Chapter 5:
Case Study in Chemical Tracking

Introduction: Need for a Chemical Tracking System

Like other large research universities across the country, the University of Michigan has been experiencing an upward trend in hazardous waste generation associated with its departmental research. The increasing amount of hazardous waste generated at the University, the rising cost of its disposal, and the safety hazards associated with the use and storage of toxic chemicals create a pressing situation that must be addressed.

After members of the Pollution Prevention Master's Project (PolPrev) spoke with key faculty and staff from the Chemistry Department and Occupational Safety and Environmental Health (OSEH), it became apparent to us that the University needed an improved means for integrating and updating its current system for chemical ordering, inventory, and disposal. Based on the information collected from our audit and the contacts we made with Chemistry and OSEH, PolPrev decided to implement a demonstration project focusing hazardous waste reduction at U-M.

Project Overview

We utilized principles of action research and community participation in developing and modifying our project. Initially, PolPrev's Chemical Tracking group envisioned implementing a chemical exchange program to reduce the University's hazardous waste stream. This is a chemical management system in which one researcher's unused chemicals become another's raw material. A researcher consults an inventory of available surplus chemicals before ordering new ones. In this way, researchers share unused

chemicals instead of disposing of them. However, as the project progressed and as we reflected on the information we had gathered, the barriers we had encountered, and the opportunities that had arisen for pursuing interventions, we found it necessary to change our intervention strategy. Rather than focus exclusively on the establishment of a chemical exchange program at the University, our group decided to channel our energies into researching and building the framework and support necessary to establish a chemical tracking system (CTS)—a computer database designed to monitor chemicals from the point of purchase to the point of disposal. Because a tracking system would not only help facilitate surplus chemical exchange, but would also enable departments to identify on-site chemicals, the amount remaining, and their specific location, OSEH and Chemistry personnel encouraged our group to pursue chemical tracking as the primary focus for our project.

Such periods of re-evaluation and change in our project represented major decision points for the Chemical Tracking group. These decision points are emphasized throughout the following chronology section to reflect the project's continual evolution and modification.

As a consequence of these modifications in the project, our group's role in the effort to reduce hazardous waste at U-M also changed. Originally, we envisioned our group as leaders of this effort. However, as we became more cognizant of the complexity of establishing a university-wide CTS, we realized that our group should adopt the role of facilitator—that of bringing together people from different departments to solicit their ideas and suggestions for the design of the CTS. We believed it important that users of the tracking system be involved in its design, not only for ownership purposes, but also to ensure that the system would meet their individual and departmental needs. The interdisciplinary nature of our project, which involved technical, economical, environmental, and social issues, was an additional impetus to include people from different departments and disciplines in the planning of the tracking system.

To facilitate these cross-campus links, the Chemical Tracking group decided to form a focus group of University administrators, managers, faculty, staff, and students to help assess different CTS software programs and make suggestions for establishing a tracking system at U-M.

Interviews with other universities, ongoing meetings with people from the Chemistry Department and OSEH, and consultation with companies

developing chemical tracking systems were also key action components of our project.

This chapter presents a chronology of our Chemical Tracking project, highlighting our planning process and the challenges we encountered while trying to implement an interdepartmental chemical tracking system in a decentralized University. A more detailed description of tracking systems and their potential value to universities is discussed in the proposal section. Lastly, in the recommendations section of this chapter, we discuss our vision for chemical tracking at the University—what we would like to see happen to the system, such as expanding the system throughout the University, and using it to reduce hazardous waste via surplus chemical exchange.

Chronology

June 2, 1992: Recycling and "U" Conference

At a conference promoting recycling at the University, OSEH intern Jeffrey Hacala gave a presentation on his study of hazardous waste generation at U-M. After the presentation, the PolPrev member responsible for the hazardous waste section of our audit spoke with Hacala to inquire further about the study. Hacala suggested contacting the Director of OSEH, not only to get access to this report, but also to obtain the hazardous materials audit information we were still seeking. This contact with Hacala served as a springboard for future contacts with OSEH and the Chemistry Department.

August 3, 1992: First Contact With OSEH

PolPrev scheduled a meeting with OSEH's Director, Ken Schatzel, and Hazardous Waste Coordinator, Hank Baier, who provided us with information and data for our audit and a copy of Hacala's 1992 report, *Strategies for Hazardous Waste Reduction at the University of Michigan*. While reading the report, we became increasingly aware of the hazardous waste problems at U-M. Hacala's waste stream audit showed a distinct upward trend in hazardous waste generation at the University. In addition, disposal costs were rising twice as fast as generation and more than five times as fast as research revenue. From this meeting and the insight provided by the report, we realized that hazardous waste generation at U-M was a pressing problem presenting an opportunity for pollution prevention.

August 17, 1992: Introduction to Tracking Systems

A second meeting with Schatzle and Baier was held to introduce them to our Project advisor, Professor Bulkley, and to discuss possible opportunities for carrying out a demonstration project that would focus on reducing hazardous waste at U-M. Both Schatzle and Baier were amenable to using OSEH for our demonstration project, but desired a better understanding of what our intentions were and what the project would entail. When asked what would be the one best way of reducing hazardous waste at U-M, Baier replied, "a way to track chemicals." This was our first introduction to CTSs.

At the same meeting, Bulkley mentioned that a member of the National Pollution Prevention Center (NPPC) External Advisory Committee—Joseph Morabito, Director of AT&T Bell Laboratories' Environmental Health and Safety Center—was involved in developing tracking systems. Because PolPrev was to present an overview of our Project and audit at the September Advisory Committee meeting, we decided that this would also be an opportune time to meet with Morabito to acquire a better working knowledge of chemical tracking systems.

September 2, 1992: NPPC External Advisory Committee Meeting

PolPrev members presented an overview of our Master's Project, including the findings from our audit and our desire to develop demonstration projects that would address problematic waste streams. Based on the audit findings, which indicated problems in the University's management of hazardous chemicals, and our interest in hazardous waste issues, Morabito encouraged us to look into Bell Lab's chemical tracking system as a means for reducing hazardous waste at U-M. He felt that although Bell Lab's system had been designed for use in industries, it could easily be adapted to meet a university's needs. At this point, however, PolPrev had not yet decided on demonstration projects and the waste streams that would be targeted. Thus, the idea of implementing a CTS at the University was viewed as only one of many possible pollution prevention interventions that could be pursued.

September 11, 1992: Demonstration Project Chosen

At the beginning of fall 1992, PolPrev evaluated the audit information that had been collected over the summer. As explained at the end of Chapter Two, PolPrev members carefully considered and then decided upon two complementary demonstration projects, one at the Business School and the other

focusing on hazardous waste reduction. Members interested in the latter met to discuss their ideas and suggestions for an intervention project.

September 17, 1992: OSEH Confirms Commitment to Our Project

Baier met with PolPrev's Chemical Tracking group to confirm OSEH's commitment to working with us on our demonstration project. As OSEH's Hazardous Waste Coordinator, Baier was very knowledgeable about practices at the University and helped guide our project in its early stages.

Initially, our group considered establishing a chemical exchange program. However, Baier felt chemical tracking would be a more viable and useful intervention. In an attempt to guide us in our project while ensuring OSEH's needs were met, Baier suggested that we:

- research and interpret Superfund Amendment and Reauthorization Act (SARA) Title III regulations and clarify which rules universities must comply with.
- research information on chemical tracking systems.
- contact the U.S. government and encourage the creation of a national MSDS (Material Safety Data Sheet) database.

Also during this meeting, Baier helped us to gain a better understanding of the nature and function of tracking systems by outlining what a CTS looks like. Overall, this meeting helped our group to establish a working relationship with OSEH and focus the beginning of our project.

October 6, 1992: Clarification of Questions

After reviewing several articles on CTSs and discussing the development of a chemical tracking project at U-M, we found that there were a number of general questions to clarify to ensure that we were focusing our energies in the proper direction. Once again, we decided to meet with Baier whom we hoped could address our questions. Prior to the meeting, our group prepared a list of questions for him (see Appendix XI). Some of the more important questions included:

- How can we get information on U-M's chemical purchasing practices?
- How do we obtain information on the number of individual labs using hazardous materials?

- What steps are necessary to implement a tracking system at U-M?
- What steps are needed to get support from the University community?
- What areas of resistance will we run into?
- Would it be helpful to focus on the Chemistry Department as a model for the chemical tracking and exchange program?

From this session with Baier, we gained new insights into how the University manages hazardous chemicals. A key piece of information was that maintaining a chemical inventory is left up to the discretion of each individual department. Whether a department chooses to inventory its chemicals (e.g., location, amount left in the container, date purchased) is completely voluntary.

Baier suggested the following as steps which needed to be taken prior to implementing a CTS at the University:

- Develop organizational charts for OSEH, the Chemistry Department, and University Purchasing and Stores to ascertain the key contact people in each of these departments.
- Create a flowchart of how the CTS will work at U-M.
- Bring staff and faculty together from different departments to help plan the tracking system to give them a sense of ownership over the system.
- Write a proposal or strong argument for the reasons why a CTS should be implemented at U-M.

Baier agreed that it would be helpful to focus on the Chemistry Department as a model for the chemical tracking program. Subsequently, our group began contacting chemistry professors to determine how the Department managed its hazardous chemicals and whether faculty would be receptive to using a chemical tracking and exchange program.

October 9, 1992: First Contact With the Chemistry Department

Our group met with Henry Griffin, Professor and Associate Chair, Department of Chemistry, to discuss the possibility of using the Department as a model for our demonstration project. Griffin expressed an interest in working with us and mentioned that implementing a CTS within the Department had been a goal of his for over a year.

This meeting gave our group a better idea of the different needs a tracking system would have to meet. On the one hand, OSEH wanted a system that would help the University achieve better regulatory compliance and that could generate SARA reports for the EPA. The Chemistry Department, on the other hand, needed a system that would track chemicals from the time they were received at the loading dock and "read into" the system by a bar-code reader, until the time they were disposed of and "read out" of the system. In other words, the system should allow the Department to maintain a comprehensive chemical inventory of all the hazardous chemicals in the Chemistry building. Furthermore, the system needed to be flexible enough to be integrated into the Purchasing Department's database.

Griffin stressed improved efficiency and safety as the major reasons for implementing a CTS. Waste reduction was not his primary focus, but he seemed to think that a CTS would help achieve this.

Overall, he envisioned our group piloting a tracking system in the Chemistry Department that would be both accessible to OSEH and interfaced with the Purchasing Department. This pilot project would then serve as a model for the rest of the University.

At the close of our meeting, he pointed out that we would need to convince key University administrators to fund this project. For this to happen, we would need to write a proposal describing the need for a CTS at U-M and how it would benefit the University. Our group agreed to follow up on these suggestions. However, we continued to struggle with the following questions: How will the tracking system fit into the Department's current system for ordering, receiving, controlling and disposing of hazardous materials? How can the system be adapted for use in a decentralized university?

October 14, 1992: Interviews With Chemistry Faculty and Staff

To learn how the Chemistry Department orders, manages, and disposes of its hazardous waste, our group interviewed research professors, the stockroom manager, and the building manager. During our interviews, it became evident that the Chemistry Department has no way of verifying what happens to the hazardous chemicals once they are received at the loading dock—it only records that the chemicals were received. After the individual researchers pick up their chemical orders, what happens to the chemicals is often unknown. This could pose any number of safety and fire hazards. For instance,

if a fire were to start in a Chemistry lab, the Ann Arbor Fire Department would have no way of determining what chemicals were in that lab and whether firefighters should enter such a potentially dangerous environment. Based on our research into chemical tracking systems, we believed such hazards could be prevented by implementing a tracking system.

October 22, 1992: Chemistry Department Committed to a CTS

After interviewing Chemistry faculty and lab managers, our group was put into contact with Richard Giszczak, the Department's Lab Safety Officer. At this meeting, we learned of Giszczak's involvement in the Department's plan to install a CTS. He had requested information from several companies that develop CTS programs. However, due to his other job responsibilities, he did not have the time to follow up on these contacts. He shared with us what information he knew about tracking systems and provided suggestions for how best to carry out our project.

Like our contact people in OSEH, Giszczak also felt we should put together some sort of design committee, comprised of people from several different departments, who could provide feedback on the CTS's design. In addition, he encouraged us to write a proposal to the University, requesting funds for the installation of a tracking system in the Chemistry Department. His commitment to having a CTS in place in the near future further indicated the Department's commitment to our project.

Also in this meeting, Giszczak spent time detailing how the Chemistry Department orders and manages its chemicals, and how a CTS would help make this process more efficient. Lastly, he suggested that we might want to consider attending an upcoming CTS presentation by Chemtox, a company that develops CTS software, which was to take place in Dearborn, Michigan the following week. We agreed that the presentation would be a good opportunity to research chemical tracking systems and decided to send two members of our group to the presentation.

October 28, 1992: Planning a Focus Group

As we increasingly realized the need to involve a variety of personnel in our project who were from a number of different departments, we decided to talk with Raymond DeYoung, an assistant professor in the School of Natural Resources and Environment (SNRE) who is knowledgeable about behavior change and community participation issues. DeYoung agreed that our project

would stand a better chance of being successful if it were to establish cross-campus links and were to invite people from different departments to participate in the CTS planning process. He suggested forming an administrative focus group, which would participate in a series of meetings to discuss their interest in and vision for a chemical tracking system at U-M. He also suggested establishing connections through letters and computer conferences if meetings were too difficult to coordinate.

November 9, 1992: Bell Labs Presentation

After speaking with the Bell Labs representative and conducting further research into chemical tracking systems, our group decided to schedule a presentation of Bell Lab's tracking system. As suggested by Baier, Giszczak, and DeYoung, we decided to bring together a focus group—composed of administrators, managers, faculty, staff, and students from different U-M departments —to discuss the benefits and feasibility of implementing a CTS at U-M. The following departments were represented: Chemistry, OSEH, Risk Management, Purchasing and Stores, SNRE, Civil and Environmental Engineering, and the Office of the Vice-President for Research.

Prior to the close of the presentation, we expressed an interest in forming a second focus group, which would meet before the end of the semester, to continue the discussion and assessment of the University's need for a tracking system. We passed around a sign-up sheet for people who wanted to participate in this ongoing work group. Those who signed their names—representatives from Chemistry and OSEH—became integrally involved in our project. With us, they formed the core working group that laid the foundation for the installation of a CTS at U-M.

December 8, 1992: Preparation for Chemtox Presentation

After members of our group had attended the CTS presentation by Chemtox earlier in the fall, we decided to ask the people who had attended the Bell Lab's presentation to also assess Chemtox's software package. Originally, we intended to invite the entire focus group back for this and other software review meetings, but Baier advised us that this process might be too tedious and time-consuming to keep the interest of the entire focus group. Consequently, we decided to just have the smaller working group attend the CTS reviews. We would send memos to the larger group to keep them informed or our project.

December 8–14, 1992: University Interviews

To assess how well adapted the Chemtox system was to a university setting, our group decided to interview staff at other universities who were currently using Chemtox's software. We prepared a questionnaire containing general questions about chemical tracking and exchange at the universities, as well as specific questions about Chemtox's tracking system (see Appendix XII). We contacted people at the University of Illinois (Chicago), West Virginia University, and Boston University. The interviews were very helpful in our assessment of the Chemtox system.

At the time, we hoped to conduct similar interviews with universities using other software programs, but discovered that we were essentially pioneers in this field. Only a handful of universities—those listed above plus Columbia University and Antioch College—were using these programs. However, of those universities, most were using the systems for report generation purposes, not to track chemicals.

December 14, 1992: Chemtox Presentation

As mentioned above, the Chemical Tracking group invited members of the core working group to attend this presentation. Due to scheduling difficulties with the representative of Chemtox, the presentation had to be electronically transmitted via a modem and speaker phone. To keep the attendees of the Bell Labs presentation informed of our group's progress, we documented the Chemtox Presentation and sent them memos.

Also at this meeting, we presented the working group with the first draft of our chemical tracking proposal. We asked each of the members to review the proposal and give us their comments and suggestions for revisions.

January 1, 1993: Stanford University Hit With Fines

Stanford University, cited for 28 violations in its hazardous materials (hazmat) program, was assessed a fine of $186,000 for infractions encountered in 1988-89. The newest infractions could result in penalties of up to $25,000 per violation per day. Our group hoped that the violations cited at Stanford would serve as an impetus for U-M to reassess its own hazmat program and take necessary actions to ensure compliance with federal and state regulations. The news article citing the violations lent credibility to our project by pointing out the need for improved chemical tracking systems on college campuses. This is especially important at large research universities like U-M.

January 12, 1993: Survey of the Chemistry Department

The Chemical Tracking group decided to conduct a survey in the Chemistry Department to obtain information on the amount of chemicals the Department purchases in a year. Giszczak organized the effort. Estimating the amount of chemicals purchased was no easy task for the Chemistry Department. Staff had to go back and manually total all the individual accounts (approximately 150) within Chemistry for the 12-month time period between September 1, 1991 and August 31, 1992—a process that took an estimated four full working days, further illustrating the need for a CTS at the school.

February, 1993: Computer Purchased

In early February, Giszczak informed our group that the Chemistry Department would be purchasing a computer for the purpose of using it as a CTS database. On one hand, our group was excited—Chemistry's decision to buy the hardware for the system re-emphasized their commitment to establishing a CTS for itself. On the other hand, we were concerned that the Chemistry Department would go their own way and, in effect, dismantle the groundwork we had laid to make this a cooperative project between OSEH and Chemistry. To expand and integrate the tracking system throughout the University, we felt it crucial that the project remain a cooperative effort between the two departments. To date, this continues to be a challenge for us.

February 18, 1993: Chemguard Presentation

Again, we limited the audience to members of the working group—primarily OSEH and Chemistry personnel. We documented the presentation and sent memos to members of the larger focus group. By this point, our working group had reviewed a total of three CTS software programs. While members of the working group were impressed with the design of two of the chemical tracking systems (Bell Labs and Chemguard), they still felt that we should at least review one or two other systems before choosing one for the University. Thus, we continued to research other available CTS programs.

March 3, 1993: LogiTrac Presentation

We concluded our review of different tracking systems by bringing in another company, Logical Technologies Inc., to give a presentation of their system—LogiTrac. While LogiTrac appeared comprehensive and adaptable to a university setting, the working group did not feel that it was as developed or easy to use as the Chemguard and Bell Labs systems.

After the meeting, the Chemical Tracking group met to debrief and to decide what our next step should be. With the semester drawing to a close, the group felt a need to bring the working group together one final time. We needed to assess the different chemical tracking systems we had reviewed and choose one that would meet OSEH's and Chemistry's needs, as well as one that could easily be expanded throughout the rest of the campus.

March 26, 1993: Proposal Submitted

In an effort to complete our demonstration project, we finalized the CTS proposal and sent it to key U-M administrators who would ultimately make the decision of whether or not to grant the funds for a CTS at U-M.

Our group also created a decision matrix (see below), to help members of the working group better assess the different tracking systems we had reviewed. Members were asked to rank the chemical tracking systems according to the systems' abilities to meet the criteria listed on the matrix (1 = poor, 5 = excellent). After ranking the CTSs, members were to mail us their responses so we could compile the data and coordinate a meeting to discuss the results.

Decision Matrix

Criteria	Bell Labs	Chemtox	Chemguard	LogiTrac
ability to track from purchase to disposal				
chemical inventory by building and room				
integrative with purchasing department				
ability to use barcode technology for data entry				
report generation capabilities				
accessible MSDS information				
user friendly				
cost				
reliability				
maintenance				
product support				
fully developed system				
licensing possible				

April 25, 1993: Meeting With U-M Administration

To ensure that our demonstration project's momentum would continue after we graduated, the Chemical Tracking group met with Vice-President for Research, Sarah Newman, to strategize ways to maintain support for the system and expand it throughout the University. She offered helpful suggestions and, most importantly, her support to continue working on this project.

Currently, we are investigating potential sources of funding for the system and are trying to establish it as a faculty sponsored research project.

For a discussion of how the project progressed during May–December, 1993, please refer to the end of this section, page 75.

Chemical Tracking Proposal

The implementation of a chemical tracking system at a university requires not only the support of the people who will be directly involved, but also financial support. To acquire the funding necessary to implement a CTS at the University of Michigan, the Chemical Tracking group drafted the following proposal, describing the function of a chemical tracking system and how such a system could benefit U-M. We sent this to key University managers and administrators, including the Associate Vice President for Business Operations, the Academic Affairs Provost and Vice President, and the Associate Vice President for Research.

Proposal for the Installation of a Chemical Tracking System at the University of Michigan

Executive Summary

The level and quality of research at the University of Michigan is among the finest anywhere, yet the increasing amount of hazardous waste generation associated with this research, the rising cost of its disposal and the safety hazards associated with the use and the storage of toxic chemicals are creating a situation which must be addressed.

The purpose of this proposal is to inform key people at the University about the value of installing a chemical tracking system at the University in order to gain their support. This document demonstrates how this project fulfills a necessary role in chemical management at the University and achieves quality management in an area with great potential for improvement at most universities in the United States. The University of Michigan has the opportunity to lead the nation's top research universities on the path toward improving regulatory compliance, safety, cost savings and waste minimization through accurate chemical management.

Problem Statement

Regulatory Compliance

Complying with federal, state and local hazardous material statutes may once have been optional, but with the passage of the Resource Conservation and Recovery Act (RCRA), Superfund Amendments and Reauthorization Act (SARA) Title III, and Occupational Safety and Health Act (OSHA) Right-To-Know laws, it is now a financial and legal necessity. Every year, the number of regulations governing the use of hazardous materials increases. As this happens, the cost of complying with those regulations also increases. Violations are leading to stiffening civil and criminal penalties.

Just this year, the California Environmental Protection Agency (CEPA) cited Stanford University's hazmat program for 28 violations including: containers that were badly rusted and ready to deteriorate, containers without labels, and incompatibles stored together. As a result of these violations, Stanford was assessed a fine of $186,000 for violations encountered in 1988–89 and was fined another $25,000 per day for the newest infractions.

The violations cited at Stanford University should serve as an impetus for Universities everywhere to reassess their hazmat programs and to take necessary actions to ensure compliance with federal and state regulations. Lack of compliance with these hazardous waste laws could result in fines of substantial magnitude.

Increasing Costs

A university that utilizes hazardous chemicals in teaching or research faces more than just the potential financial penalties associated with regulatory non-compliance. If a university lacks a comprehensive inventory control system, other costs likely to be incurred include:

- increased disposal costs.
- increased and often unnecessary chemical purchases.
- increased time and labor spent filing and updating records.

A recent waste stream audit conducted here at the University of Michigan revealed a distinct upward trend in hazardous waste generation (Hacala, J., *Strategies for Hazardous Waste Reduction at the University of Michigan,* 1992). The results of the report showed waste disposal costs are rising more than twice as fast as generation and more than five times the rate of increase in research revenue. Reasons for disposal included spent product of reaction, unknown age, and suspected contamination. Such reasons for disposal can be mitigated with improved inventory control. Thus, there is a need for tighter inventory control to achieve a more efficient purchasing strategy—knowledge of chemicals purchased or chemicals already in stock would be available.

Finally, the current University system for filing and updating chemical records is inefficient, labor intensive, and unnecessarily expensive. A chemical tracking system will greatly improve present conditions.

Safety

Presently, there is no system in place at this University to record and update the location of hazardous chemicals stored and used in laboratories. As a result, many chemicals are kept past their shelf life, presenting potential fire and safety hazards. The presence of unknown chemicals in laboratories

poses further hazards as in the case of fires, spills, or other emergencies. The University needs to address these safety concerns and implement a program capable of producing a hazard summary of chemicals in specific locations to facilitate emergency response.

Furthermore, Material Safety Data Sheets (MSDS)—documents containing vital health, fire, and exposure hazard information, as well as exposure treatment and chemical disposal procedures—are only useful when the people who need them, have them. MSDSs should be accessible to every employee 24 hours a day, 365 days a year. The University of Michigan would benefit greatly and serve as a role model of safety to other universities by installing a program that would make such accessibility a reality.

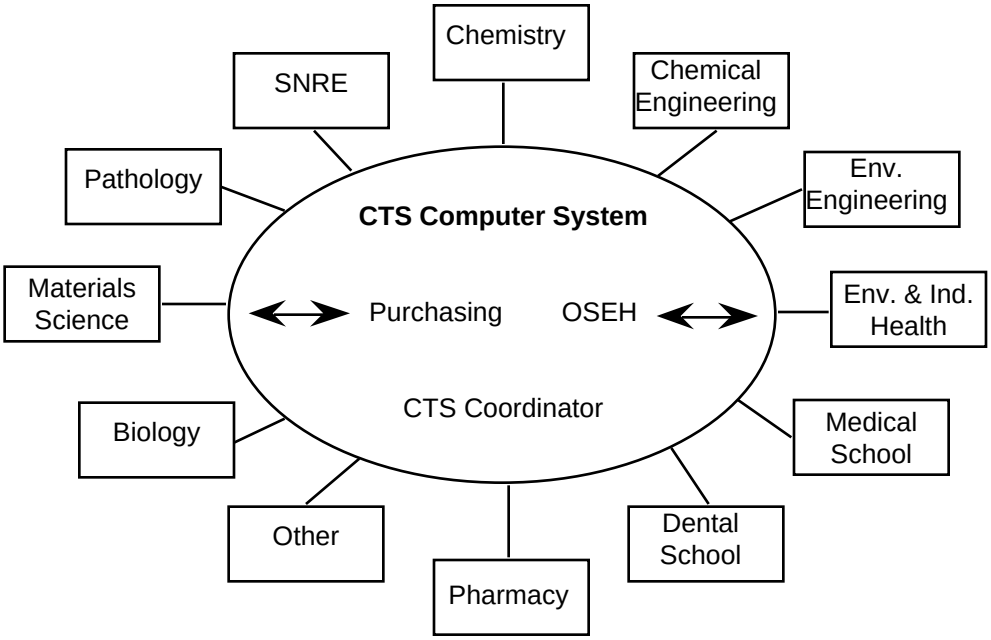
Waste Generation

The waste stream audit conducted at the University showed that 214,389 pounds of hazardous waste were generated in fiscal year 1990-1991. This represents a 29% increase over the 1989-1990 baseline of 165,864 pounds. The 1991-1992 totals were projected to be up 38% over that baseline. Findings also showed that the Chemistry Department ships more hazardous waste than any other department within the University. A successful chemical exchange program could help curb the upward trend in hazardous waste generation and significantly decrease disposal costs as well.

Action Plan

Since September 1992, the Pollution Prevention Masters Project has been working with the office of Occupational Safety and Environmental Health (OSEH) and the Chemistry Department in evaluating chemical tracking systems for implementation at the University. In March 1993, a pilot project in the Chemistry Department will test a CTS to determine its effects. Once the CTS is established in the Chemistry Department, expansion of the system to the remainder of the University could easily be achieved. OSEH would play a primary role in the expanded system. A CTS coordinator position should be created to oversee functional operations of the University-wide CTS. (See Figure 1.)

Figure 1: A Conceptual Model of a Fully Integrated CTS



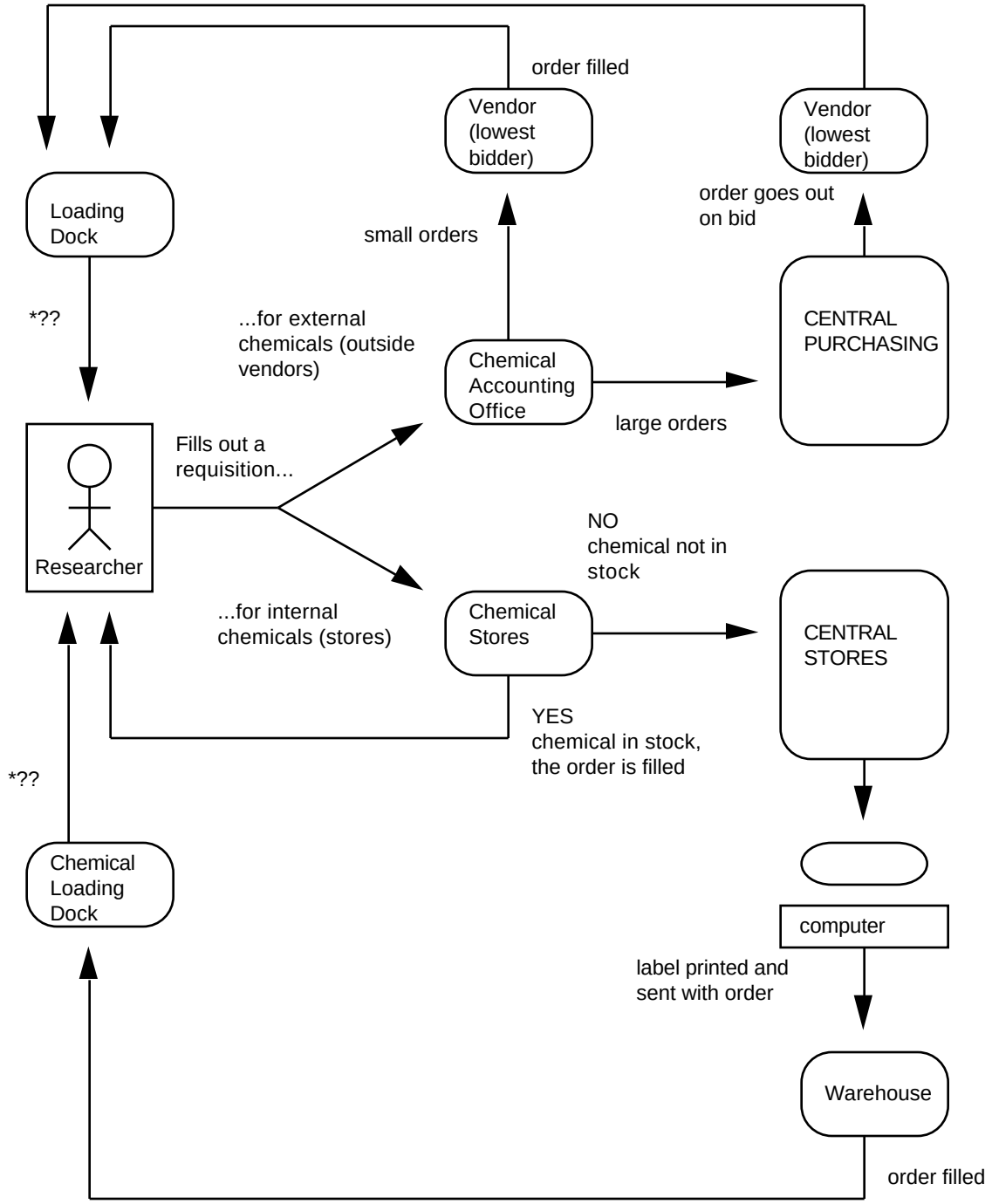
Description of a CTS

A chemical tracking system is a computer database that contains information on the handling, storage and disposal procedures necessary to safely deal with chemicals present at an institution. A computer database combined with bar-code technology provides the means to track the use of chemicals for safe and efficient management. At the University of Michigan, a quality CTS would:

- Use bar-code technology to track chemicals from the time they are received and "read into" the system until the time they are disposed of and "read out" of the system.
- Provide the means for integrating and updating the current systems for chemical ordering, control and disposal.
- Provide Material Safety Data Sheets (MSDSs) for each chemical present at the institution. (This would also be a part of the CTS database which fulfills legal requirements of the University.)

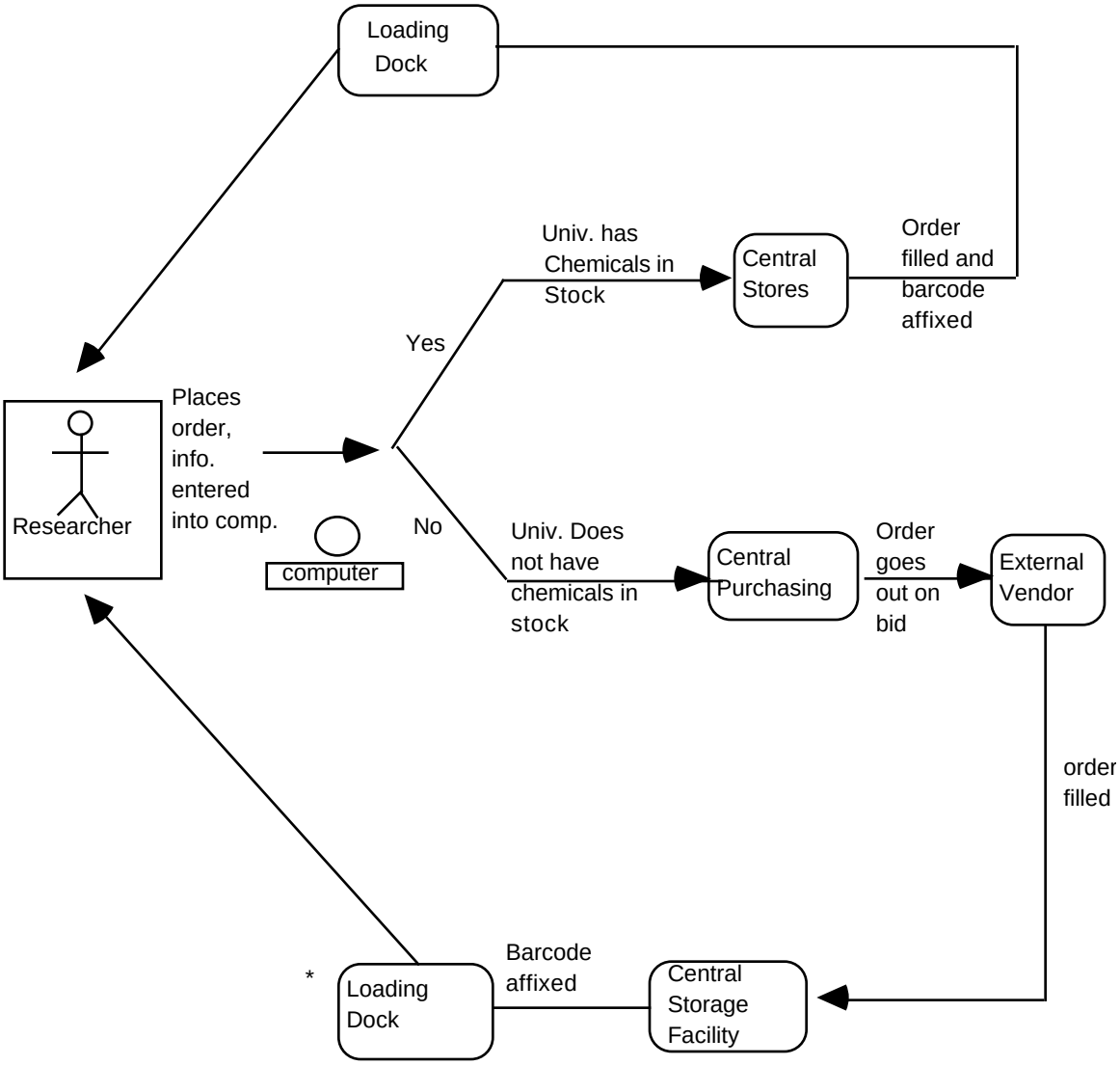
A brief look at the Chemistry Department's current system for ordering and distributing chemicals and how this would be changed using the CTS is provided in figures 2 and 3 on the next two pages.

Figure 2: Chemical Department's Current System for Ordering and Distributing Chemicals



* Currently there is no check and balance system to ensure that chemicals delivered to the loading dock are received by the appropriate researcher.

Figure 3: University-Wide Chemical Ordering System
With Chemical Tracking System Installed



* If there is no central storage facility for the chemicals, a barcode label would be affixed to the container at the loading dock or the receiving area of that department.

Criteria to evaluate existing CTS software include the following:

- can track chemicals from purchase to disposal
- can record and update the location of chemicals by building and room
- can be interfaced with Purchasing Department's database
- utilizes barcode technology for data entry
- offers report generation capabilities
- provides easy access to MSDS information
- is user friendly
- is affordable
- is reliable and easy to maintain
- CTS company offers ongoing product support

Conclusions: Potential Impacts of CTS

The increase in hazardous waste regulations combined with skyrocketing disposal costs poses a disturbing trend and could lead to future financial and legal concerns for the University. Use of a CTS would help provide the framework necessary to fulfill the following goals:

Regulatory Compliance

- reduce potential for ever-increasing fines
- increase accuracy in fulfilling state and federal reporting requirements
- provide easier accessibility to Right-To-Know information

Cost Savings

- decrease disposal costs
- reduce unnecessary purchases through improved inventory control
- reduce time and labor spent filing and updating chemical records

Safety

- location, quantity, and type of hazardous chemicals is known rather than estimated
- MSDS database is easily accessed

Waste Minimization

- upward trend in hazardous waste generation can be curbed via chemical exchange opportunities
- inefficiencies that lead to unnecessary waste can be accurately tracked
- unnecessary chemical purchases can be reduced through tighter inventory control

Conclusions

One of the most significant characteristics of the Chemical Tracking project was the way in which our group's goals changed and evolved throughout the project. Initially, we wanted to implement a pollution prevention strategy that would lead directly to the reduction of hazardous wastes at U-M. Our goal was to work toward establishing a chemical tracking system with the intent that it would lead to a University wide chemical exchange program. However, while OSEH and Chemistry were interested in the development of a chemical tracking system, they were not as interested in the use of this system for a chemical exchange program. This caused our group to re-evaluate the focus of our project. We wanted to work on a project that would lead directly to hazardous waste reduction. We also wanted to act as facilitators for this project—not directors pushing our own agenda.

After reflecting upon the situation and upon Chemistry's and OSEH's needs, we decided to place all of our energies into the establishment of a chemical tracking system at the University. We realized that implementing a tracking system would actually help to lay the groundwork necessary for an effective chemical exchange program to take place. Further, our group felt that the baseline data that would be generated from a CTS would help to paint a clearer picture of chemical usage and disposal practices at the University.

The evolution of this demonstration project reflected both the challenge of addressing individual and departmental needs at a university and the difficulty of implementing a significant pollution prevention intervention within a short time-frame.

Recommendations

Future Leadership. To ensure that our efforts at establishing a chemical tracking system continue after our project ends, new leadership must be formed. We recommend the following as potential strategies for coordinating this leadership: working with the Chemistry Department to establish a Research Assistant position to oversee the initial implementation and operation of the CTS; encouraging OSEH to fund an internship through the Office of Waste Reduction Services to help with the implementation of the tracking system and its subsequent expansion throughout the University; educating faculty within the School of Natural Resources and Environment about our Project so that they can promote it to incoming students who would be looking for Master's Projects to take on; and finally, investigating opportunities for developing it into a faculty sponsored research project.

Expanding the System. Another issue which remains to be addressed is how to expand the tracking system throughout the University. Originally, the Chemistry Department was chosen to pilot the program because it is one of the largest consumers of hazardous chemicals at U-M and since its administration had been interested in implementing a tracking system for over a year. However, many other departments across the campus also use hazardous chemicals, and are confronting similar problems in their hazmat programs: regulatory compliance, safety, cost of disposal, and waste generation.

To ensure that these problems get addressed, the CTS must be expanded throughout the University to service departments other than Chemistry and OSEH. This will require an ongoing effort to forge and maintain cross campus links between departments. These links are important for bringing people together to discuss individual and departmental needs concerning the design of the CTS and for tapping into existing resources and support systems at the University.

Chemical Exchange. Unused chemicals can constitute as much as 40% of the hazardous waste generated from laboratories (RCRA, 1985). Because surplus chemicals place increased demands, in terms of expense, time, and workforce, on waste removal, these chemicals should be exchanged rather than left as waste. Through a surplus chemical exchange program, the materials would

become part of the inventory of the entire chemical management system. Once the chemical tracking system is firmly established at U-M, a conscious and strategic effort should be made to use the system for such chemical exchange purposes. The CTS will provide the University with a centralized database containing information on the quantity and type of surplus chemicals available to chemical users. A well designed exchange system could lead to an effective hazardous waste reduction program.

Follow-up: May–December 1993

Over the past six months, under the capable guidance of Vice President for Research Sarah Newman, the system has been expanded from simply a CTS for Chemistry to a university-wide CTS. Newman was impressed with the fact that the original CTS group was formed with grassroots support from members of the university community, and that the committee had not simply been administratively appointed. Thus, she took the project on wholeheartedly.

In May, the CTS group decided to make the CTS university-wide rather than simply a Chemistry Department experiment which would then be expanded to other departments. The group realized that if the Chemistry Department built the CTS for their needs, only they would have input into the definition of the data fields, and set up the system. Since the University is very decentralized administratively, perhaps the system would be incompatible for other department and therefore, would never be expanded university-wide. Because of this, the final decision on which software package to buy was postponed and CTS group was expanded.

The current CTS group includes members from OSEH, the Vice President for Research's Office, both the basic and clinical Medical Schools, the College of Engineering, the Department of Chemistry, the School of Natural Resources & Environment, and the College of Pharmacy. These people have developed the preliminary plan to test a university-wide chemical tracking system through data modeling sessions.

The Information Technology Division on campus will hold three half-day sessions to brainstorm and refine the elements of the plan which would be necessary for an effective CTS at the University of Michigan. This refined view of the CTS will then be written up in another proposal to the Office of the Vice President for Research and the Office of Business and Finance. These

two offices have been receiving verbal updates on the project and they seem to be supportive at this time. The Director of University Purchasing is very interested in the project as well.

The planning should be finished by the end of the April 1994; then the group plans to have several test sites around campus. According to Newman, "there is NO chance that this is NOT going to happen."

It is Newman's understanding that only one other university, the University of Washington, has a CTS in place. Therefore, this CTS will be the only other major chemical tracking system at a large research institution in the nation.

As you can see, the Chemical Tracking System is moving forward—full speed ahead.

References

Hacala, Jeff (1992) Strategies for Hazardous Waste Reduction at the University of Michigan. Unpublished.