countries) to require firms to accept (and perhaps collect) their products and packaging back from customers.

- Biota includes both animals and plants, which in turn can be direct carriers or means by which chemicals ultimately are ingested by humans.

- We have included both immediate health effects (i.e., injury or sickness) and reproductive damage (fetal damage, sterility, genetic damage) to emphasize that some effects that may take years to appear.

- Although the items labeled "Employee Personal Use" and "Activist/Terrorist" may seem far-fetched, they arise from anecdotes related by executives discussing the case. Strong, general-purpose solvents are, unfortunately, attractive candidates for "home use" by employees.

- The items labeled "Community Reputation" and "Labels" are not exit media per se, but they represent important channels through which costly effects can be incurred. The Fortune article states that labeling would cost "hundreds of thousands of dollars," which seems like a low estimate. Under community reputation, I include negative publicity like the newspaper article included in the case, as well as the lost opportunity for a positive community image, "green marketing," etc.

C. Downstream Elements

None of these elements is mentioned directly in the case, so the instructor can add to or delete from this list

at will. Entire sessions could be devoted to these as individual topics, so the motivation at this point is consciousness-raising, especially in the sense of filling out the list of potential costs associated with TCA usage.

- Recovery and Recycling: One can discuss recent trends, especially in the European Union, toward mandatory return and recycling programs. Some examples now exist in the U.S., such as Apple Computer's battery return program.

- Emission Controls: We can immediately fill in the line indicating a flow from imperfect emission controls to air, ground water, soil, biota, and humans. Even successful emission controls leave us with the problem of what to do with the recaptured chemicals. This leads naturally to the next entry.

- Hazardous Waste Disposal: Under Superfund disposal site liability rules, a company that contributed even a small fraction of the hazardous waste in a site can be liable for cleaning up the entire site. In response, many large companies have started sending hazardous waste only to sites whose customers are limited to other large, financially secure firms. This practice makes it even more difficult for small firms to dispose of hazardous waste, and may encourage "midnight dumping" into municipal sewer systems, etc. See, for example, "The Super Morass of Superfund" for further background.

- Continual Monitoring: I have included two monitoring nodes, one at the process "end of pipe" and another on the far right. The first is intended to indicate on-line monitors that measure the emission of specific chemicals. This consideration allows one to introduce the notion of environmental audits and the types of measurements necessary to meet regulations such as SARA Title III and the Toxic Release Inventory. The second node is intended to indicate monitoring of the ambient air and water quality in the areas surrounding the plant, which attempts to measure the overall effects of discharges from the plant.

D. Cost Items Mentioned in Video

At this point, I show approximately five minutes of the AT&T Columbus Works Solder Cell Team video, using the portion in which the second speaker (Jeff) lays out the problem to be solved. Note that the video refers to PERC, rather than the TCA project. The instructor may wish to view the entire tape, especially the sixth speaker (Ray) who reviews the results of the project. Jeff includes the following elements, which appear in the center of the diagram and in a few other blocks.

- Space used for cleaning equipment, vats, etc.

- Increased throughput time (referred to as "manufacturing interval" in the video): With the PERC cleaning step in the process, the soldering cell was averaging a throughput time of eight days. Removal of the PERC step cut this average to four days.

- Defects introduced by cleaning process: The cleaning equipment occasionally would damage the printed wiring boards, and the PERC itself could damage certain components. The Solder Cell was averaging $5000 per month in scrap as a direct result of the cleaning process. As Ray points out later in the tape, this entire amount was saved by removing the PERC cleaning step.

- Monitoring: Jeff mentions that the following departments all were involved in the 24 hour per day task of monitoring, documenting, and reporting emissions to environmental authorities: Operations, Maintenance, Engineering, Management, Plant and Factory, Safety, Environmental.

- Emergency preparedness: Emergency repair and clean-up crews maintained 24 hour per day readiness

to respond to accidental spills.

- Employee morale.

- By inference, regulatory compliance and perhaps insurance costs.

I include these as examples of cost elements incurred because of hazardous chemical usage. They are not sources of pollution per se, but the Quality Improvement team clearly associates them with the PERC and TCA projects.

E. Upstream Elements

We usually reach these considerations last, as we work our way upstream from usage toward design.

- Acquisition and Transport: Cost items here include special storage containers and special conveyance vehicles in transport. Even if the supplier or transportation firm retains legal liability for spills, it is not uncommon for the media to identify the customer in reporting toxic chemical spills (e.g., the Sacramento River rail car spill). Again, emergency response capability is necessary, and may be conducted at the industry rather then the firm level (cooperative oil spill reaction teams, for example).

- Supplier Selection and Certification: This may be necessary if firms must certify that no CFC's are used in any of their own processes or in the production of purchased components.

- Substance Research and Approval on Entry: The case states that the Columbus Works monitors 20,000 chemicals. A verification process is required when a new chemical is proposed, to meet product standards, safety standards, regulatory emission standards, and disposal standards. Even unregulated materials are tested for potential hazards.

Finally, we reach Product and Process Design. Various rules of thumb state that 80% to 90% of a product's costs are determined in the design phase. The final page of the case contains three "next step" items, attributed to Al Rauck and Barbara Thompson. The first two are related:

- Environmental expenses should be treated as product costs, and charged to the business unit managers;

- Environmental issues should be integrated into process (and product) design.

This allows the instructor to draw a "big box" around everything after the Product & Process Design node, to indicate that AT&T might want a system that feeds back these costs and concerns to designers and other upstream decision makers. Realistically, how can we transmit this information? One reply is through cost accounting systems that reflect full "life cycle" costs. This is a good set-up for one or more subsequent sessions on that topic. One must ask whether even some of the current proposals in this regard would capture all the costs that we have identified here. This discussion opens the door for the measurement issues that follow in this note.

If students do not raise the question of how to "price out" externalities, the instructor may wish to interject it. Consider the notion that TCA usage is an informational problem in the classic externality sense: a decision maker (here, the process designer) does not bear (or is not aware of) the full social costs of his or her actions.

The problem is to force that decision maker to "internalize" the costs. As a possible solution, why don't we push that information even further upstream, onto the supplier of TCA? If the market price of TCA included all these items, a process designer would "automatically" understand the full costs of using TCA.

Recall the statement in the Fortune article that, "the early phase-out [of CFC's] saves AT&T $25 million annually in supply costs, since taxes on CFC's have helped send the price rocketing from about 80 cents per pound in 1986 to over $11; the substitutes average 50 cents per pound." (p. 116). The instructor can use this discussion to launch a session on the theory of externalities and the use of taxes to mitigate them. Here, one confronts the question of whether the costs are generic to TCA or specific to the manner in which TCA will be used by the purchaser. One school of thought on dealing with externalities is to make their costs appear in the objective function of the parties most able to affect social costs through their private decisions. In this case, the most "influential" party may be AT&T, rather than the supplier of the chemical.

Discussion of the Process Improvement Project

The Process Improvement Project is an example of classic TQM techniques. Note that Florida Power and Light also is a PCEQ member, and was the first U.S. firm to win the Deming Prize, a prestigious quality award given by the Union of Japanese Scientists and Engineers. (It predates the Malcolm Baldrige National Quality Award.) Florida Power and Light was a proponent of a "storyboard" approach that embodies the Shewhart-Deming "Plan-Do-Check-Act" (PDCA) cycle, and that systematically employs the six classic TQM tools:

- Pareto Analysis
- Ishikawa Diagrams (Fishbone Diagrams)
- Process Flow Diagrams
- Histograms
- Control Charts
- Scatter Plots

These techniques are described in detail in the Harvard case entitled Florida Power and Light Quality Improvement (QI) Story Exercise (A) [#9-689-041]. The article entitled "Root Cause Analysis" by Ikenberry (see references) provides a similar review of TQM techniques in an environmental setting. The Columbus Works teams appear to apply the techniques in straightforward ways, which permits the instructor to briefly review the ideas, but does not provide novel or controversial aspects to stimulate class discussion.

For example, the Pareto Diagram of all substances on Toxic Release Inventory (Exhibit 6) identifies the most serious pollutants; we find that numbers 1 and 2 already are scheduled for elimination, and number 3 is TCA. A second Pareto Diagram of TCA emission sources by shop (Exhibit 8) indicates that six shops account for 78% of TCA emissions and 84% of its usage.

The results of the soldering cell team PERC project are quite impressive. One alternative was to find a substitute for PERC in the process, and AT&T actually did develop two biodegradable solvents to replace it. However, the team went beyond this level to the root cause of the problem (excess flux on circuit boards) and solved it by redesigning the process to use a low-solids flux, and to spray it on in an even, controlled fashion, rather than applying it by dipping. In this way, no cleaning was required, so they eliminated the use of PERC entirely. This change reduced material costs, reduced environmental costs, and freed valuable floor space.

In the TCA project, the team evaluated four generic alternatives:

- Eliminate the process using TCA
- Substitute a non-toxic chemical for TCA
- Substitute a less-toxic chemical for TCA
- Install emission control equipment

The team brainstormed possible solutions for specific situations, which were evaluated through the barriers and aids approach (see exhibit on page 12), which also appears in the Florida Power and Light case. As we leave the case, implementation teams have begun to replace TCA with non-toxic solvents in several of the shops.

Measuring Environmental Performance

When using this case as a stand-alone session, I try to save 20 to 30 minutes for this section; one can easily expand it to much more. The Ikenberry article delineates two types of environmental performance data: Scientific Data and Management Data (see Figure 7). To these, we can add a third category, Systems Assessment Data. This third category is consistent with the TQM approach, with its heavy focus on process analysis as the key to better outcomes. (The article by FitzGerald provides further references.)

As time permits, I have used four examples of environmental performance measurement. The first is the AT&T Environmental Annual Report for 1992, which contains examples of both scientific and management data. Students also may be interested in the sections on "Design for Environment" and "Green Design" on page 7.

1. Scientific Data
    - CFC emissions (p. 2)
    - Toxic air emissions (p. 5)
    - Manufacturing waste disposals (p. 6)
    - Paper recycling (p. 10)

2. Management Data
    - Fuel cost savings of $60,000 in first year of landfill methane burning (p. 5)
    - Hazardous waste disposal cost saving of $750,000 (p. 6)
    - Awards won (p. 16)

Next, I return to the Fortune Magazine Environmental Scorecard, which is described in the sidebar at the end of the article (p. 118), and summarized in Figure 8. Although the description is not complete, one can roughly categorize the various dimensions measured:

1. Scientific Data
    - Amount of Toxic Chemical Releases
    - Percentage Reduction of Toxic Chemical Releases

- Recycling of Hazardous Waste
- Recycling of Solid Waste

2. Management Data
    - Violations of Environmental Laws
    - Potential Responsibility for Large Number of Superfund Sites

3. Systems Assessment Data
    - Comprehensiveness of Environmental Program
    - Written Policy and Goals
    - Employee Incentives
    - Ratings by Credible Environmental Groups
    - Participation In EPA Voluntary Programs

Next, we discuss two examples of comprehensive environmental system assessment techniques. The first is the GEMI/Deloitte and Touche Environmental Self-Assessment Program (ESAP) summarized in Figure 9. This system is based on the Principles for Environmental Management contained in the ICC Business Charter for Sustainable Development. For each of the sixteen principles of the ICC charter, the ESAP constructs a set of activity-based elements. For example, Principle 8 concerns Facilities and Operations, and includes the following elements:

1. Internal Operating Standards and Practices
2. Solid and Hazardous Waste Reduction and Treatment
3. Waste Residue Management and Disposal
4. Energy Minimization Program
5. Natural Resources Extraction and Raw Materials Usage
6. Habitat Protection
7. Pollution Control and Reduction
8. Employee Health and Safety

On each element, you score your firm's level of activity on a four-point scale. Note that although a generic label is given here for each level, the assessment has a specific description of what each level entails for every element:

1 = Compliance

2 = Systems Development and Implementation

3 = Integration into General Business Functions

4 = Total Quality Approach

As a final step, you are asked to weight each activity by importance (1-3), and compute an overall score.

The second example is the TQEM Primer and Self-Assessment Matrix designed by the Council of Great

Lakes Industries. The Matrix is based on seven criteria adapted from the Malcolm Baldrige National Quality Award. The criteria and their relative weights are summarized in Figure 10.

- Leadership: 15%
- Information and Analysis: 7.5%
- Strategic Planning: 7.5%
- Human Resources: 10%
- Quality Assurance of Environmental Performance: 15%
- Environmental Results: 30%
- Customer/Stakeholder Satisfaction: 15%

The matrix contains a detailed scoring system in which you assess your firm's performance on each criterion, using a 10-point scale. The manual contains complete instructions for scoring a firm, as well as a detailed case study (again mirroring the Baldrige Award procedures).

Both self-assessment programs provide "benchmarking" data, another frequently mentioned feature of TQM programs. Using these tools, firms can compare plants or divisions, monitor the firm's progress through time, or compare themselves to other firms or industries that also use the self-assessment measures.

Incentives for Managers to Take These Issues Seriously

In closing, I return to Barbara Thompson's idea at the end of the case about developing cost accounting systems at the product line or divisional manager level to reflect environmental costs and measure environmental performance. Both convey the notion of accountability for environmental effects, and we can ask how these measures should be used to affect behavior. One can begin by discussing or distributing the Environment Today article entitled "More Execs Find Pay Linked to EHS Goals." The article links the trend toward environmental aspects of compensation to firms with active Total Quality Management Programs. (Note that Charles McGlashan, the Deloitte and Touche EHS consultant quoted on the first page, was project manager for the GEMI Self-Assessment project.) The list of companies mentioned in the article includes:

- General Electric
- Hercules
- Huntsman Chemical Corporation
- Browning-Ferris Industries
- Lockheed Space and Missiles Company
- Duke Power Company
- Chevron

Finally, I draw students' attention to two passages in the Forbes article entitled "Designated Inmates":

1. Since 1990, every possible violation of the Clean Air Act can be considered a felony.

2. Under the responsible corporate officer liability doctrine, an executive need not know that his subordinates stored a chemical improperly to be prosecuted. He need only be deemed negligent for not knowing it.

Students may ask whether it is likely that such severe penalties, especially jail sentences, actually will be imposed. According to an Industry Week article, between 1982 and 1990 the Environmental Crimes Section of the (federal) Justice Department obtained 432 convictions and guilty pleas from 569 indictments. The cases triggered $26 million in fines (almost half in 1989 alone), and 270 years in jail sentences, about 40% of which had been served by 1990. In one case, a New Jersey judge handed down a ten-year sentence to an executive who conspired to abandon 200 barrels of chemical waste in the state. Note that these sentences were imposed *before* the "stiffening" of the Clean Air Act. The Clean Water Act's penalties include prison terms of up to one year (and fines) for violations due to negligence, which is doubled for a second offense. Those who *knowingly* violate the Clean Water Act face penalties of $50,000 per day of violation and three years in jail, both doubling for repeat offenders.

On a somewhat more positive note, in November, 1993 the Advisory Group on Environmental Sanctions submitted to the U.S. Sentencing Commission a draft of proposed sanctions for organizations (as opposed to individuals) convicted of environmental offenses. Parts of the recommendations concern "Mitigating Factors in Sentencing" (shown in Figure 11), which include:

1. Commitment to Environmental Compliance, as demonstrated by
    - Line Management Attention to Compliance
    - Integration of Environmental Policies, Standards, and Procedures
    - Auditing, Monitoring, Reporting, and Tracking Systems
    - Regulatory expertise, training, and evaluation
    - Incentives [for employees] for Compliance
    - Disciplinary Procedures [for non-compliance]
    - Continuing Evaluation and Improvement
    - Additional Innovative Approaches

2. Cooperation and Self Reporting

3. Remedial Assistance

Comparing this list of mitigating factors to the sixteen elements of the GEMI Self-Assessment Program adds a final endorsement for a strong TQEM initiative.

FIGURE 1

President's Commission on Environmental Quality
Total Quality Environmental Management Demonstration Projects

1.AT&T Columbus Works

2.Chevron Perth Amboy Refinery

3.Dow Chemical Company Louisiana Division Glycol II Plant

4.DuPont Chemical Company Acrylonitrile Operations

5.Ford Motor Company Climate Control Division

6.General Electric Company Medical System Business Group, Magnet Systems

7.International Paper Androscoggin Mill

8.Merck & Company Manufacturing Division Rahway-Linden Site

9. 3M Company Medical Products Division Plant

10.Procter & Gamble Manufacturing Plant, Lima, Ohio

11.Procter & Gamble Manufacturing Plant, Mehoopany, Pennsylvania

12.U.S. Generating Co. Cogenerating Facility, Indiantown, Florida (Bechtel Group, Inc. and Pacific Gas & Electric)

FIGURE 2

GEMI: Global Environmental Management Initiative

- Allied-Signal Inc.
- Amoco Corporation
- AT&T
- The Boeing Company
- Browning-Ferris Industries
- Digital Equipment Corporation
- The Dow Chemical Company
- Duke Power Company
- Eastman Kodak Company
- E. I. duPont de Nemours & Company
- Florida Power & Light
- ICI Americas, Inc.
- Merck & Company, Inc.
- Occidental Petroleum Corporation
- The Procter & Gamble Company
- The Southern Company
- Tenneco, Inc.
- Union Carbide Corporation
- USX Corporation
- W. R. Grace & Co.

FIGURE 3

International Chamber of Commerce
Business Charter for Sustainable Development:
Principles for Environmental Management

1. **Corporate Priority:** To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programs and practices for conducting operations in an environmentally sound manner.

2. **Integrated Management:** To integrate these policies, programs, and practices fully into each business as an essential element of management in all its functions.

3. **Process of Improvement:** To continue to improve corporate policies, programs, and environmental performance, taking into account technical developments, scientific understanding, consumer needs, and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

4. **Employee Education:** To educate, train, and motivate employees to conduct their activities in an environmentally responsible manner.

5. **Prior Assessment:** To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

6. **Products and Services:** To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

7. **Customer Advice:** To advise, and where relevant educate, customers, distributors, and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

8. **Facilities and Operations:** To develop, design, and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimization of adverse environmental impact and waste generation, and the safe and responsible disposal of wastes.

9. **Research:** To conduct or support research on the environmental impacts of raw materials, products, processes, emissions, and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

10. **Precautionary Approach:** To modify the manufacture, marketing, or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. **Contractors and Suppliers:** To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

FIGURE 3 (continued)

12. **Emergency Preparedness:** To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities, and the local community, recognizing potential transboundary impacts.

13. **Transfer of Technology:** To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. **Contributing to the Common Effort:** To contribute to the development of public policy and to business, governmental, and intergovernmental programs and educational initiatives that will enhance environmental awareness and protection.

15. **Openness to Concerns:** To foster openness and dialog with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes, or services, including those of transboundary or global significance.

16. **Compliance and Reporting:** To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements, and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities, and the public.

FIGURE 4

WARNING: Contains Perchloroethylene, a substance that harms public health and the environment by destroying ozone in the upper atmosphere.

FIGURE 5

AT&T's Environmental Goals

1.Eliminate chlorofluorocarbon usage by end of 1994
- 1986 CFC emissions = 2,500,000 pounds
- Down by 86% in 1992
- Usage was eliminated by May 15, 1993

2.Reduce reportable toxic air emissions by 95% by end of 1995
- 1987 toxic air emissions = 11,500,000 pounds
- Down by 81% in 1992

3.Decrease manufacturing process waste disposal by 25% by end of 1994
- 1987 manufacturing process waste disposal = 115,000,000 pounds
- Down by 49% in 1992

4. Recycle 60% of paper by end of 1994 (original goal was 35%)
- Reached 60% in 1992

5.Reduce paper use by 15% by end of 1994
- 1990 paper use = 60,000,000 pounds
- Down by 10% in 1992

FIGURE 6

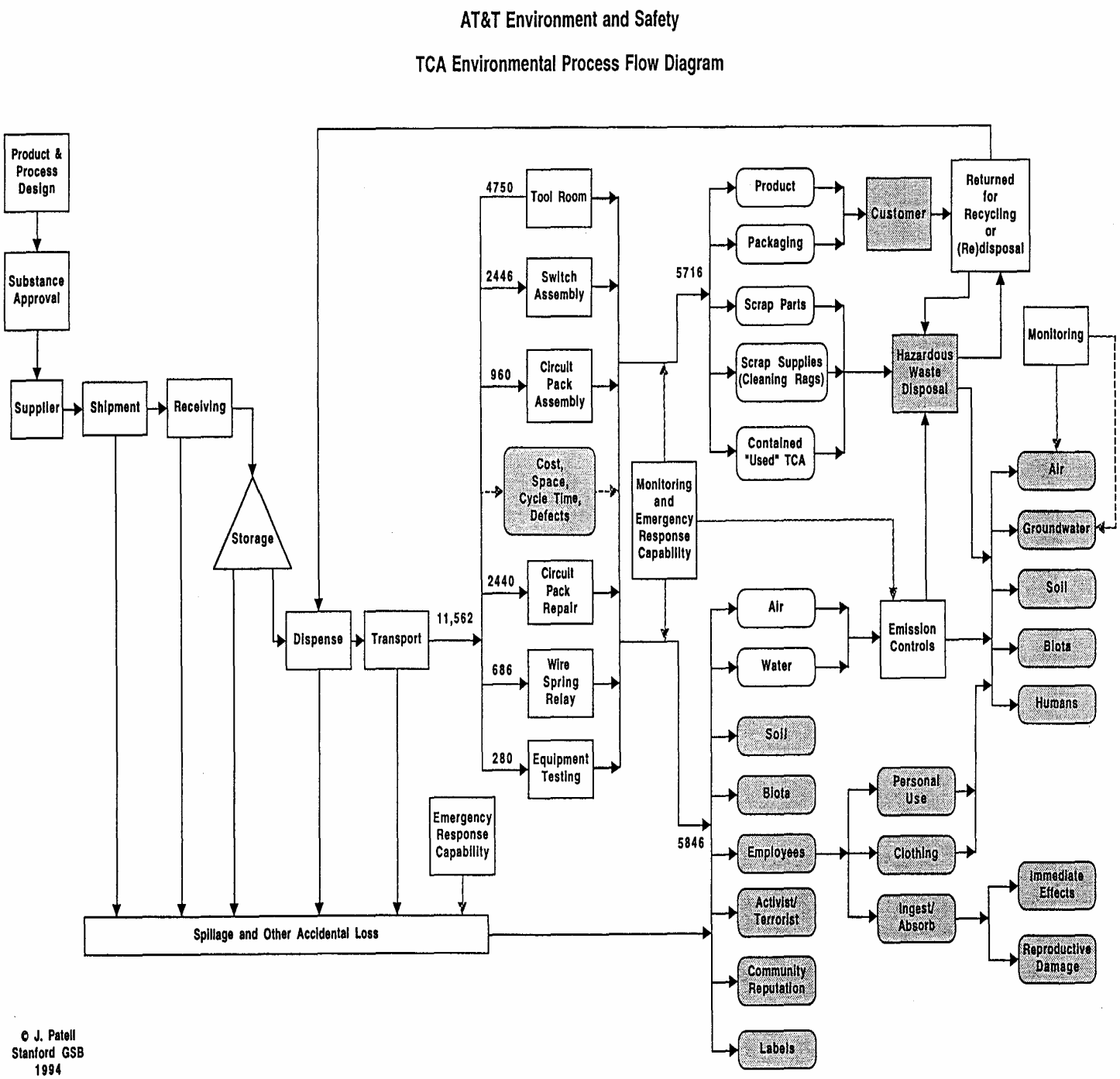
AT&T Environment and Safety
TCA Environmental Process Flow Diagram
Product & Process Design
Substance Approval
Supplier
Shipment
Receiving
Storage
Dispense
Transport
11,562
4750
Tool Room
2446
Switch Assembly
960
Circuit Pack Assembly
Cost, Space, Cycle Time, Defects
2440
Circuit Pack Repair
686
Wire Spring Relay
280
Equipment Testing
Emergency Response Capability
Spillage and Other Accidental Loss
Monitoring and Emergency Response Capability
5716
5846
Product
Packaging
Scrap Parts
Scrap Supplies (Cleaning Rags)
Contained "Used" TCA
Customer
Returned for Recycling or (Re)disposal
Hazardous Waste Disposal
Monitoring
Air
Water
Soil
Biota
Employees
Activist/ Terrorist
Community Reputation
Labels
Emission Controls
Personal Use
Clothing
Ingest/ Absorb
Immediate Effects
Reproductive Damage
Air
Groundwater
Soil
Biota
Humans
© J. Patell
Stanford GSB
1994

FIGURE 7

Measuring Environmental Performance

•Scientific Data

- Physical information on substances (lb. used, lb. emitted)
- Physical information on environment (quality of air, water, etc.)

•Management Data

- Compliance (with regulations, company policies or goals, community, supplier, or customer specifications)
- Costs (waste management, remediation, administrative)

•Systems Assessment

- GEMI Self-Assessment Program
- CGLI Self-Assessment Matrix
- ISO 14000 Certification

FIGURE 8

Fortune Magazine Environmental Scorecard

• Amount of Toxic Chemical Releases

• Percentage Reduction of Toxic Chemical Releases

• Comprehensiveness of Environmental Program

1. Written Policy and Goals
2. Employee Incentives

• Violations of Environmental Laws

• Ratings by Credible Environmental Groups

• Potential Responsibility for Large Number of Superfund Sites

• Recycling of Hazardous Waste

• Recycling of Solid Waste

• Participation In EPA Voluntary Programs

FIGURE 9

Global Environmental Management Initiative Self-Assessment Program

1. Corporate Priority
- Scope
- Management Involvement
- Resources
- Communications
- Implementation
- Accountability

2. Integrated Management
- Planning
- Reporting
- Information Flows
- Control

3. Process of Improvement
- Technical Developments, Scientific Understanding, External Expectations
- Improvement of Policies
- Improvement of Programs and Products
- Improvement of Performance
- Process for Change

4. Employee Education
- Awareness Programs
- General Skills and Training
- Environmental Health and Safety Professionals Training
- Management Development
- Motivation

5. Prior Assessment
- Property and Business Acquisition or Divestiture, and Joint Facility or Venture Planning
- Site Closure Planning
- New Business Activity or Project Planning

6. Products and Services
- Environmental Impact
- Product and Service Safety and Integrity
- Energy Consumption
- Use of Natural Resources and Raw Materials
- Stewardship of Natural Resources
- Waste Minimization and Management

7. Customer Advice
- Advice to Customers and Distributors
- Advice to Transporters
- Advice to Consumers
- Advice to the Public and Environmental Groups

FIGURE 9 (continued)

Global Environmental Management Initiative Self-Assessment Program

8. Facilities and Operations
• Internal Operating Standards/Practices
• Solid and Hazardous Waste Reduction and Treatment
• Waste Residue Management and Disposal
• Energy Minimization Program
• Natural Resources Extraction and Raw Materials Usage
• Habitat Protection
• Pollution Control and Reduction
• Employee Health and Safety
• Risk Evaluation and Reduction

9. Research
• Research on Raw Materials Procurement and Use
• Research on Products
• Research on Processes
• Research on Waste Minimization and Emissions

10. Precautionary Approach
• Process Changes
• Marketing Changes
• Changes in Products or Services
• Changes in Conduct of Activities

11. Contractors and Suppliers
• Contractor Priority
• Contractor Performance
• Supplier Priority and Performance

12. Emergency Preparedness
• Hazard and Incident Assessment
• Emergency Response Plans
• Product and Service Safety
• Employee Training

13. Transfer of Technology
• Technology Information
• Management Methods
• Transfer to Industrial Sector
• Transfer to Public Sector

14. Contributing to the Common Effort
• Public Policy
• Contribution to Environmental Protection Programs
• Environmental Education Initiatives

FIGURE 9 (continued)

Global Environmental Management Initiative Self-Assessment Program

15. Openness to Concerns
- Employee Workplace Concerns
- Customer and Consumer Concerns
- Community Concerns

16. Compliance and Reporting
- Environmental Audits
- Progress Measurement
- Internal Performance Reporting
- External Performance Reporting

FIGURE 10

Council of Great Lakes Industries Environmental Self-Assessment Matrix

1. Leadership: 15%
• EHS Vision, Mission, Principles
• Visible Personal Commitment
• Commitment to Integration of EHS into Overall Management Strategies
• Employee Empowerment
• Benchmarking

2. Information and Analysis: 7.5%
• Types of Data Collected
• Quality of Data
• Data Management Systems
• How Data are Used
• Benchmarking

3. Strategic Planning: 7.5%
• Planning Processes
• Input to Planning
• Commitment to Environmental Management Excellence

4. Human Resources: 10%
• Clear Assignment of Responsibility
• Training and Education
• Career Development and Integration with EHS Goals
• Employee Attitudes Toward EHS Management

5. Quality Assurance of Environmental Performance: 15%
• Quality Assurance Processes and Systems
• Benchmarking

6. Environmental Results: 30%
• Establishing and Communicating Measures and Results
• Evaluating and Using Results
• Benchmarking

7. Customer/Stakeholder Satisfaction: 15%
• Management Processes and Measures
• Benchmarking

FIGURE 11

U.S. Sentencing Commission
Advisory Group on Environmental Sanctions
Draft Report, November 1993

Mitigating Factors in Sentencing

1. Commitment to Environmental Compliance

- Line Management Attention to Compliance
- Integration of Environmental Policies, Standards, and Procedures
- Auditing, Monitoring, Reporting, and Tracking Systems
- Regulatory Expertise, Training, and Evaluation
- Incentives [for Employees] for Compliance
- Disciplinary Procedures [for Non-Compliance]
- Continuing Evaluation and Improvement
- Additional Innovative Approaches

2. Cooperation and Self Reporting

3. Remedial Assistance

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   Global Environmental Management Initiative
   2000 L. Street, N.W.
   Suite 710
   Washington, D. C. 20036
   (202) 296-7449

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   TQEM PRIMER/MATRIX ORDER/CGLI
   c/o Detroit/Wayne County Port Authority
   151 West Jefferson, Suite 275
   Detroit Michigan 48226.
   The Council of Great Lakes Industries is located at 35 East Wacker Drive, Suite 1850, Chicago Illinois 60601, (312) 407-0177.

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