A MANAGEMENT SYSTEM FOR OCCUPATIONAL SAFETY AND HEALTH PROGRAMS FOR ACADEMIC RESEARCH LABORATORIES

An Administrative Resource Guide

Sandra L. Smith
Gretchen L. Schultze
Blair H. Curry
Kirschner and Associates, Inc.
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NIOSH Project Officer: Jerry Newman
Principal Investigator: Sandra Smith

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CONTENTS

CONTENTS

EXHIBITS

EXHIBITS

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INTRODUCTION

UNIVERSITY MANAGEMENT IS UNIQUE

This report addresses the special problems associated with introducing a management systems approach to occupational safety and health programs which relate to university research environments. Much of the written material about the management of safety and health programs is based on industrial environments. Frequently, this writing is not easily applicable to a non-profit or university environment. Factors which have a particular bearing on university occupational safety and health programs include:*

- Professionals, rather than managers, dominate the university environment. The close-knit organizational hierarchy with its clear lines of authority, with which industry is familiar, is particularly ill-adapted to describing relationships among university researchers, administrators, safety and health program managers, and funding agency representatives.

- The autonomy of university researchers is generally greater than their counterparts in industrial laboratories. University researchers may be more free to engage in basic, as opposed to applied, research.

- University researchers use a wide variety of chemical agents in small amounts and with low frequency, which makes control and monitoring of hazardous agents more difficult than in, for example, a testing laboratory or a manufacturing plant.

- Universities have multiple and conflicting objectives. This is also true of profit-making organizations, but profit is the dominant objective. This makes it easier to obtain congruence on priorities.

*Robert Anthony and Regina Herzlinger, Management Control in Non-Profit Organizations, Homewood, Illinois, Richard D. Irwin, Inc., 1975, pp. 34-58.

- Performance may be difficult to measure. The quality of a university is measured across several dimensions. Historically, university administrators have had less experience than corporate managers with management systems based on quantitative measurements of performance.

This report acknowledges these complexities and constraints in the university environment in presenting a general model for a management system for occupational safety and health programs for research. It is difficult to suggest a specific model management system appropriate for all universities because universities differ so much. Variations in size, geographic dispersion, organization, private versus public support, and academic programs are obvious factors influencing the way universities are operated and managed. Other differences may be more subtle and yet more significant in terms of the applicability of any single management approach for monitoring and controlling research hazards. The number and variety of externally funded research projects, the organization and staffing of these projects, and the degree of sophistication and hazardous nature of the projects are factors which influence directly the scope and complexity of the occupational safety and health program. Indirectly, the management of the program and the use of controls and systems is very much dependent upon the existing management infrastructure of the university. Two aspects of the infrastructure are particularly critical:

- The organization of management/administrative functions of the university, particularly those functions which relate most directly to the safety and health program, i.e., budget and financial management, research administration, risk management and insurance; and

- The data handling and record-keeping capabilities of the university, particularly in the areas of financial management, research administration, personnel, and health services.

Particularly as a result of differences in these two areas -- specific differences in procedure and approach as well as broad differences in capacity and sophistication -- it is impossible to produce one set of documents or standards which can be applied to all universities. Therefore, this report will provide a general approach or orientation to the systematic management of occupational safety and health programs.

The University Should Tailor This General Approach

The development of a management system requires structuring data and information to help managers and administrators make decisions. This report considers the managerial function as an on-going cycle of planning, operating, and evaluating. In order to select and develop appropriate informational and control tools, the needs of the program manager and university administrators during each phase of decision-making must be investigated. The involved positions would include, in addition to the safety and health program manager:

- The vice president (or similar title) to whom the safety and health program manager reports;
- The vice president (or similar title) in charge of research administration;
- The risk manager or insurance manager;
- The vice president for business management;
- A budgeting staff member; and
- A data processing staff member.

If the management system is to address adequately the needs of those individuals, they should be represented during the systems design process. Several methods are available to obtain their involvement. The pertinent decisionmakers can be surveyed; they can belong to a task force, thereby actually participating in the design process; or they can be asked to review and comment at various stages of the process.

BACKGROUND OF THIS REPORT

In developing a management system approach, a number of universities, private corporations and institutions, and government agencies were contacted regarding their management procedures in the area of occupational safety and health in research environments. On-site field visits were made to some institutions; others were contacted by telephone. The information provided by these institutions was supplemented by a review of literature discussing pertinent program management concepts. Sometimes this literature was directed specifically at the management of safety and health programs; in other cases, information was drawn from general management sources.

Throughout the information gathering and review process, the safety and health management system design process was approached from a managerial rather than a technical perspective. This document, therefore, is less concerned with technical interventions to control hazards than with management interventions to assure that the proper technical activities are, in fact, taking place.

APPLICATION OF A SYSTEMS APPROACH

In presenting a general approach to systems management for occupational safety and health, this document attempts to give broad coverage to the full spectrum of safety and health activities which might arise in a university research environment. All universities do not have such broad occupational safety and health programs, however, due to the nature of their research activities. Moreover, it is unwise to attempt to monitor, measure, and control every aspect of the occupational safety and health program; for the program management function can become overwhelmed with data. Management systems should be introduced selectively. An incremental approach allows the program management and university administrative staff time to modify the system and adapt to it as well. Incrementalism provides another benefit, too. By slowing the pace, it helps to prevent management systems-oriented individuals from losing sight of the ultimate objective of the program and its systems: preserving the health and safety of individuals who are directly, indirectly, or even accidentally exposed to the research environment.

In tailoring a management system for an occupational safety and health program at a university, the ultimate purpose of the program and the role of researchers at a university should be kept in mind. Some points to bear in mind are listed below.

(1) Recognize the Delicate Balance Between Reasonable Protection and Interference

Researchers are aware that certain activities are necessary because of legal requirements imposed by federal, state, or local agencies or by funding agency guidelines. They generally will be willing to comply with procedures that are visibly important for the protection of their technicians', their graduate students', or their own health. Researchers will not be likely to cooperate, however, if activities which do not seem to have any bearing on the safety of their research are forced upon them without explanation. Researchers are likely to feel that academic freedom is being restricted when research activities are affected by program requirements they perceive as unnecessary. For this reason, petty interferences should be avoided and any requirements that are imposed should be clearly explained and significant. The program, after all, exists to serve the people.

(2) Strive for the Easiest, Least Bureaucratic Approach

A number of ideas are presented in this report with the hope that university administrators will use the most efficient control mechanisms for their situations. Sometimes formal controls are required to assure that important activities are performed properly, but at other times less bureaucratic approaches may serve the same purpose.

(3) Recognize the Researcher's Unique Role in the University

Anthony and Herzlinger summed up the dilemma of management control of university researchers:

> Some university professors have direct access to external funding sources for research projects. They may operate therefore quite independently of the university, and in a way that is not consistent with top management's plans for the university as a whole; under these circumstances, management control is difficult.*

The program management job will not be easier but it may be more effective if administrators take into consideration researchers' autonomy when developing the control system.

The nature of university research work also must be considered in a management system. University research work, unlike other types of work that come under the scrutiny of the general safety and health program, is highly non-routine; the problems which arise in the research laboratory, thus, are also non-routine. In addition, the researcher may be the only person or one of very few people doing a specific type of work. The researcher may feel that this work is so crucial, in a social or scientific context, that certain levels of risk are acceptable and worthwhile, for example, in the analysis of a highly infectious agent or development of a new technique.

*Anthony and Herzlinger, op. cit., p. 285.

(4) Utilize Researchers' Expertise When Possible

The researcher may be better informed about the hazards associated with his own research than anyone else in the university. The program manager should utilize this knowledge for two reasons. First, the researcher himself may be the most effective identifier of hazards. Second, the researcher is more likely to participate in program activities that he himself recognizes as necessary. There are several ways of utilizing the researcher's scientific expertise. Safety and health committees that have approval over grant proposals or over research activities (e.g., Radiation Safety Committee, Biohazard Safety Committee) are one type of self-regulatory activity in which the researcher should be included. Another method is to have researchers participate, as "clients" or "customers," in evaluating occupational safety and health program performance. Finally, the safety and health program manager can work with a network of researchers in different scientific disciplines; as research safety and health coordinators, they can act as communication linkages with the program.

WHY SHOULD UNIVERSITY ADMINISTRATORS BE CONCERNED WITH A MANAGEMENT SYSTEM OF THIS KIND?

SOME RESEARCH HAZARDS MUST BE CONTROLLED

Many university administrators are motivated by ethical considerations to establish rules and procedures that assure occupational health and safety. Certainly humanitarian concern should prompt administrators to safeguard the health and safety of university personnel. However, legal constraints on the administrator require him to establish certain practices even though he might prefer not to. Federal, state, and local legislation requires that certain research hazards be controlled whether or not the administrator himself sees the necessity for such controls.

Government Agencies Impose Requirements and Standards

First, numerous federal agencies regulate various aspects of university research programs. Researchers working with certain types of radioactive materials must be licensed by the Nuclear Regulatory Commission; to be licensed, they must comply with certain regulations. The Public Health Service and the Department of Agriculture together control access to, use of, and transfer of certain etiologic agents. If the university researcher utilizes any materials designated as hazardous by the Environmental Protection Agency, it has requirements for the way in which he handles and disposes of these materials. These are only a few examples of the various types of federal controls placed on the researcher. The administrator must also take into account the regulations of such agencies as the Drug Enforcement Administration, the Occupational Safety and Health Administration, the National Institutes of Health, the National Cancer Institute, and the Department of Transportation. An indication of the various federal agencies involved and the scope of their various requirements and standards related to universities is provided in Exhibit II-2 (see pages 20 - 31). The information in this exhibit is not intended as definitive reference material but rather as an illustration of the diversity of government involvement.

The administrator should be aware that the power and intent of governmental agencies in relation to academic research varies. For example, the Occupational Safety and Health Administration may impose a fine if an inspector discovers that a laboratory is not complying with regulations. The National Institutes of Health (NIH) does not have this kind of control over the university because NIH guidelines, e.g., those governing research with recombinant DNA, do not carry the force of law. However, if the university is interested in receiving a grant from NIH for DNA research, compliance with the guidelines is required. The administrator, then, may not legally be required to assure compliance with all regulations, but he may want to comply for the university's benefit. Sound administrative decisions regarding the university's occupational safety and health program require that he knows what the regulations are and how each applies to his university. Then he can make judgments based on the types of research the university is involved in, and the costs of compliance versus the benefits of compliance.

University research efforts are also affected by state and local legislation. Some universities are regulated by state rather than federal OSHA regulations, if OSHA has approved their state's plan. All states have worker's compensation regulations which must be complied with. In addition, numerous other state regulations may apply to the university, including animal bite reporting and quarantine regulations, construction regulations, and health department regulations. Local building regulations and fire codes may also affect the administrator responsible for safety in research laboratories. For example, cities and counties often adopt the Uniform Building Code by ordinance.

By no means does this cover all possible types of state and local regulations that could affect the administrator of an occupational safety and health management system. There is a great deal of variation from locality to locality regarding specific safety requirements. The university's management system must be responsive to changes in state and local regulations that might apply to safety in the university research program.

Finally, the administrator must deal with rules and procedures unique to the university itself. One example of this may be insurance company standards which are adopted by the university as a condition of receiving coverage. Another example is a safety standard that may be nationally developed and recognized: National Fire Protection Association Standards and those from the American National Standards Institute are often mandated by local or state law.

With the tremendous variety of regulations, guidelines, codes, and standards coming from the federal, state, and local levels that apply to university research, it is necessary that the university establish some sort of system to assure that appropriate information is collected and disseminated to appropriate administrative staff, the occupational health and safety program, and the researcher who is ultimately affected by compliance. Simply keeping track of current regulations can be an onerous task, and one that is compounded by the necessity for identifying and specifying the "who, what, when, and where" of various university research endeavors affected by these regulations, standards, and guidelines. Interface with the university's legal office is often helpful because this office often reviews the Federal Register, which is a good source of information on pending regulations. The tracking and identification must precede the operational task of installing the requisite safety procedures and controls.

Insurance Premium and Claims Costs Are Increasing

The costs of managing risks from research hazards through the purchase of insurance are rising. During the past decade, the costs for malpractice and general liability insurance have increased at a rate exceeding normal inflation. Governmental bodies and educational institutions may feel the cost pressure more than other organizations, not because they are more susceptible to litigation, but because they have so long been immune to such liabilities. Having operated for many years under the doctrine of sovereign immunity, colleges and universities in most states have had a great deal of difficulty adjusting to their newly discovered vulnerability. Indeed, less than a quarter of the states currently retain the immunity doctrine under their laws.

Colleges and universities have found themselves visible targets for a number of legal actions, which have often involved substantial damage claims. In addition to these costs borne by the institutions (in the forms of direct payments or increased insurance premiums), top-echelon officers and faculty members of colleges and universities have been held legally accountable for actions (or inactions) on the part of the institution or its staff.

These legal involvements and increased operating costs have caused many institutions of higher education to examine their insurance and loss control efforts and to expand greatly the scope of their risk management functions.

A Climate of Increased Social Concern Prevails

Anyone who has any exposure to the news media is bombarded with warnings regarding the food he eats, the air he breathes, the water he drinks, and the chemicals he uses in his daily life. This barrage of warnings has raised questions in people's minds regarding the safety and healthiness of their workplaces and the substances with which they come into contact there.

Thus, the university administrator is under increasing social pressure to minimize the danger to which students, employees, visitors, and the community at large can be exposed due to university activities. Controlling research hazards will be increasingly important as public awareness of possible hazards increases.

An Incident of Non-Compliance or an Accident May Have Broad Repurcussions

Also, partially as a result of this increased social concern regarding safety and health, the university administrator must realize that the repercussions of an incident of non-compliance or of a research-related accident will extend far beyond the direct costs incurred. Some case histories of research-related accidents provide powerful examples of this.

In one incident cited in the Proceedings of the Workshop on Cancer Research Safety in September, 1977, the improper disposal of 25 grams of diethyl mercaptan into a cup sink in a fume hood prompted the evacuation of several large buildings. This error could have had widespread implications and contamination potential for people far removed from the source of the hazardous substance. The public image of a university could have been adversely affected by this situation. At the same workshop, another case was described in which an investigator had taken less than 100 grams of diethyl nitrosourea out of his refrigerator and left it on top of a cabinet in his laboratory for about a week. It exploded without warning.

In addition to the direct costs incurred to clean up a damaged laboratory or to pay the salary of a researcher who is unable to work because of an accident, the university administrator must consider the less tangible costs of having several buildings temporarily out of use, numerous employees displaced, or large numbers of people exposed unnecessarily to hazardous materials. Even without any penalties imposed from outside the university, such an accident certainly does not enhance the professional reputations of a university's researchers or administrators. Such intangible costs must be considered when evaluating the potential benefits of occupational safety and health program activities directed at reducing research risks.

A MANAGEMENT SYSTEM REINFORCES TECHNICAL CONTROLS

A variety of factors support the need for managing the occupational safety and health program in a systematic way. University administrators and faculty members, by virtue of their positions, frequently must document the institution's compliance with regulations, requirements, and guidelines. They may also be requested to convey the institution's level of concern for its staff, students, and community. Thus, these individuals should be particularly sensitive to the validity of their assertions. They should require some sort of information or "audit checks" which assure them that the university is in fact free from reasonably preventable risk.

Other factors argue for a management system. The first relates to the need to funnel information upward to the responsible (or avowing) administrator. The need for upward communication arises for two reasons, only one of which has been alluded to, that is, the need for administrative assurance.

The second need, and one that the program manager may find more compelling and immediate, is the program manager's need to communicate with individuals who have the authority to allocate resources. In many cases, the program manager is a technical specialist who must present a claim for the university's increasingly scarce resources to an administrator who is not only beseiged by conflicting requests but who understands very little of the technical nature of the program. Several scenarios may result. The program manager may plead his case on the basis of the ethics, morality, or propriety of protecting human life. Although the administrator may agree with the principles and sentiment of this presentation, they do nothing to ease a recurring administrative dilemma--doling out limited dollars to increasing demands. The administrator may feel that he is faced with a "do or die" proposition: either accept the manager's request or potentially jeopardize human life. At this point, the administrator may request that the program manager set priorities for program elements. Again, however, the two may have no common ground for discussion--the managerial implications of alternatives become submerged.

Alternatively, the program manager may justify resource requests based upon the demands of outsiders: "look what they're making us do." This approach may be effective in the short run, but in the long run, it may act against the program and the university's best interests. The administrator is now on guard against becoming a patsy of the regulators, insurers, and funders, and wants to do no more than is absolutely necessary. Again, he may feel faced with the same kind of a "go, no-go" decision, the pertinent difference being that feelings of benevolence have been replaced by cynicism.

One of the purposes of a management system is to avert this kind of dilemma by providing the program manager and the non-technical administrator with some common ground for communication. That is, a management system can help the program manager address the resource allocation process in terms that are more likely to be responsive to administrators' more pressing problems. A management system can focus on such questions as those below in terms that both the manager and the administrator can deal with:

- Why does this program cost so much? Where is the money going?
- What is the university getting out of it?
- How much of it is really critical?

A management system also can provide an even more valuable service in coordinating the activities and expenditures needed to accomplish occupational safety and health objectives. These activities are usually quite widely dispersed among various organizational units of a campus or university. Looking at expenditures only, consider the numerous areas in which safety and health expenditures can accrue:

- If a laboratory must be constructed or modified to meet containment standards or to provide improved ventilation, these costs may appear only in a capital budget. The budget may be presented by an operating unit--a school, department, or institute. It is unlikely that they would be presented by the occupational safety and health program.

- Expenditures for special equipment for safety and health purposes, e.g., fume hoods, containment cabinets, personal protective equipment, etc., may be included in budgets either for specific research projects or for an academic department.

- The budget for the program management staff will reflect staff and other costs for those activities undertaken by the program: facilities, inspections, environmental monitoring, medical monitoring of personnel, training, consultation, and direct services. In some universities, these activities may be themselves dispersed.

- The costs of medical monitoring, epidemiological studies, accident reporting, etc., may be borne by the university health services.

Even if the university does not track expenditures for occupational safety and health across organizational units, the program manager will need to coordinate the efforts of a considerable number of involved units in order to monitor program activities. Consider the following example:

Researcher Jones is applying for a research grant for a project involving the innoculation of laboratory animals with infectious material. How many other individuals and organizations in the university may be involved, either through an approval process or through direct service or contact, with helping to keep his laboratory safe and healthy?

- His research protocols and proposal will be signed off by a biohazard committee, certifying that he has taken appropriate precautions.

- A similar review and approval process will be performed by an animal care committee.

- A special containment cabinet will be purchased for the infectious material through the procurement office.

- His research staff may require periodic inoculations or blood tests from university health services.

- Precautionary signs may be posted on the laboratory door.

- Training may have to be provided to not only the research staff itself, but also to physical plant and maintenance personnel who might have to work in or enter the lab for any reason.

- University security police and the local fire department will need to be informed about procedures to follow in case of an emergency.

- The laboratory itself may require modification--perhaps showers and a changing room will be added, or additional fire prevention equipment would be advisable.

- Special containers and procedures for the disposal of all animal wastes must be employed and the personnel who perform this function must be alerted to potential hazards.

- Periodic reports and inspections may be required. Some of the reports may be submitted by Researcher Jones; others will require sign-off by the biosafety committee or the occupational safety and health program manager.

- The occupational safety and health program manager, the insurance carrier, and various governmental agencies will wish to inspect the lab periodically.

Multiply this scenario by the number of grants a large university may have at any one time, and the voluminous nature of the control problem becomes apparent. Exhibit II-1 is a summary table illustrating the scope and dispersion of university administrative functions that support or relate to research.

EXHIBIT II-1

UNIVERSITY ADMINISTRATIVE FUNCTIONS RELATING TO RESEARCH

FOCUS OF INVOLVEMENT	TYPE OF INVOLVEMENT	POSITIONS/DEPARTMENTS INVOLVED
• Research Activity	• Review of Grant Proposals	• Research Administration
		• Faculty Review Committees
	• Supervision of Research Work	• Principal Investigator
• Physical Environment of Laboratory	• Inspections of Facilities and Equipment	• Occupational Safety and Health Program
	• Maintenance of Facilities and Equipment	• Maintenance Department or Physical Plant
	• Planning for Modification or Construction of Laboratories	• Physical Plant, Planning Department
	• Posting Precautionary Signs	• Occupational Safety and Health Program
	• Disposal of Waste Material	• Maintenance or Physical Plant
		• Occupational Safety and Health Program
• Expenditures for Research	• Purchases of Supplies and Equipment for Laboratories	• Purchasing, Accounting Department
		• University Hospital, Administrative Departments
		• Academic Department
		• Occupational Safety and Health Program

EXHIBIT II-1 (cont.)

FOCUS OF INVOLVEMENT	TYPE OF INVOLVEMENT	POSITIONS/DEPARTMENTS INVOLVED
• Expenditures cont.	• Purchases of Supplies and Equipment Specifically for Research Projects	• Purchasing, Accounting Department
		• Research Administration
		• Occupational Safety and Health Program
	• Staff Time and Effort on Research Projects	• Research Administration
		• Accounting Department
		• Principal Investigator
• Emergencies in the Laboratory	• Emergency Intervention	• University Police or Security
		• University Health Services
		• Maintenance Department or Physical Plant
• People in the Laboratory	• Health Care	• University Health Services or Hospital
		• Occupational Safety and Health Program
	• Health and Accident Care Records	• Risk Management/ Insurance Department
		• Occupational Safety and Health Program
		• University Health Services
	• Personnel Records	• Personnel Department
		• Accounting Department

EXHIBIT II-1 (cont.)

FOCUS OF INVOLVEMENT	TYPE OF INVOLVEMENT	POSITIONS/DEPARTMENTS INVOLVED
• People in the Laboratory cont.	• Training of People in the Laboratory	• Principal Investigator • Departmental Faculty • Occupational Safety and Health Program
• Payments for Research	• All Payments	• Research Administration • Accounting Department

Without a management system the manager of occupational safety and health may have difficulty monitoring the various aspects of research that have some relationship to safety and health. Clearly, the manager or even a large staff cannot be the sole source, "data bank," and transmitter of all information.

The larger consequence of the problem is that merely conveying information to researchers and others about their safety and health responsibilities is insufficient, particularly if an accident occurred and a liability suit were entered. In that case, the university would have to prove that it had an auditable system for assuring that certain actions were taken and for alerting responsible personnel if they were not taken.

A management system can do more than control hazards of which the university is already aware, however. It can help identify hazards of which the program manager and other university officials are unaware. For example, in the above scenario, if Researcher Jones seeks to modify an existing research project by inoculating with a different infectious material, he may not notify anyone of his decision. However, a purchase requisition for a particular virus or bacterial agent may provide the clue that can set the occupational safety and health program in motion.

The preceding discussion of the dispersion of activity and responsibility with regard to laboratory safety and health issues is reminiscent of the old saying that "a university would be an easy place to manage, if it weren't for the students and the faculty." Interviews with program managers in preparation of this report indicated that they sometimes feel considerable frustration in their capacity (or lack thereof) to be influential with faculty and research staffs. On the other hand, faculty and research administrative representatives, while agreeing with the underlying goal of improved health and safety in the research laboratory, also sometimes expressed frustration with the increased constraints upon their operating autonomy posed by increased regulation and intervention in the area of safety and health.

The point of raising this issue is not to argue either side, but rather to point out that one of the benefits of a management system is that it provides not only a way to plan and control program operations, but also provides a record of what the program does. This record is clearly important for evaluation purposes, but it has another virtue as well: it provides documentation of the level and extent of service and contact between different units of the university and the safety and health program. Thus, a management system can document the level of support, as well as the introduction of new requirements, that different departments receive from the safety and health program. Therefore, it can assist both the program manager and the university administrative staff to build a more cooperative relationship with educational and research staff.

ADMINISTRATIVE RESPONSIBILITY IS SHARED

First line responsibility for research safety and health lies with the positions having direct authority over the research effort. This is generally the principal investigator, although at times it may be a laboratory supervisor. The program manager has responsibility for supporting and monitoring the actions of the principal investigators. The vice president and any other university administrator to whom the program manager reports also has responsibility for overseeing the efficiency and effectiveness of the program. These relationships are generally clear and acknowledged.

However, other university administrators also are involved, through various relationships, in the occupational safety and health program.

The University Risk Manager Has a Related Program Responsibility

The role of the risk manager/insurance manager necessarily interrelates with the university's health and safety operation, even if the two functions are organizationally independent. In order to assess the appropriate risk, the university risk manager must have a thorough understanding of the perils that face not only the physical property of the university but also employees, students, visitors, and others who might in some way become involved in the university community. The nature of these perils, and the expected costs associated with them, form the basis for every policy decision and recommendation made by the university risk manager.

The Administrator Responsible for Research Administration Should be Involved

Research administrators may see their overall role as one of facilitating the flow of external funding to the university in support of its research endeavors. Therefore, any situation which could jeopardize the institution's capacity to compete for research funding should be of interest. The failure to take the proper precautions for research safety and health or an incident which reflects a lack of caution could have long reaching impact on the institution's future viability in a particular research area. Therefore, these individuals also must be considered as having programmatic interest and involvement.

Others Who Share Responsibility

The loss of immunity from litigation means that university administrators can be liable for the accuracy of documents they sign as responsible officials. As individuals, they, as well as the institution, can be subject to litigation. In addition, administrators who are responsible for university resources are accountable to the board of trustees and the financial supporters of the university. This would include the state government in the case of state universities. Thus, not only should the safety and healthiness of the university environment receive their attention, but also the viability of the program itself.

EXHIBIT II-2

FEDERAL REGULATORY AND FUNDING AGENCIES' REGULATIONS AND GUIDELINES RELEVANT TO UNIVERSITIES

DEPARTMENT OF AGRICULTURE

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: To protect American livestock by strictly regulating the importation and interstate shipment of animal disease organisms and vectors.

LICENSING REQUIREMENTS: Permit required for importation and interstate shipment of designated organisms.

INSPECTIONS/SURVEYS: USDA conducts inspections of laboratories to determine whether they are biologically secure.

TRAINING: Not applicable.

RECORDKEEPING/REPORTING:
1) Institution must acknowledge receipt of materials
2) Institution must notify USDA after all materials and their derivatives have been destroyed.

HEALTH SCREENING/MEDICAL MONITORING: Not applicable.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:
1) Designated materials limited to in vitro experimentation only
2) All equipment, wastes, cages, packaging materials, containers, and unused portions of imported materials must be sterilized by autoclaving or incineration after direct or indirect contact with designated materials
3) Requirements regarding methods of shipping.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Application for permit requires signature of responsible official.

INVENTORY CONTROLS: USDA notified when institution receives materials and when they are destroyed.

NOTIFICATION, SIGN POSTING: Not applicable.

PHYSICAL CONDITIONS OF ENVIRONMENT: Designated materials require isolated and rodent-proof facilities.

EXHIBIT II-2 (cont.)

DRUG ENFORCEMENT ADMINISTRATION

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Recordkeeping and security with regard to controlled drugs.

LICENSING REQUIREMENTS:

1) State Controlled Substances Permit issued to universities

2) Annual registration of universities.

INSPECTIONS/SURVEYS: DEA conducts pre-registration investigations of universities.

TRAINING: Not applicable

RECORDKEEPING/REPORTING:

1) Loss of controlled drugs
2) Inventories of controlled drugs
3) Purchase of controlled drugs
4) Use of controlled drugs.

HEALTH SCREENING/MEDICAL MONITORING: Not applicable.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:

1) Must request approval for disposal of controlled drugs or contaminated, unusable, or excess drugs
2) Proper secure storage of controlled drugs.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Not applicable.

INVENTORY CONTROLS:

1) Quantities of controlled drugs
2) Purchase of controlled drugs
3) Use of controlled drugs.

NOTIFICATION, SIGN POSTING: Not applicable.

PHYSICAL CONDITIONS OF ENVIRONMENT: Not applicable.

EXHIBIT II-2 (cont.)

ENVIRONMENTAL PROTECTION AGENCY

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: The effect of hazardous materials and other environmental interference on the environment.

LICENSING REQUIREMENTS: Issue permits for any institutions which dispose of designated hazardous materials.

INSPECTION/SURVEYS: Not applicable.

TRAINING:
1) Use of potentially hazardous materials
2) Information on noise research and noise control programs
3) Water pollution monitoring.

RECORDKEEPING/REPORTING:
1) Reports regarding how wastes are disposed of for those who who generate over 100 kg/month of waste or designated hazardous materials
2) Reporting requirements if transport hazardous wastes.

HEALTH SCREENING/MEDICAL MONITORING: Not applicable.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:
1) Regulations to govern disposal of hazardous wastes
2) Regulations on kind and amount of airborne effluent
3) Regulations on kind and amount of waterborne effluent
4) Regulations on handling of solid wastes
5) Regulations on introduction and flow of toxic materials through environment.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Not applicable.

INVENTORY CONTROLS: Quantities of hazardous materials on hand.

NOTIFICATION, SIGN POSTING: Not applicable.

PHYSICAL CONDITIONS OF ENVIRONMENT: Not applicable.

EXHIBIT II-2 (cont.)

NATIONAL CANCER INSTITUTE I*

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Oncogenic viruses; Note: mandatory for NCI laboratories and to be complied with by all contractors; recommended for adaptation and adoption by anyone doing oncogenic virus research.

LICENSING REQUIREMENTS: Not applicable.

INSPECTIONS/SURVEYS: Not applicable.

TRAINING: Employee training in safe practices.

RECORDKEEPING/REPORTING: Maintenance of accident records.

HEALTH SCREENING/MEDICAL MONITORING:

1) Employee preassignment physicals
2) Protective clothing
3) Restricted entry
4) Emergency treatment.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:

1) All pipetting by mechanical means
2) Proper labelling of all containers
3) Methods for transporting materials
4) Specific housekeeping procedures
5) Specific procedures for decontamination and waste disposal.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Not applicable.

INVENTORY CONTROLS: Inventory of all oncogenic viruses.

NOTIFICATION, SIGN POSTING: Biohazard signs.

PHYSICAL CONDITIONS OF ENVIRONMENT: Some types of work area specifications.

*Because NCI's regulations differ depending on the substance under consideration, the information regarding NCI regulations has been divided into two parts.

EXHIBIT II-2 (cont.)

NATIONAL CANCER INSTITUTE II

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Chemical carcinogens; Note: mandatory for NCI laboratories; recommended for adoption by others using chemical carcinogens.

LICENSING REQUIREMENTS: Not applicable.

INSPECTIONS/SURVEYS: Not applicable.

TRAINING: Employee training in safe practices.

RECORDKEEPING/REPORTING: Maintain medical records.

HEALTH SCREENING/MEDICAL MONITORING:

1) Preassignment physicals and periodic exams
2) Protective clothing
3) Protective equipments
4) Showers
5) Controlled access.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:

1) Mechanical pipetting
2) No eating, drinking, smoking in labs
3) Specific types of work surfaces and containment devices
4) Labelling of all containers
5) Specific and secure storage area
6) Specific housekeeping procedures
7) Specific procedures for decontamination and disposal
8) Specific animal housing methods.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Specific staff responsibilities.

INVENTORY CONTROLS: Inventory of chemical carcinogens.

NOTIFICATION, SIGN POSTING: Warning signs.

PHYSICAL CONDITIONS OF ENVIRONMENT: Specific types of facilities.

EXHIBIT II-2 (cont.)

NATIONAL INSTITUTES OF HEALTH

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Recombinant DNA; Note: required compliance for National Institutes of Health grantees and contractors; recombinant DNA research guidelines apply also to grantees of the National Science Foundation, Department of Energy, National Aeronautics and Space Administration, and Department of Defense.

LICENSING REQUIREMENTS: Not applicable.

INSPECTIONS/SURVEYS:
1) University must certify on grant application that facilities have been reviewed and approved
2) If high hazard containment (P4) is necessary, the facility must be inspected by NIH team.

TRAINING: Minimum levels of employee training.

RECORDKEEPING/REPORTING: Required reporting to the institutional biohazards committee and to NIH.

HEALTH SCREENING/MEDICAL MONITORING:
1) Restricts personnel to be exposed
2) Requires use of protective clothing
3) Experiments which require too hazardous a material are prohibited.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:
1) Packaging of hazardous materials for shipment
2) Containment methods with DNA experimentation
3) Decontamination of waste materials before disposal
4) General procedures and practice in work area.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW:
1) Specific responsibilities of various staff members
2) Required establishment of institutional biohazards committee.

INVENTORY CONTROLS: Not applicable.

NOTIFICATIONS, SIGN POSTING: Biohazard signs.

PHYSICAL CONDITIONS OF ENVIRONMENT: Special types of facilities required for some experiments.

EXHIBIT II-2 (cont.)

NUCLEAR REGULATORY COMMISSION

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Radioactive materials under an NRC license (including source materials, fissionable materials, by-product materials).

LICENSING REQUIREMENTS:
1) Issue license for source materials
2) Issue license for special nuclear materials
3) Issue license for by-product materials
4) Require complete description of waste disposal methodology
5) Require written radiation safety procedures
6) May exempt from licensing.

INSPECTIONS/SURVEYS: University required to perform as needed to delineate radiation areas, restricted areas, and radiation levels at surface of shipping containers.

TRAINING: Instructions on the presence and use of radioactive materials and related health protection problems and procedures.

RECORDKEEPING/REPORTING:
1) Personnel exposure monitoring
2) Use and disposition of all radioactive materials
3) Theft and loss of licensed materials
4) Dangerous incidents, overexposures, excessive levels or concentrations.

HEALTH SCREENING/MEDICAL MONITORING:
1) Respiratory protection devices and protective clothing
2) Bioassay measurements
3) Standards on dose levels and concentrations of radioactive materials
4) Appropriate personnel monitoring equipment.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:
1) Restricts level of radiation in effluents
2) Specifies waste disposal procedures
3) Specifies procedures for picking up, receiving and opening packages.

EXHIBIT II-2 (cont.)

NUCLEAR REGULATORY COMMISSION
(cont.)

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW:

1) Radiation Safety Committee required for broad licensees
2) Sometimes required to appoint Medical Isotope Committee
3) Appoint Radiation Protection Officer
4) Designate responsibility for controlling usage of radioactive materials.

INVENTORY CONTROLS: Specified limits on possession.

NOTIFICATION, SIGN POSTING:

1) Inform employees of radioisotope body burden and/or accumulated radiation dosage
2) Caution signs
3) Specified regulations, license, operating procedures, notice of violation.

PHYSICAL CONDITIONS OF ENVIRONMENT:

1) Restricted radiation areas must be controlled for radiation safety purposes
2) Unrestricted radiation areas may not exceed specified levels of radiation.

EXHIBIT II-2 (cont.)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Safety and health for employees through federal standard setting and federal/state workplace inspection; university departments working with, for, or totally funded by federal grants must comply; private universities and colleges subject to federal regulations unless state has approved plan; public universities will be under state enforcement when their state plan is approved.

LICENSING REQUIREMENTS: Not applicable.

INSPECTIONS/SURVEYS:

1) University must conduct periodic inspections specified for equipment, safety systems
2) University must meet permissible exposure limits for airborne contaminants
3) University is limited to maximum allowable exposure to intermittent or continuous noise for unprotected people
4) University is required to monitor specific agents, including benzene, asbestos, vinyl chloride, and acrylonitrile.

TRAINING:

1) Employee training in use of specified equipment and materials
2) Employee training in first aid (if no full time medical service is available)
3) Employee training for handling of certain chemicals
4) Employee training in the use of respiratory protective equipment.

RECORDKEEPING/REPORTING:

1) Occupational injury and illness records if more than 10 employees
2) Notify DOL within 48 hours of serious accident resulting in death or multiple hospitalization
3) Training records
4) Inspection records including medical records
5) Annual injury, illness report to BLS if notified university is part of national sample.

HEALTH SCREENING/MEDICAL MONITORING:

1) Various employee medical examinations if using certain materials or under certain circumstances
2) Standards regarding exposure to regulated carcinogens
3) Regulations on radiation exposure from sources not licensed under NRC.

EXHIBIT II-2 (cont.)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
(cont.)

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:

1) Standards regarding regulated carcinogens
2) Standards regarding flammable liquids in containers
3) Safety specifications for equipment
4) Protective eye- and facewear requirements
5) Requirements regarding disposal of asbestos wastes
6) Proper labelling of hazardous materials
7) Labelling of unsafe equipment.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Not applicable.

INVENTORY CONTROLS: On hand amounts of regulated carcinogens, including location, user, additions or deletions to supply.

NOTIFICATIONS, SIGN POSTING:

1) Warning signs
2) Specified colors, symbols, lettering size and proportions in signs
3) Poster informing employees of rights and responsibilities.

PHYSICAL CONDITIONS OF ENVIRONMENT:

1) Work area, process, equipment and machinery safety requirements
2) Designated areas where food and drink storage and consumption are permitted
3) Requirement for identification of radiation areas
4) Requirement for delineation of certain toxic substance exposure areas.

EXHIBIT II-2 (cont.)

PUBLIC HEALTH SERVICE, CENTER FOR DISEASE CONTROL

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Regulation of human etiologic agents.

LICENSING REQUIREMENTS: Permit required for importation or interstate transfer of designated agents.

INSPECTIONS/SURVEYS: Not applicable.

TRAINING: Specific levels of competence necessary for use of agents.

RECORDKEEPING/REPORTING: Diagnosis of communicable disease.

HEALTH SCREENING/MEDICAL MONITORING:

1) Immunizations
2) Protective clothing
3) Employee medical examinations.

PROCEDURES FOR HANDLING, CONTAINERIZATION, WASTE DISPOSAL, LABELLING, SHIPPING:

1) Specific decontaminization and sterilization procedures
2) Required labelling of etiologic agents.

ORGANIZATIONAL REQUIREMENTS, STAFFING REVIEW: Requests must be signed by specified party depending on class of agent.

INVENTORY CONTROLS: Not applicable.

NOTIFICATIONS, SIGN POSTING: Not applicable.

PHYSICAL CONDITIONS OF ENVIRONMENT: Work area safety requirements, including isolated ventilation systems, showers.

EXHIBIT II-2 (cont.)

DEPARTMENT OF TRANSPORTATION

FOCUS OF AGENCY RELATIVE TO UNIVERSITIES: Regulations regarding transportation of hazardous materials.

LICENSING REQUIREMENTS: Not applicable.

INSPECTIONS/SURVEYS: Not applicable.

TRAINING: Minimum levels of training for employees handling hazardous materials during shipment.

RECORDKEEPING/REPORTING: Required report if a spill occurs under certain conditions.

HEALTH SCREENING/MEDICAL MONITORING: Not applicable.

PROCEDURES FOR HANDLING CONTAINERIZATION, WASTE DISPOSAL, LABELLING SHIPPING:

1) Regulations on packaging of hazardous materials
2) Regulations on labelling of hazardous materials
3) Regulations on handling of hazardous materials.

ORGANIZATIONAL REQUIREMENTS, STAFFING, REVIEW: Not applicable.

INVENTORY CONTROLS: Not applicable.

NOTIFICATIONS, SIGN POSTING: Not applicable.

PHYSICAL CONDITIONS OF ENVIRONMENT: Not applicable.

SUGGESTED FURTHER READINGS

Aiken, Ray J., Adams, John F., Hall, John W. Liability. Legal Liabilities in Higher Education: Their Scope and Management. Washington, D.C.: Association of American Colleges, 1976.

DEFINING THE SCOPE OF A MANAGEMENT SYSTEM

A PROGRAM MANAGEMENT SYSTEM REFLECTS THE MANAGEMENT CYCLE

This chapter places the cyclical management process in a systems context and explains its application to the management of occupational safety and health programs. Fundamentally, the management cycle itself incorporates certain systems concepts. That is, this view assumes certain input-output relationships between the various phases of the cycle. This concept is displayed graphically in Exhibit III-1, which indicates the outputs of each phase of the management process providing inputs to the next phase. Overall, the system is unified through feedback (output) from evaluation, which becomes input to management planning. This is shown as occurring on an on-going iterative basis during operations monitoring and planning; this might be viewed as a continual fine-tuning process. On a more consequential level this feedback occurs during evaluation at the completion of a management cycle.

In undertaking the management activities indicated for each phase, the manager must be supplied with information. This information is an input to the management processes of each phase. The information may be supplied by other parts of the university, be supplied by other organizations entirely, or it may be collected or generated by the program itself. As a result of each phase, two kinds of outputs will be produced: (1) information or data outputs and (2) action outputs. Some of these outputs are used in subsequent phases, some are end-products in themselves, and some are disseminated or used by other parts of the organization. A graphic representation of the internal flow of information through the program management cycle is shown in Exhibit III-2.

In an information system, data flows through a processing unit that aggregates, tabulates, analyzes, or formats the data and produces an output. In automated systems, the processing is accomplished in the central processing unit of a computer. In a manual operation, it is performed by individuals who compile or arrange the data according to a pre-determined, logical set of procedures. Accounting operations provide a good illustration of the concept of a management information system. In an accounting office, numerous pieces of data describing a variety of financial transactions are collected as inputs. They are accumulated and arrayed to provide outputs in the form of orderly records, such as the general ledger, sub-ledger, and accounts journals. These outputs, however, are not management reports; they are merely

EXHIBIT III-1

PROGRAM MANAGEMENT CYCLE

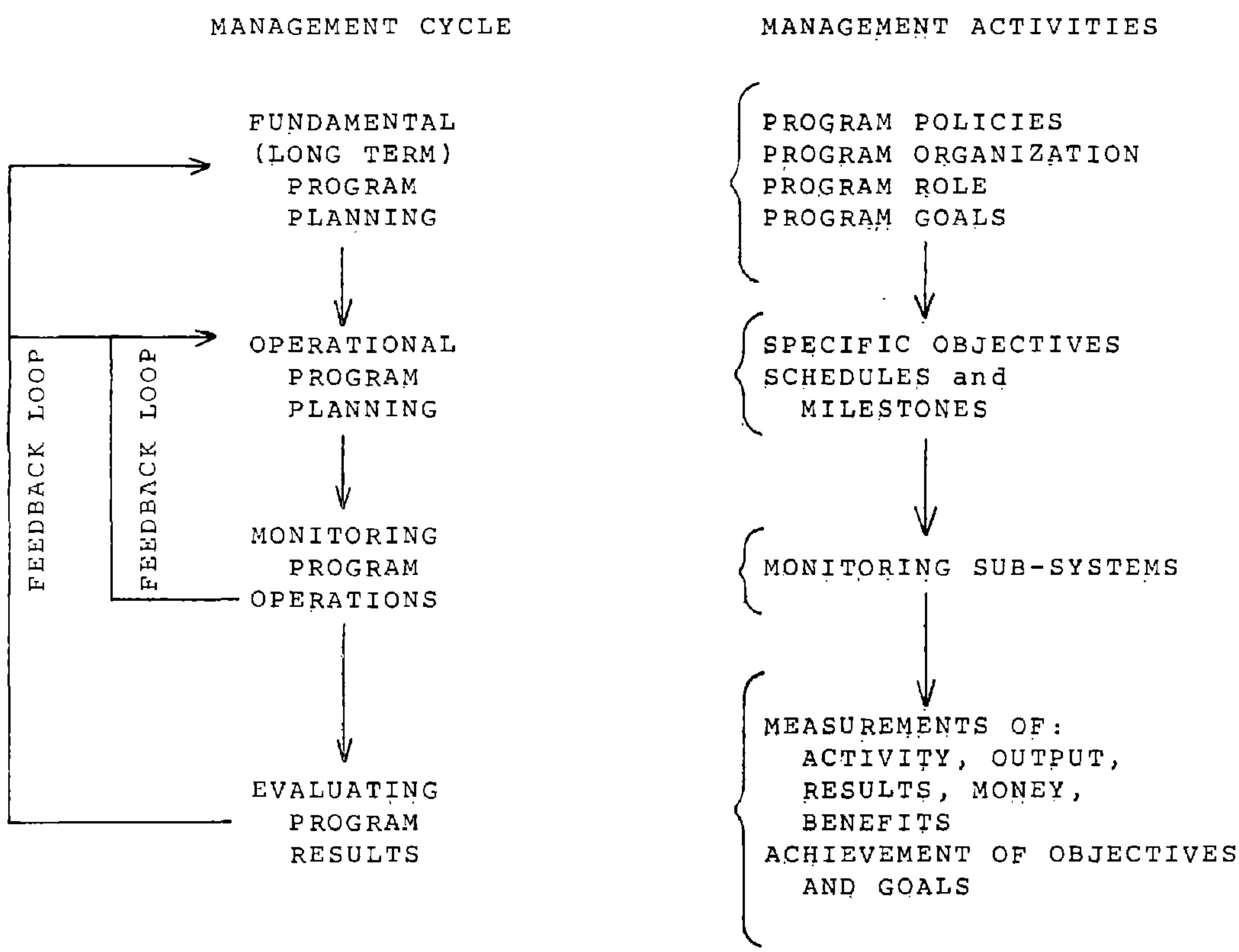
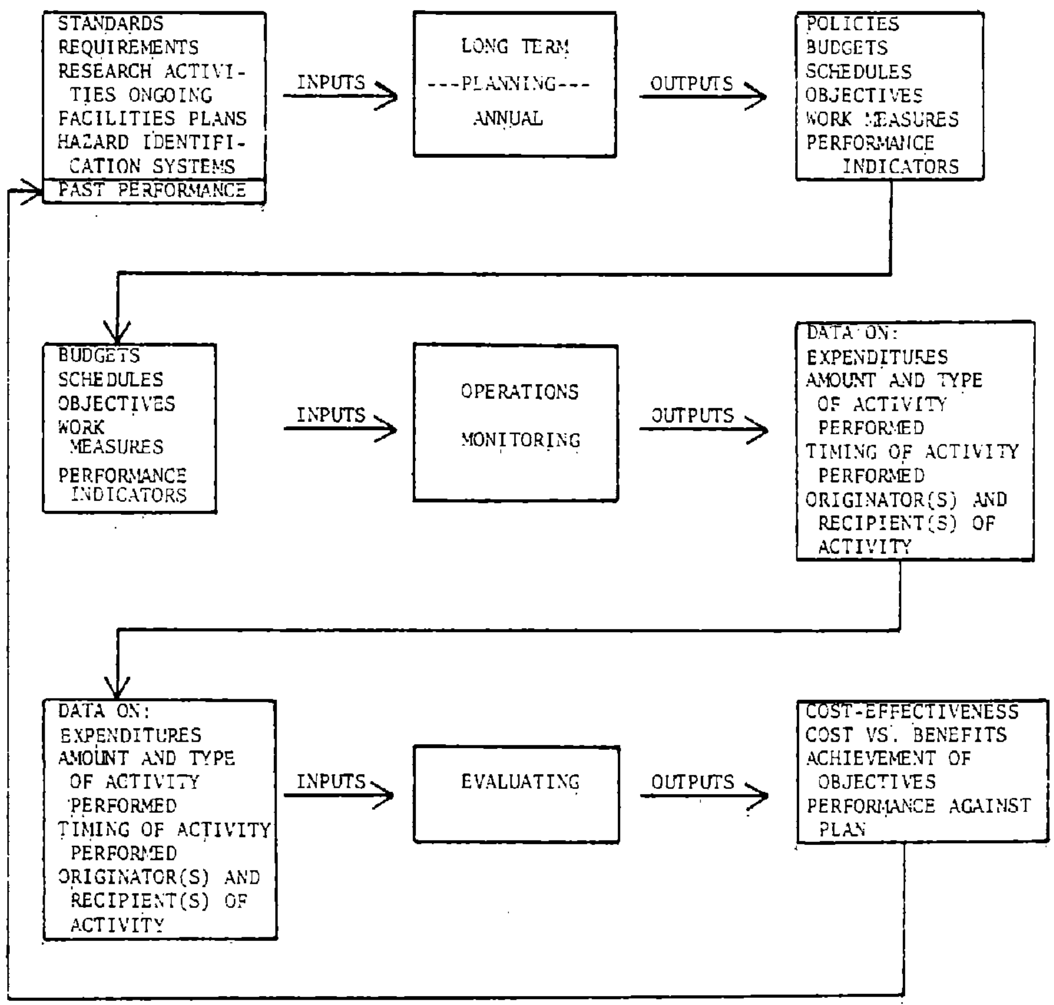


EXHIBIT III-2

PROGRAM MANAGEMENT CYCLE: INFORMATION FLOW



files or record-keeping systems in which the financial transaction data are retained in an orderly fashion. At certain time intervals, the financial transaction data must be aggregated, analyzed, and arranged to produce reports for management, such as balance sheets, income statements, funds flow statements, special financial reports, and others. It is generally these report outputs that are referred to as a management information system or MIS, although the entire accumulation, storage, record-keeping, and report production process is, in fact, an information system.

The accounting analogy illustrates the two levels of outputs from the information system: a series of transaction records or files and a series of reports or management information system. In most information systems, the transaction records are used on a day-to-day basis and must be easily accessible. Examples of transaction records at a university would include class rosters, personnel records, student health records, and research project records. These orderly records may be stored in a computer or manual files, but they represent organizations of data, rather than analyses of data. The management information system (MIS) reports, however, involve aggregation and analysis of data for use in higher level decisions. The management information system reports generated for decision-making are of three types:

- Periodical--scheduled reports which are produced on a regular basis

- Demand--preformatted or free format reports which are generated only when required for special analysis or decision-making purposes

- Exception--reports that are automatically generated when error or exceptional conditions are present in the system. These reports are designed to flag problem areas.

The bits of data which are stored in orderly record files and are subsequently analyzed and arrayed in management information system reports are referred to as the data base.

A university has a number of record files and management information systems that are supplied by operating data stored in various data bases. All of the information available to the university in these separate data bases may be considered as parts of an Institutional Data Base. Generally, the information needs of a specific function (e.g., personnel, accounting, academic administration) determine the type, format, and frequency of the elements in the data base, as well as the organization of orderly record files. However, management decisions usually require information, including information that is drawn from separate files or data bases. The management process of planning, operating, and evaluating the university creates broad needs for analytical information for university administrators.

APPLICATION TO OCCUPATIONAL SAFETY AND HEALTH FOR RESEARCH

The occupational safety and health program has two types of information needs. The first type is the collection, orderly storage, and analysis of data generated by the program itself. The second is the need to have access to other parts of the Institutional Data Base in order to have information about activities occurring in other parts of the university which have relevance to the occupational safety and health program. Exhibit III-3 indicates some of the information sources for a program management information system. As is indicated in the exhibit, some of the data is compiled from transactions that occur within the program itself (such as the scheduling, performance, and results of various monitoring activities), but other data is compiled from activities that are occurring in other parts of the university (such as the accounting or procurement offices).

The research safety and health management system, then, is not composed of one information stream, but many, coming from different parts of the university organization. Program management decision-making is supported by a management information system, which is, in itself, supported by subordinate record-keeping systems and data bases. The program data bases accumulate information based upon activities which occur within the program itself, but other university data bases will also be involved. Of particular interest are data from the accounting and finance, risk management, health services, and research administration offices of the university. Much of the subsequent material in this report is concerned with the role these offices play in contributing toward the information requirements of a program management decision-making cycle and indicating the information inputs upon which the management information will be constructed.

As a result, the management topics included within this document are quite varied. The collection of data through formal and informal reporting relationships with other parts of the university and procedures for internal program tracking are primary focuses. In addition, topics relating to techniques for data analysis and structuring the management information system are included.

THE MIS MUST BE DESIGNED TO MEET THE NEEDS OF ITS USERS

The system design process is one of selecting and modifying elements, such as those presented in this report, to meet the needs of university administrators and the program manager. This process should produce an integrated system which focuses administrative attention on achieving objectives.

Certain conclusions have been drawn about the information needs of university administrators in various positions. Generally, it is assumed that the higher an individual is in the university administrative structure, the less time he will have available for in-depth involvement in any one program. He will be more reliant

EXHIBIT III-3

PROGRAM AND INSTITUTIONAL DATA BASE INFORMATION
FOR A PROGRAM MANAGEMENT SYSTEM

MANAGEMENT PROCESS	PROGRAM DATA BASE INFORMATION	INSTITUTIONAL DATA BASE INFORMATION
Planning	• Historical Activity Load, Work Measurement Data • Results of Survey, Inspections, Monitoring, Training, Consultation, and Intervention Activities	• Historical Expenditure Data • Institutional Revenue Projections • Research Projects Information • Facilities Additions and Modifications Plans • Insurance Claims Data • Insurance Inspections Data • Purchasing Information • Health Services Data
Operating	• Work Measurement Data • Schedules • Productivity Tracking for Surveys, Inspections, Monitoring, and Training • Activity Records for Consultations and Interventions	• Program Expenditures • Changes in Research Projects Information • Insurance Claims Reports • Insurance Inspections Reports • Purchase Requisition Records • Health Service Records
Evaluating	• Time/Activity Data • Output Data • Performance Data: Results of Surveys, Inspections, Monitoring, Training, Consultation, and Intervention Activities	• Financial Data • Insurance Claims Data • Insurance Inspections Data • Cost/Benefit Data • Health Service Data • Purchasing Data

upon summary reports and, at the highest levels, may be primarily interested in policy formulation and critical events that could have significant or long-term impacts on the university. The different information needs of different positions are summarized as follows:

- The program manager has the need for the greatest amount of detailed information. He is a first level system user. He may aggregate or summarize information to disseminate it to his superiors.

- The vice president or vice chancellor having administrative overview of the safety and health program will require two types of reports:

  - summary activity reports submitted on a regular basis

  - exception reports on significant or unusual incidents

- The chief executive officer and the university governing board will require highly summarized activity reports and exception reports of situations having major potential impact on the policies or operations of the university.

SUGGESTED FURTHER READINGS

Anthony, Robert N., Herzlinger, Regina. Management Control in Nonprofit Organizations. Homewood, Illinois: Richard D. Irwin, Inc., 1975.

Dermer, Jerry. "Management Reporting: Who Really Needs What?" NACUBO Professional File, March 1974, pp. 1-4.

PLANNING

Program planning is the determination of the activities and functions to be undertaken by the occupational safety and health program as well as their frequency and priority. Although the primary emphasis in this chapter is on annual or short-term program planning, some long-term or strategic planning issues also are discussed because strategic decisions significantly influence program management. Strategic decisions involve the basic structure, role, and functions of the program. The management system must help managers and administrators do both kinds of planning. The subjects discussed in this chapter include:

1. Strategic Program Planning
   - Location of the Program
   - Organization of the Program
   - Selection of a Program Role
2. Cyclical Program Planning
   - Hazard Identification
   - Activity Forecasting
   - Priority Setting
   - Objective Setting
3. Outputs of the Program Planning Process

STRATEGIC PROGRAM PLANNING

A management system can help administrators measure and monitor activity; however, unless fundamental decisions regarding the organization and location of the program and its staff are consistent with the responsibilities of the program, a management system may be impossible or futile to implement.

Program Staff Location in the University Organizational Structure

Several factors should be considered in determining the most suitable location for the program staff unit.* First, the program should report to a high-level administrator at a vice-presidential level. There are two reasons for this: (1) the need for authority and (2) the need for the capability to interrelate with other organizational units of the university at a managerial level.

Second, the program must have autonomy. It is unfortunate that some university health and safety program staffs have been located so that their capacity for objectivity is impaired. Locating the occupational safety and health program in any operating department over which the program is expected to have jurisdiction introduces a potential for conflict of interest and undermines the program staff's capacity to make objective recommendations.

Organization of the Program Staff Unit

In addition to the organizational location of the program staff, the internal organization of the program staff must also be considered. Several considerations are pertinent. First, it appears that the capacity of the program staff to relate effectively to university researchers is significantly correlated to their own scientific expertise. To a large extent, research safety is a cooperative effort. Some program managers have indicated that possessing a doctoral degree or holding a faculty appointment greatly facilitated their capacity to interact effectively with faculty and researchers. Others believe that this kind of "paper credentialing" is unnecessary and could be used to disqualify potentially able program managers. What does appear to be generally accepted, however, is that the capability to relate to sophisticated researchers is substantially enhanced by a sound foundation in one of the physical sciences as well as by a thorough understanding of research hazard control.

Second, an integrated occupational safety and health program staff generally appears to offer the greatest potential for program and cost effectiveness. "Integration" refers to uniting all safety and health program staff specialists in one group under one manager. There are several reasons why this integrated approach is to be preferred: (A) Given the number of administrative linkages which are required to effectively monitor research hazards, the fragmentation of program staff responsibilities among several units merely multiplies the amount of coordination that must go on. With more than one unit, the proportion

*Roger DeRoos, "Environmental Health and Safety in the Academic Setting," American Journal of Public Health, September 1977, Vol. 67, No. 9, p.852.

of effort that is expended for coordinative purposes reduces total program efficiency. And (B) closely related to the first issue is the problem of achieving program visibility and recognition if program management responsibilities are dispersed. Some considerable portion of program staff time in operating programs is dedicated to activities which are responsive in nature. In these situations, the program staff is reliant upon "cueing" from another branch of the university. Other branches of the university may be less likely to seek assistance or intervention if there are a number of units to deal with, each specializing in different areas.

Third, the extent of diversification and specialization of staff or sub-units within the program staff itself is dependent upon the amount, variety, and sophistication of the research conducted by the university. The corollary to this is that a decision on the part of the university to change or expand its research efforts has implications for the number and specialization of staff in the occupational safety and health program. The control of hazards in various research areas, such as research involving oncogenic viruses, chemical carcinogens, radiation, or recombinant DNA, has become sufficiently sophisticated so that specialized expertise is frequently necessary.

If full-time professional staff are not financially feasible, specialists on a part-time or consultant basis should be considered. Faculty members can provide consultative and training assistance on a part-time basis; however, inspections and certifications should be performed by outsiders in the interest of objectivity.

To date, there has been no experience with joint program staffs funded by and providing service to more than one college or university. In situations where several universities are located in the same area or have adjacent campuses, this might prove to be a cost-effective way of providing requisite specialized safety and health staff support.

Program Role

There are two basic behavioral models for the kinds of roles assumed by program managers and their staffs in regard to their relationships to researchers: the "service-provider" role and the "enforcer/monitor" role. In the first role, the program staff seek to work cooperatively with researchers in a more or less consultative mode. In the second role, the program staff communicate their responsibilities as objective and independent experts, acting in accordance with standards and authority above and beyond that of the university and attempting to assure that researchers comply with these standards.

Regardless of the role selected, there should be congruence between that role, the attitude and capabilities of the program manager, and the types of management system used. Specifically, the service provider role demands a program manager who will be viewed as a peer by a faculty; who will be responsive to researcher's needs as well as to his own professional standards; and who can successfully utilize informal as well as formal management techniques and information exchanges. The enforcer/monitor role demands an individual who is acknowledged as an expert in his field, and who utilizes an extensive and comprehensive system of formal controls.

Experience has shown that there are strong reasons to believe that a "service provider" approach may be more effective overall in many university settings. There are several reasons for this. First, the relationship between a researcher working on an externally-funded project and the university is not analogous to that of employee to employer. The researcher may not feel obligated to provide information or comply with requests which are not required in his relationship with the funding agent.

Second, the nature of much university research may make it less amenable to formal control than research at other types of institutions. Much university research (68 percent of all university expenditures for research and development in 1976, according to the National Science Foundation*) is in the area of basic research. As such, it is exploratory, unpredictable, and unstandardized. Some research may be so new that the hazards are not clearly defined or the hazards themselves may be under investigation. Formal systems and procedures depend for their effectiveness upon some aspect(s) of the environment that is routine or predictable. For example, industrial laboratories not only have a more established hierarchy and clearer lines of authority over researchers but also may have standardized working hours, capacity to control entrance and egress from buildings, less diversity in the kinds of research undertaken, a single funding source, etc. The university program manager may at times be dealing with an environment in which there is so much variety that it is difficult to exercise comprehensive effective control. Given this situation, the program staff may depend much more heavily on volunteered information--information which they are unlikely to receive unless a service-provider role is adopted.

Third, the research occupational safety and health program manager may have difficulty in utilizing formal management mechanisms simply because the levels of specialized expertise as well as generalized innovativeness of university researchers enable

*National Science Foundation, Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1976.

them to circumvent any requirement that may be constraining in their view. It is hard for many program staffs to be hardline enforcers in areas where the researcher's specialized expertise is greater than the staff's.

CYCLICAL PROGRAM PLANNING

Hazard Identification

The size and shape of the safety and health program is dependent to a large degree on the nature and scope of the hazards to be monitored. Hazard identification is an on-going program activity which is required not only for program planning but also for controlling hazards.

Most hazard identification mechanisms are well-known to the safety and health program professional. They include the fundamental technical activities of the profession, such as:

- Inspections of facilities
- Inspections of equipment
- Monitoring of environment
- Monitoring of personnel exposure
- Medical surveillance of personnel.

These mechanisms provide "snapshots" of information. They must be repeated at regular intervals to have validity. They should be augmented by other mechanisms which provide hazard identification information through information linkages with other organizational units of the university. These linkage mechanisms are described below:

Grant/Contract Proposal Review--
Many aspects of a proposal must be reviewed and approved by the various officials and representatives of the university prior to the proposal's submission. Some items for review are required by law (e.g., the licensing of investigators using ionizing radiation), others are stipulated by a funding agency or are required by the university itself (e.g., review of proposed costs). The review process is summarized and monitored through the use of a cover sheet on which the pertinent characteristics of the proposed research are identified. The safety and health program should work with the research administration program to include safety and health issues on the proposal summary cover sheet. Most of the safety and health issues would not require formal approval prior to submission. However, if positive responses were indicated, a copy of the summary sheet would be forwarded to the safety and health program office automatically, and the researcher would be directed to contact the program prior to submission.

Pertinent hazard information which should be included is listed on Exhibit IV-1.

The summary cover sheet is used to provide an exception-reporting linkage between the research administration office and the safety and health program office. (If the university does not have an office of research administration or sponsored programs, then the linkage must be established with whichever office must sign off on all grant applications--the Business Office or the Office of the Vice President for Academic Affairs may be appropriate.) By reviewing proposals, the safety and health program office can develop a fairly good forecast of general trends in research and potential hazard implications.

Participation in Research Management Process--
The review of grant proposals provides an initial link to potential principal investigators and potential areas of research investigation. At many universities, however, there seems to be no comparable information flow to the safety and health program office when grants are approved or when research work actually is in progress. A review of existing university software for research administration indicates that many universities have computerized some aspects of research administration.* The most commonly computerized research function is financial administration. However, a number of universities report having computer programs for proposal/award monitoring, space management, personnel management, equipment management, program management, data base management, and report generation. If the university does have an automated system for storing and updating research project information after awards are made, it would be useful for the safety and health program office to "piggyback" project profile information for safety and health purposes onto the existing system if possible. Pertinent data for safety and health planning purposes would include (in addition to the hazard information listed on the grant cover sheet):

- Project personnel
- Laboratory location
- Laboratory containment level
- Special equipment required
- Health standard monitoring required.

The grant application would provide most of the input data, although it might require expansion to include the above issues.

*Zella Ruthberg and Gloria Bolotsky, Software Exchange Directory for University Research Administration, Washington, D.C.: U.S. Government Printing Office, 1976.

EXHIBIT IV-1

RESEARCH HAZARD IDENTIFICATION AND MONITORING INFORMATION OBTAINABLE THROUGH THE GRANT APPLICATION AND REVIEW PROCESS

The information listed below is relevant to the needs of the occupational safety and health program. Other information may be required for research administration purposes.

The proposed sponsor of the research

The project title

The duration of the project

The Principal Investigator(s): name, rank, department, address, phone number

Proposed research staff: names, rank, departments, addresses, phone numbers

The location of the laboratory in which proposed research will be performed

Containment level of the proposed laboratory

Details on any protective equipment required for the proposed research

Use of any of the following in proposed research, and if so, indication of notification of the institution's occupational safety and health program as well as appropriate special review committees:

- Human Subjects
- Warm-blooded Animals
- Recombinant DNA
- Ionizing or Nonionizing Radiation Sources
- Highly Toxic, Flammable, or Reactive Chemicals
- Biologically Hazardous Agents
- Human or Animal Carcinogens

University's commitment in any of the following areas:

EXHIBIT IV-1 (cont.)

Additional space

Alterations of facilities

Use of university staff, financial or physical resources beyond duration of contract agreement

Office or research equipment which has not been requested from sponsor

Approval of application by the following:

Department head

Dean

Research administration program

Appropriate committee chairmen as indicated by the type of research proposed.

Any other routinely submitted input documents from the principal investigator--such as expenditure reports--might be modifiable to provide a continuous flow of updated profile information.

Review of Purchase Requisitions--
Forwarding purchase requisitions that cover hazardous agents or safety equipment for review by the safety and health program office is another mechanism for identifying hazards. This method is primarily useful for identifying researchers or faculty who are ordering or using hazardous materials and who are not identified through the research administration/grant proposal review process. Approval by the radiation safety officer of purchases of radioactive materials is required under the terms of a university broad licensing agreement with Nuclear Regulatory Commission. However, the safety and health program office may determine that approval should be stipulated for other items also or that certain requests should at least be forwarded to the office for review.

The appeal of an exception-reporting linkage is great because of its superficial simplicity; the safety and health program office simply provides a checklist of hazardous materials and the procurement office forwards a copy of the purchase requisition whenever any of the listed items is requisitioned. The simplicity may be deceiving, however. Several complexities have to be overcome for this linkage to function effectively. First, the list of exception items should be limited to true exceptions--significant or high risk items. If the list is lengthy, the procurement office may find cooperation burdensome or the safety and health program office may be buried in unimportant paper. Second, the exception list must be based upon a stipulated standard vocabulary. If researchers request items by a variety of referents--e.g., catalog number, abbreviated name, generic name, brand or manufacturer's name--the procurement office may find it impossible to enforce exception-reporting. The use of one standardized supply catalog reduces this problem. Moreover, if procurement personnel are experienced in ordering technical and scientific apparatus and supplies, they have fewer difficulties in complying with a standardized checklist. (Exhibit IV-2 lists some items which might be included in a procurement exception-reporting checklist.)

Review of Facilities Modification and Construction Plans--
Procedures should be established so that the safety and health program office reviews all plans for new research facilities as well as modifications to existing facilities to assure that safety and health standards are met. This review process provides two benefits: it enables the program managers to make certain that all research facilities are as safe as possible, and it provides an additional mechanism for informing the program office of the kinds of research planned for the future.

EXHIBIT IV-2*

SAMPLE PROCUREMENT EXCEPTION CHECKLIST

Equipment	Materials
Alphatron vacuum gauges	Toxic compressed gases
Ammonia developing machines	Explosives
Biological safety cabinets	Herbicides and pesticides
Chromatography equipment	Liquified gases
Electron microscopes	Perchloric acid
Electrophoresis equipment	Radioactive materials
Fume hoods	Tetra ethyl lead
Fumigation equipment	Chemical carcinogens
Gas chromatographs	Infectious agents and biohazards
High voltage supplier above 20kv	
Lasers	
Liquid scintillation counter	
Microwave ovens and equipment	
Pressure vessels	
Radiation detection instruments	
Resuscitators	
Personal protective equipment	
Static eliminators	
TV sets or monitors	
X-ray equipment	

*Adapted from University of California at Berkeley hazardous materials and equipment list.

Reporting Relationships With University Health Services--
If employees are sent to the university health services when they have an accident, copies of the accident report should be forwarded to the safety and health program office. This information presents after-the-fact hazard information. Similarly, if the health services office prepares summary reports or epidemiological analyses of service utilization, this information also can provide insight into hazards.

Reporting Relationships With the Risk Management/Insurance Function--
Copies of inspection reports from insurance carriers should be forwarded automatically to the safety and health program office.

Other Relationships and Mechanisms for Hazard Identification--
In addition to reporting relationships, other kinds of relationships and mechanisms, some of which are less formal, can be employed to augment the safety and health program awareness of research hazards. Committees are a cornerstone of many universities' safety programs. Committees which provide a peer review function for researchers would be particularly appropriate conduits for hazard information. One risk management consultant convenes ad hoc committees in various research disciplines to participate in research identification "brain-storming" sessions. A laboratory safety and health coordinator network composed of representative researchers in different fields can be used to develop informal communications linkages with researchers in different laboratories in the university. These representatives can assist in reinforcing safe research practices, communicating safety and health policy, and identifying hazards and program needs. One approach to this is to have graduate students serve as laboratory "safety officers"; these may be unpaid positions to which students are appointed by the faculty member in charge of the lab. Feedback from training and orientation programs on occupational safety and health practices can provide an informal source of hazard information. Informal and ongoing contact with personnel in physical plant, maintenance, and security functions can provide hazard information; these personnel are in research facilities frequently and may spot unusual situations or gross carelessness. Good working relationships with researchers themselves may be the most important element for identifying hazards and for overall program effectiveness. Defining the formula for good working relationships is not within the purview of this report; however, the establishment of a good service relationship strengthened through high caliber consultation, timely relief in crises, and pertinent and regular occupational safety and health information communications all help.

Finally, the occupational safety and health program manager should remember that the definition of a "hazard"--particularly for chemical agents--may change with further research and higher standards. Part of the hazard identification process, therefore, involves maintaining information ties to the external environment, particularly to governmental agencies.

Activity Forecasting

When hazard classes have been identified, it is necessary for the safety and health program manager to determine the activity requirements imposed by the hazard identification process. To do this, hazard information should be analyzed for workload implications.

In effect, through various mechanisms the program will accumulate a data base of hazard information. This data must be stored in orderly records so that it can be accessible for day-to-day reference. It may not be possible or desirable to utilize an automated system. However, the potential for "piggybacking" some of the information related to research projects with an existing research administration system should be considered. If this approach is used this hazard information undoubtedly would be filed on a project basis. Each file would contain information relevant to safety and health that would be gleaned from the application cover sheet. In addition, some provision would need to be made to assure that the files could be updated whenever significant changes occurred on the projects, such as changes in research staff, hazardous agents employed, or laboratory location. The pragmatism of this approach would be heavily influenced by the existing system and procedures.

Alternatively, all hazard information could be maintained in a separate filing system unique to the program. The system should provide for retrieval of information across three fields: function or element of the occupational safety and health program, laboratory facility, and research project (or principal investigator). If, for example, biosafety is a program element, data on specific biohazards should be retrievable by location and by project. In other words, a cross-indexing capability should be installed. The capacity to cross-index, either manually or by computer, provides two benefits. First, data that is collected by other parts of the university and is transmitted to the safety and health program can be directed to the correct record. Second, cross-indexing provides greater flexibility in satisfying management needs for information. For example, on subsequent days, the program manager may need to know how many laboratories are involved in generating radioactive waste or what staff worked on specific research projects at a particular time.

Initially, however, the construction of a hazard data base is useful in developing an activity forecast. This is simply a tabulation of the potential kinds and level of effort required to monitor the hazards present in the university research environment. Requirements could include both legal requirements and professional standards. For example, certain types of equipment, such as fire extinguishers and biohazard containment cabinets, should be inspected at regular intervals. Knowing the number of extinguishers and the time needed to inspect each, the program manager can make a rough projection of the total workload required. Similar projections can be made for many predetermined routinized activities, such as training, environmental monitoring, administrative record-keeping, and inspections. In general, legal constraints and funding agency requirements can provide a "floor" of activities that the program ought to do. This base level of activity will then be modified as a result of the program manager's professional judgment and responsiveness to the priorities of the university. Estimating the level and types of work activity required based on the hazard data base is also a matter of judgment. However, work measurement systems, which are discussed below, can facilitate the decision-making process.

Work Measurement Systems Provide Data for Activity Forecasting

A work measurement system records staff time and effort spent on different types of activities over a period of time. It is like an accounting system for human resources instead of dollar resources. Work measurement systems usually assign code numbers to different categories of activity. Program staff use the codes to record the way their time is spent or the amount of work completed. This information usually is collected on a monthly or pay period basis.

The process of developing a structure for work measurement can help to provide a framework for the overall program management process. Care should be taken to select classifications that are pertinent to the kinds of decisions and alternatives the program manager must deal with in evaluating results and allocating resources. Some activity classification categories used by universities include:

- Functional nature of activity
- Incidence of activity (by type)
- Location of activity
- Individual recipient of activity (e.g., faculty, staff, student, visitor)
- Nature of hazard class involved (e.g., fire safety, biosafety, radiation safety)
- Nature of procedure involved (e.g., requested procedure, unplanned procedure, routine procedure)
- Program objective of activity (i.e., specific objective of the safety and health program).

Not all of these categories are required or needed. The program manager can select as many or as few as he needs to support his planning and budgeting process. Simplicity is desirable, since information gathering always involves expense. Exhibit IV-3 is an example, but not a suggestion, of a work measurement approach.

There are two advantages to having some quantitative data upon which to base activity forecasts and subsequently staff and budget requests:

- First, data can provide greater specificity over time than qualitative recollection.
- Second, data provides a more objective basis for communication with other university administrators.

Priorities Must Be Established

There is never enough money to do all desirable things. Consequently, all potentially desirable occupational safety and health activities must be objectively evaluated so that the university can decide rationally which activities will be pursued and which will be modified, deferred, or abandoned.

The process of setting priorities should be broadly collaborative, so that the priorities selected are reflective of the overall interests of the university. One of the first functions which should be consulted regarding occupational safety and health program priorities is the risk management function. The relationship between the safety and health program and the risk management program is one that has potential for close integration, since both functions are concerned with risk, albeit from somewhat different perspectives. The process of risk analysis used in the risk management functions is particularly useful in assisting safety and health program managers to define criteria for evaluating program priorities.

Risk analysis is a process for evaluating potential risks associated with particular activities. Usually, risk analysis involves consideration of two aspects of potentially negative incidents: probability and severity. "Probability" refers to the estimated frequency or likelihood of incidence. "Severity" refers to the impact of loss in terms of dollars or degree of physical impairment. The procedure for risk analysis using these two factors involves the development of classes for severity and probability or risk. These classes are used subsequently to rank the

EXHIBIT IV-3
A TYPE OF WORK MEASUREMENT

Record of hours worked

ACTIVITY	SERVICE	LOCATION	① 16	② 17	③ 18	④ 19	⑤ 20	6 21	7 22	⑧ 23	⑨ 24	⑩ 25	⑪ 26	⑫ 27	13 28	14 29	15 30	31
03	01	03	8	8	8													
04	01	03				2				2		2	7	6				
01	01	03				6												
12	01	03								2			1					
10	00	00									8							
09	01	03					8											
11	01	07								6		6		2				
TOTAL																		

Employees Signature

Approved by

PERIOD JAN 1-12

ACTIVITY

01 Inspection
02 Survey
03 Training
04 Consultation
05 Medical Monitoring
06 Personnel Monitoring
07 Environmental Monitoring
08 Administration/Record Keeping
09 R&D/Special Studies
10 Leave
11 Planning/Arch Review
12 Committee Meeting
13 Waste Disposal

LOCATION

01 Residences
02 Classroom Bldg.
03 Laboratory
04 Hospital-Patient Area
05 Forestry Center
06 Observatory
07 Administrative Offices
08 Fine Arts Building
09 Student Union
10 Stadium/Athletic Facility
11 Grounds

PROGRAM SERVICE

01 Biohazard Control
02 Fire Safety
03 Radiation Control
04 Ventilation
05 Air Pollution Control
06 Noise Control
07 Insect and Rodent Control

riskiness of alternative events. The following classes are illustrative of those used by some organizations.

SEVERITY CLASSES		PROBABILITY CLASSES	
I.	CATASTROPHIC	A.	IMMINENT
II.	CRITICAL	B.	PROBABLE
III.	MARGINAL	C.	POSSIBLE
IV.	NEGLIGIBLE	D.	UNLIKELY

Definitions are developed explaining each class in terms that are meaningful to the organization. (For example, "catastrophic" may, to one organization, refer to losses over $500,000 and involving death or dismemberment to more than one person; another organization may have lower or higher standards. Historical data describing university experiences with accidents is used to develop definitions.) A risk analysis matrix is developed and risk categories which combine both variables are determined. (The exhibit on the following page displays graphically one such matrix.) Various events are ranked in terms of the probability and severity, and those events that fall in the categories of high combined risk (e.g., imminent and catastrophic) are considered priority risks to be addressed by program activities. Thus, potential accidents or incidents are ranked so that management attention can be focused on those having the worst repercussions.

Some university safety and health program managers raise questions regarding the use of only two variables. From their vantage point, "severity" should be broken down into two variables: intensity, i.e., dollar impact or severity of injury, and extensiveness, i.e., the number of people affected per incident. The argument for this is that it provides more emphasis on the human involvement in risk. However, the introduction of a third variable makes the matrix construction and evaluation process much more complex. For illustrative purposes, a three-dimensional matrix is shown on the following page.

The difficulties in applying risk analysis to a university research environment are: first, much of the program activity is determined by outside standards and requirements, and second, the probabilities and consequences of some types of research accidents are unknown. It may not prove satisfactory for comparing specific activities. However, it can be helpful in providing a framework for examining alternative areas of program functional emphasis or in comparing alternative projects involving significant expenditures.

Another approach to comparing varied activity alternatives with different potentials for risk is cost/benefit analysis. Cost/benefit analysis is a modification of a method for analyzing investment decision alternatives called the net present value method, which is used in the private sector. The first step in conducting cost/benefit analysis is to list all the potential costs involved in undertaking a project. Future as well as immediate costs, both

EXHIBIT IV-4
A RISK ANALYSIS MATRIX USING TWO VARIABLES

SEVERITY

PROBABILITY	I	II	III	IV
A	IA	IIA	IIIA	IVA
B	IB	IIB	IIIB	IVB
C	IC	IIC	IIIC	IVC
D	ID	IID	IIID	IVD

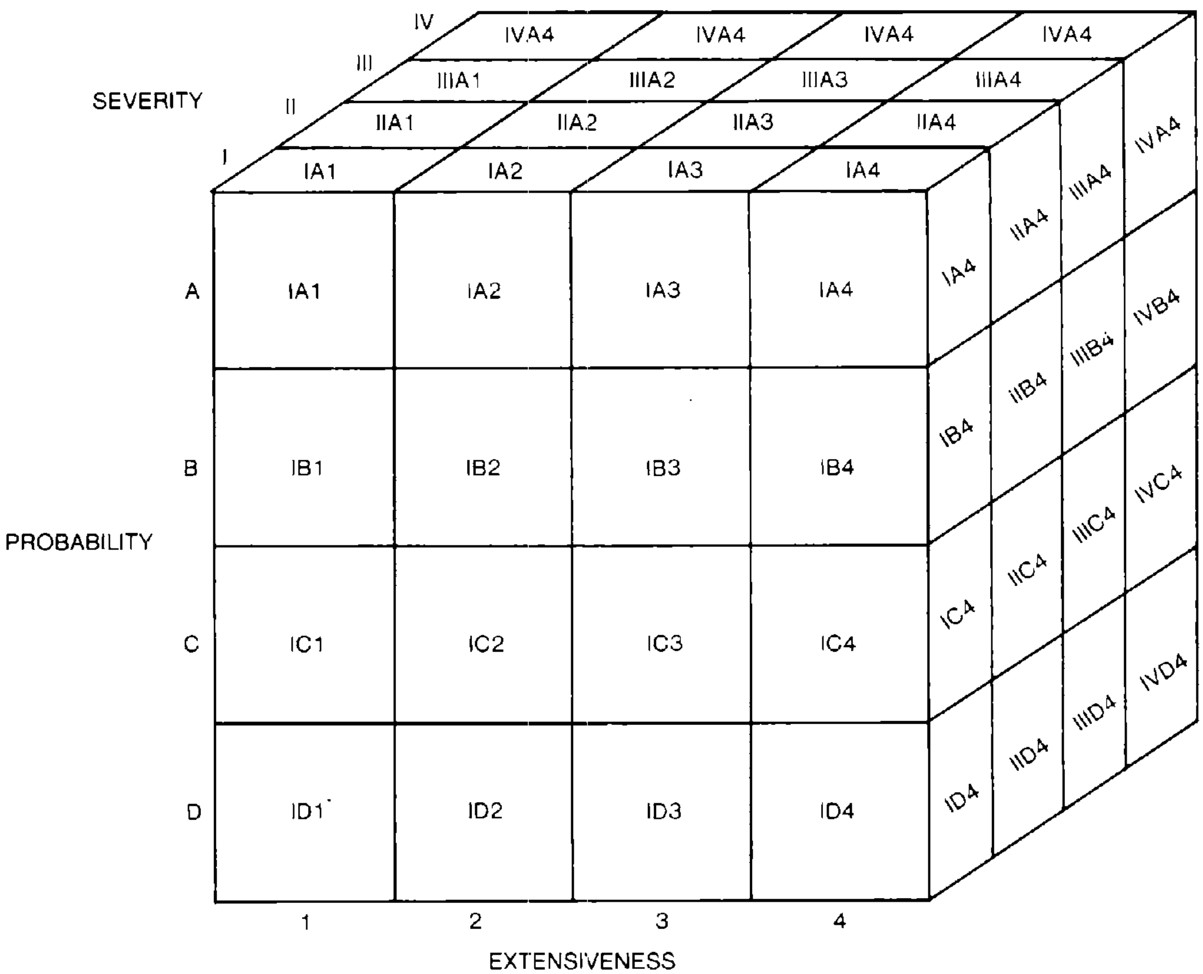
IMMINENT DANGER: IA or IIA

SERIOUS DEFICIENCY: IB, IC, ID, IIB, IIC, or IID

NON-SERIOUS DEFICIENCY: IIIA, IIIB, IIIC, or IIID

MINIMAL DEFICIENCY: IVA, IVB, IVC, or IVD

EXHIBIT IV-5
A RISK ANALYSIS MATRIX WITH THREE VARIABLES



SEVERITY CLASSES	PROBABILITY CLASSES	EXTENSIVENESS CLASSES
I. CATASTROPHIC	A. IMMINENT	1. TOTAL
II. CRITICAL	B. PROBABLE	2. BROAD
III. MARGINAL	C. POSSIBLE	3. LIMITED
IV. NEGLIGIBLE	D. UNLIKELY	4. SINGULAR

direct and indirect, should be included. These costs form a stream of dollar outflows from the organization. The stream may continue indefinitely or may discontinue after a period of years. For most major expenditures (such as capital improvements), however, dollar outflows will be required over a period greater than one year. Maintenance and upkeep costs, for example, should be included in the cost outflow stream. The outflow stream should be displayed in terms of the years in which outflows will occur:

Year 1	$25,000	
Year 2	1,500	
Year 3	800	(per annum)

A similar process is conducted for benefits. To do so, all benefits also must be expressed in dollar terms. For most non-profit organizations, such as universities, the attribution of dollar costs to certain kinds of benefits, for example, saving a human life, poses difficult judgmental problems. There are books and articles,* however, which provide information on procedures other organizations have used. When benefits are expressed in dollar terms, a dollar inflow stream can be constructed, similar to the cost outflow stream. Again, the benefit dollar stream is related to the years in which benefits will accrue.

At this point, the project under review is expressed in terms of a series of cash flows (either proceeds or outlays) extending over several time periods. Now the two cash flow streams must be compared. The comparison is achieved by expressing both streams in terms of their total present dollar value. The determination of the present value of a dollar to be realized (or expended) at some point in the future is achieved through the application of a discount rate. The principle behind the use of a discount rate is that future dollars are inherently less valuable than present dollars, due to income loss. Thus, costs incurred five years from now are less onerous than costs incurred now, and benefits accruing this year are more desirable than those accruing five years from now. The discount rate is mathematically derived from annual rates of compound interest. Thus, the present value of x dollars received in the future equals y dollars at present, if invested at a particular rate of interest.

The specific discount rate selected is based upon the cost of capital (i.e., the cost of getting additional money) to the institution. (The present value concept is an accepted financial

*See, for example, Anthony and Herzlinger, op. cit., pp. 198-199.

evaluation principle; further description can be obtained from any text on capital budgeting.)* When the discount rate is applied, if the present value of dollar inflows exceeds the present value of dollar outflows, the proposal has a positive cost/benefit ratio.

Several critical points emerge regarding the use of cost/benefit analysis to evaluate safety and health program alternatives:

- First, benefits and costs are not simply tallied up and compared. The time in which they occur is critical to the acceptability of the proposal. Thus, $10,000 to prevent slow developing leukemias will not present the same ratio of desirability as $10,000 to prevent fires, even if both will produce $25,000 of benefits, if the benefits from fire prevention start next year and those from leukemia start in fifteen years.

- Second, the process can be highly judgmental. Assigning dollars to social benefits can be strongly influenced by personal biases, or can be biased by the yardsticks used. For example, valuing a life on the basis of income expectancy has been done by some organizations. From this point of view, alternatives which accrue benefits from saving faculty researchers will always appear advantageous as compared to those for saving maintenance workers.

- Finally, the process can be mathematically complex. Forecasting income streams and setting the cost of capital can involve substantial computational effort.

Therefore, many universities may wish to utilize cost/benefit analysis only for major capital undertakings, if at all.

Many universities may find that both risk analysis and cost/benefit analysis are too cumbersome to be useful for examining the day-to-day operating activities of the program and developing an annual program plan. A more judgmental approach which may be useful is called the Delphi method. This method merely requires that decisions regarding priorities are based upon the collaboration and consensus of representative experts. Thus,

*The net present value of a proposal is:

$$N = A_o + \frac{A_1}{(1+k)} + \frac{A_2}{(1+k)^2} + \ldots \frac{An}{(1+k)^n}$$

where k equals the discount rate, and A the cash flow.

occupational program staff might participate in an initial review of program priorities. The results of their review subsequently would be reviewed by other university administrative staff. The administrators who should be involved include: the risk manager, the head of research administration, the vice presidents of finance and academic affairs, and the director of the physical plant.

By forcing broad collaboration, this approach may encourage a wider commitment to and understanding of the program. It would appear most useful when used in combination with some preliminary ranking of projects, or structuring of the problem, through risk analysis or cost/benefit analysis.

Priorities Can Be Translated Into Program Objectives

The development of specific objectives is a characteristic of a management-by-objectives (MBO) system. A detailed application of MBO may not be desired by the safety and health program, nor is it necessarily advocated. However, the underlying concept of MBO is essential to successful program management, and that is managing for results.

In MBO, objectives have specific characteristics. These characteristics are pertinent to defining results.

- First, an objective must be action-oriented.
- Second, it must relate to results which can be directly influenced through efforts of the organization. There must be a logical and direct relationship between effort and result.
- Third, it must be quantifiable. It must be amenable to objective measurement, not subjective evaluation.
- Fourth, it must be time-limited. The objective must indicate when the results are to be produced.

Regardless of whether a formal system for MBO is instigated, the process of setting objectives and managing for their achievement serves some valuable purposes. It provides a framework for future evaluations of performance, both of the program as a whole and of individual staff members. Thus, objectives supply a control mechanism much like a sales target. Objectives also force explicit statements of intention, which enable groups of individuals to act cooperatively. Safety and health programs require cooperative efforts, not only from program staff, but also from other parts of the university.

OUTPUTS OF THE PROGRAM PLANNING PROCESS

As a result of the program planning process, the safety and health program manager should have the following outputs:

- A hazard profile of the university
- An activity forecast
- A program activity structure and work measurement system
- Specific objectives with time deadlines.

At this point, day-to-day management controls such as staff assignments and work schedules should be developed. These operating level systems are the subject of the next chapter.

SUGGESTED FURTHER READINGS

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CONTROL OF OPERATIONS

This chapter presents techniques for monitoring activities so that the occupational safety and health program achieves its objectives. In this chapter, techniques are presented to monitor activities performed by the program directly as well as activities performed by other parts of the university. The following topics are discussed: (1) program activity controls for routine activities, (2) program activity controls for unpredictable activities, and (3) controls for activities performed by non-program personnel.

PROGRAM ACTIVITY CONTROLS

The chapter on planning discussed the process by which the program examines the hazard profile of the university and develops a program plan to address it. The task of the operational phase is to develop mechanisms to reinforce the planning effort.

There are really two kinds of effort which the program manager must control: routine, predictable activities and non-routine, responsive activities. Clearly, only the first set of activities is amenable to a priori control mechanisms; responsive activities can be monitored but not, to a great extent, controlled.

Controlling Routine Activities

Conceptually, the development of systems to control routine activities is simple. Most control mechanisms are variations of checklists or schedules. As such, they provide a systematic record for indicating what needs to be done and when; what should have been done and has not been; and what has been done. Although these three issues are minor variations on the same theme, all three types of records are required for managerial and legal purposes. The control system can serve as a legal liability protection only if it provides an "audit trail" of expenditures and actions completed. Documentation should be retained to indicate that the safety and health program has exercised proper responsibility and due caution.

The development of an operations control and documentation system is drawn from the activity forecasting and program design process. When the planned program activities and specific objectives are determined, it is necessary to set up a system to monitor performance against plan. The design of control mechanisms is determined primarily by the functional nature of the activity involved.

It is anticipated that as a result of the need for staff specialization many safety and health programs will be organized on a hazard class basis rather than on a functional basis; that is, staff will be assigned on the basis of expertise in radiation safety, biosafety, industrial hygiene, industrial safety, etc. However, it is simpler to present general systems concepts based on the functional nature of the activity, i.e., inspections, surveys, monitoring, etc., rather than hazard class. These control approaches apply only to those services to be performed by the program office itself. Other control mechanisims, which will be discussed later, relate to those program activities assumed by other units of the university or by outside organizations and consultants.

Inspections--

Inspection activity should be controlled initially by schedule. The various types of inspections of both laboratory facilities and equipment which must be conducted at a large university with extensive research activities should be classified by type (e.g., fire extinguishers, fume hoods, laboratories) and separate scheduling systems set up. At smaller universities, it may be feasible to set up one master schedule which would list all the types of inspections to be conducted on a monthly basis. In either cases the schedule system would include:

- Type of inspections (type of equipment, type of facility inspection)
- Sites of inspections
- Research activity on-going (if appropriate)
- Responsible department
- Principal investigator(s).

The result of the inspection activity itself will be an inspection report or document certifying that the inspection took place and, in some cases, a list of findings and corrections. The documentation associated with inspections will vary according to the type of inspection--a "walk through" inspection of a laboratory building may produce an actual report of findings and corrections, while inspection of fire extinguishers might generally only require signature on a certification tag. In order to utilize the scheduling process as a control mechanism, however, some provision must be made for feedback or verification, from the inspection activity to the schedule log. The technique selected to verify that an inspection occurred should be as automatic as possible, both to minimize work and to increase validity of the control. For example, if laboratory inspection reports are numbered sequentially when submitted, the report number can be entered in the schedule log as evidence of completion. By using the number as a control, the system has a built-in verification check using the report itself as physical evidence.

There should also be a feedback loop which enables follow-up controls on the correction of impairments. That is, if the inspection report indicates that corrections are to be made by the safety and health program, then this information should be incorporated into the program activity forecast. Abatement plan schedules can be incorporated into the program activity forecast. If other parts of the university are to perform corrections, this information should be fed back into the inspection schedule log to be verified at a future date.

The process of using an inspection schedule control system is summarized graphically on the following page.

Surveys--
Surveys are generally used by safety and health programs to develop inventory records of hazardous agents or equipment or safety/protective equipment. The survey also may be used to update hazard profile information, such as names and locations of research project staff, nature of research, special safety equipment requirements, etc.

Generally, the survey effort is not as burdensome as inspections in terms of workload. Therefore, although surveys should be scheduled, the control effort does not focus on scheduling the survey per se but on assuring that the widest possible number of appropriate respondents is reached and that 100 percent participation is obtained, if possible. Extensive follow-up is the only way of assuring this response rate. Therefore, the primary control mechanism is the survey log, which tracks survey forms by code or name, date of receipt, and nature and date of follow-up effort. A sample survey log sheet is shown in Exhibit V-2.

Training--
The assurance that research project staff members have been properly trained before beginning hazardous work may be the responsibility of the principal investigator or of the safety and health program. Many safety and health programs do provide training services to research programs.

The control of the training effort focuses on monitoring the training required for and received by individuals on the research staff. Identifying information about research staff members must be drawn from the research hazard data base. (Information about research staff working on externally funded projects may be obtainable from research application cover sheets or ad hoc surveys of principal investigators. If students are also to be trained by the occupational safety and health program before working in laboratories, a survey of faculty who teach laboratory courses would be required.) If the principal investigator assumes full responsibility for assuring that researchers are properly trained,

EXHIBIT V-1

INFORMATION FLOW: INSPECTION CONTROL SYSTEM

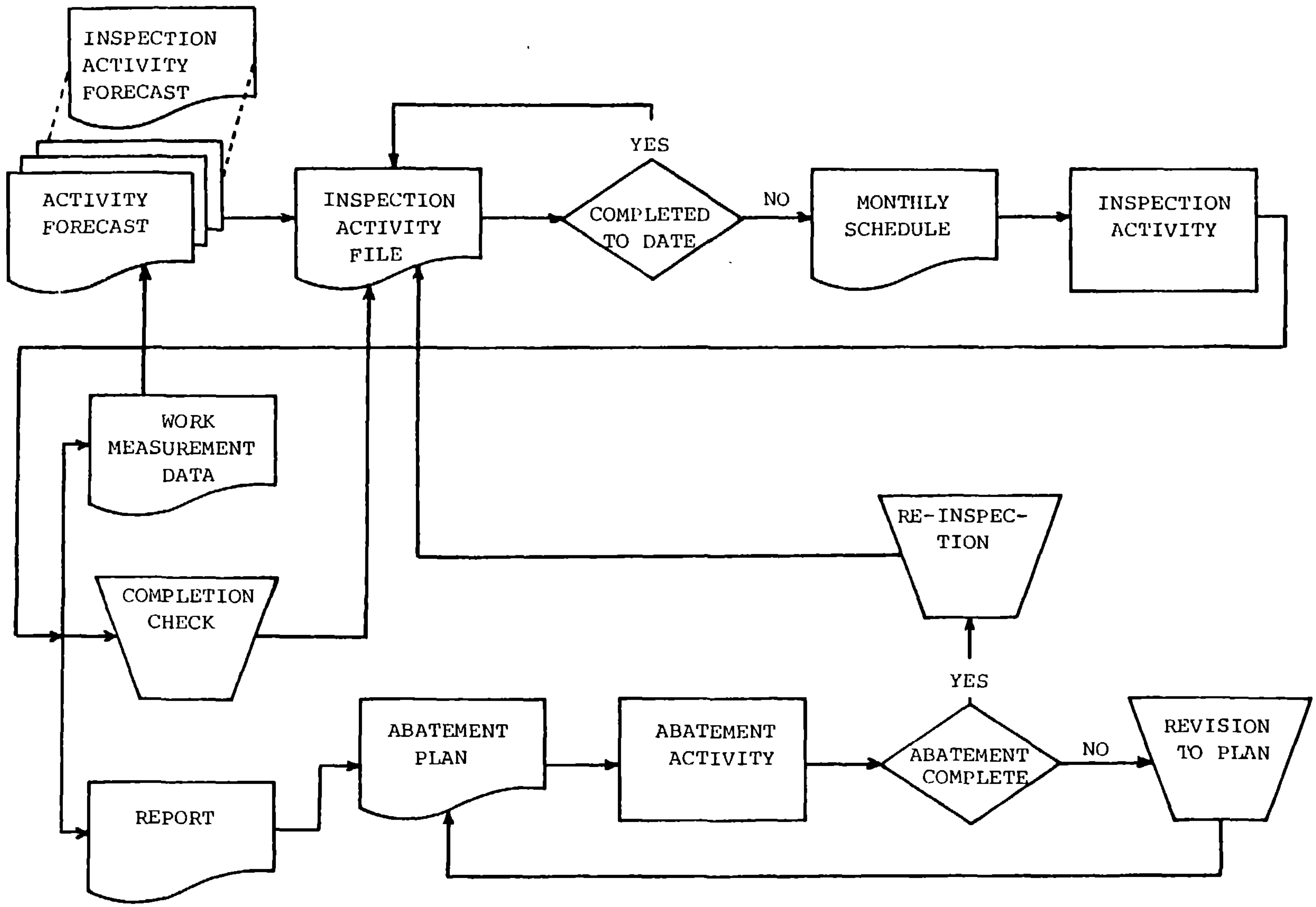


EXHIBIT V-2

SAMPLE SURVEY LOG SHEET

RESPONDENT'S NAME	I.D. NUMBER	DATE OF RECEIPT	REVIEW COMPLETED*	DATE OF FOLLOW UP

*After questionnaire has been reviewed and checked for completeness, check this column. If questionnaire is not complete, follow up on missing information and then fill in both follow up and review columns.

documentation certifying this fact must be provided by the principal investigator to the occupational safety and health program for those research hazard areas where it is required. Essentially, monitoring training activity is accomplished by maintaining current data in log form on researchers eligible for or requiring training and comparing this with attendance records, performance test results, or other records indicating that training has been received.

The best documentation of effort from an audit point of veiw is that provided by cross-checking input records from two different sources. For example, staff identification information supplied by the principal investigator and training records supplied by the safety and health program staff member conducting training would provide tighter control than simply requiring principal investigators to provide information on staff members who had not received training.

Note should be made about the meaningfulness of the receipt of training records. Training now can be provided in a variety of formats, from traditional classroom settings to programmed audio-video or cassette courses. In traditional settings, receipt of training can be demonstrated on the basis of attendance records. However, in the case of self-instruction programs, the only documentation of training that can be provided is the trainee's own certification. For purposes of operational control, attendance records are of adequate utility and self-certification is of minimal utility. However, both emphasize the control of training activity without any concern for the quality of the effort monitored. In the case of training, quality is a particularly critical aspect to monitor. Therefore, competency or performance measures (tests), which would serve both as activity records and as program evaluation inputs, are probably a superior control device in terms of addressing the intent of training requirements.

Personnel, Environmental Monitoring--
The control concepts applied to all forms of monitoring are similar, whether they are directed at potential or actual exposure to hazardous agents of persons who work in the laboratory. Like control of inspection activity, control of monitoring is accomplished through scheduling and logging techniques. However, instead of producing a report of findings and an abatement plan, monitoring activities produce a vast array of information which not only must be retained for long periods of time (20 years for medical monitoring) but is amenable to more sophisticated kinds of analysis than the kinds of data produced by inspections. The analytical potential of monitoring versus inspection data is largely attributable to the fact that much monitoring data involves scalar measurments, while inspections tend to produce binary ("yes, no"; "go, no-go") data results. The considerable and prevalent evidence of long-term health effects of environmental hazards indicates that regulations or social pressure toward further vigilance in monitoring and record-keeping prob-

ably will increase significantly over the present level. Therefore, it behooves university administrators and safety and health managers to carefully consider the control system for this aspect of the program.

Again, the starting point for determining the monitoring schedule is the hazard data base, which provides the basis for the kinds and schedules of monitoring to be performed. If any significant volume of monitoring needs to be done, the monitoring data should be put on a computerized system. However, if only a small amount of data will be obtained, it can be recorded and stored manually.

Environmental monitoring differs from laboratory inspection because measurements are taken. It is similar to inspection, however, because monitoring activity is scheduled. Therefore, some aspects of control are similar to inspections. The program hazard data base is again used to develop an activity forecast, from which is drawn a monthly or quarterly monitoring activity plan covering the full program year. Monitoring data and the activity plan should be organized first by type of monitoring (e.g., noise, radiation, air purity) and second by laboratory location. The addition of actual monitoring data results to each file record is the verification check for completion of the monitoring activity. Any file records (i.e., laboratory locations) missing results data at the end of the month are flagged for management attention. Thus, the information tracked for control purposes includes:

- the locations to be monitored
- the kind of monitoring required at each site
- a monitoring schedule
- monitoring results, by location
- flagging of sites not monitored.

Monitoring personnel involves collection of two kinds of data: exposure data, such as that provided by film badges and dosimeters for radiation exposure, and effect data, provided by medical tests and examinations. The control of the exposure monitoring process is the same for personnel as it is for laboratories except, of course, the data is filed by individual name rather than laboratory location. Since medical surveillance activities are usually performed by non-program staff, this topic is discussed later in this chapter.

Inventory Controls--

A university licensed to use radioisotopes is required by the Nuclear Regulatory Commission to keep inventory records of those radioisotopes authorized under its broad license. In addition, inventory controls of other hazardous materials and agents are required by the Environmental Protection Agency, Drug Enforcement Administration, and the National Cancer Institute. The occupational safety and health program may or may not assume inventory control responsibility for non-radioactive materials; however, the monitoring of radioisotopes coming into the university and the disposal of radioactive waste is the responsibility of the health physicist, who should be on the occupational safety and health program staff. The control of non-radioactive materials, like radioactive materials, requires a central checkpoint where purchase, receipt, and use data can be accumulated. Inventory data would be maintained by agent type for the whole university or for individual laboratory locations. Input documentation required to support an inventory data base is provided by the following documents.

- A copy of the purchase order;
- A validated copy of the packing list, including date of receipt;
- Locational assignment of the materials; and
- Copies of waste disposal forms or labels, or copies of use records provided by the researchers.

Only if both receipt and use/disposal records are routinely provided to a central data base can inventory control be accomplished on an ongoing basis. Alternatively, inventory records for hazardous materials can be maintained through regular surveys of laboratory or research project staffs. In this situation the inventory control process would be the responsibility of the research organization, which would report inventory results to the occupational safety and health program at regular intervals. In either case, regular physical inventories are required to assure that records are accurate--that all hazardous materials are, indeed, registered and that registered materials have not disappeared through theft or inappropriate disposal.

The program itself should maintain inventory records on all its equipment, particularly if the equipment is purchased through grants, if it is loaned to other parts of the university, or if the program maintains a large inventory. Equipment inventory controls can be expanded to include major non-safety research equipment, as well. Frequently, major pieces of research equipment are under-utilized at a university simply because few researchers know of their existence. Duplicate equipment may be purchased, either outright or through contracts, as a result of a lack of information. One university, the University of Iowa, has set up an inventory control system and a procedure for sharing under-utilized equipment among research project staffs, which they estimated saved the university $164,000 in 1974, the first operational year.* (This system could be adapted to include occupational safety and health equipment.) Equipment inventory records for the occupational safety and health program should include information needed for property control (an inventory number, item description, manufacturer's name, serial number, purchaser--if purchased with government funds--cost, year of purchase, estimated year of retirement) as well as information about the capacity/utility of the equipment.

Controlling Non-routine Activities

Non-planned activities include crisis intervention, decontamination, and consultation. These activities can be controlled, after a fashion, through the use of the work measurement system, which was developed initially for planning purposes. However, monitoring can only occur after the fact in these cases. The work measurement system permits accumulation of data describing the work effort of the program. Examination of the way time is spent may indicate potential areas for operating more efficiently. That is, variations in time requirements between individuals performing the same or similar activities or variations in performing the same activity for different departments may be significant. A high volume of consultation in a particular subject area may indicate that training or communications in that subject should be considered. On a more gross level, the overall proportion of time that the program spends in a reactive mode may be significant, particularly if this appears to place planned program objectives in jeopardy. The work measurement system provides a mechanism to examine trends and patterns in the safety and health program's delivery and performance of services. Without a work measurement system, significant patterns may not be discernible, particularly if the staff is large.

The analysis of work measurement data, like budget data, focuses on comparisons and variances. Comparisons may be made:

- among individuals, for the same activity
- across time periods, for the same activity
- among activities, for the same time period.

Work measurement systems, like cost accounting systems, lend themselves to the creation of standards. Activity standards entail specification of how performance is to occur. Specifications include the qualitative aspects of performance as well as the time

*Roger G. Ditzel. Research Equipment Assistance Programs, Iowa State University, October 1976.

to be devoted to the activity. Few safety and health program activities are amenable to standardization, except on a very general level. Those activities which probably are most amenable to standardization are the routine activities discussed earlier. For example, a manager should expect that inspections and monitoring activities of similar kinds in similar circumstances (e.g., the same inspection in a similar laboratory) should consume essentially the same amount of time across a number of inspections because the same specific actions would need to be performed. In terms of reactive activities, however, standardization may not be possible or desirable, except at the most general level. For example, if time per consultation shows significant patterning by individual, e.g., John spends 1/2-1 hour per consultation and Sam spends 3-4 hours, management exploration and intervention would be desirable. Standardization is most usually applied in manufacturing situations where repetitive tasks are performed; its applicability in other situations relates directly to the degree of repetition in the activities required.

Aside from the potential for standard setting, the manager's response to significant negative variances in work measurement data may be limited. One response, in some situations, is to consider the development of alternate delivery modes. Training has been cited as an alternate for some types of consultation. Consolidating routine surveys and other inquiries directed to principal investigators is desirable. Assigning one staff member to a crisis intervention function may enable other program staff to use their time more efficiently. Using consultants or other staff of the university to provide certain services also may be desirable.

CONTROLS FOR ACTIVITIES PERFORMED BY NON-PROGRAM PERSONNEL

The responsibility for programmatic management and control extends beyond the overview of activities performed by the program staff. These activities could include: waste disposal, training, procurement review activity, medical examinations and tests, and others. Several basic control techniques are employed.

Monitoring of routine activities performed outside the program office can be accomplished by many of the same scheduling and logging controls described earlier. Reporting relationships, e.g., submission of results data, can be established to assure that activity is monitored regularly. Exception-reporting mechanisms should be built into the monitoring system, and regular reporting of exceptions (e.g., personnel who do not appear for monitoring) should be an integral part of the system.

Medical surveillance is a good example of activity which is usually not performed by the occupational safety and health program staff, but which can be an important part of the program plan. Medical surveillance control techniques are similar to those for personnel and environmental monitoring, except that the amount of monitoring data obtained for each individual is more extensive than other personnel and environmental monitoring. Data elements involved in medical surveillance are listed in Exhibit V-3. There are, however, several key differences.

First, the individuals providing data to the medical surveillance data base will almost certainly not be members of the safety and health program staff, but instead will be professional medical personnel. Therefore, the process for transferring medical data to a record system--whether the transfer occurs manually with standard forms or is keyed in interactively to a computer system--must be developed in conjunction with the medical professionals performing the evaluations.

Second, some manually stored records must be maintained for all "active" personnel, i.e., individuals requiring ongoing surveillance. These records should be available to medical personnel in case of any emergency (again, regardless of how the information is stored for safety and health program purposes). For purposes of medical surveillance, it must be retrievable by individual name. This applies to both active and inactive records.

Third, the record-keeping system for medical surveillance should make provision for storage of qualitative information as well as quantitative data. Symptoms and complaints evident at the time of examination therefore can be recorded.

Fourth, individual findings from medical surveillance are, like all medical records, confidential. For control purposes, the data requirements of the safety and health program do not require individual medical data. All that is required is an activity record (i.e., that the appropriate monitoring in fact occurred), with a capability to "flag" problems and incomplete files and a capacity to aggregate data for epidemiological analysis, if the sample size and program sophistication permit this.

The flow of information in a medical surveillance control system is graphically displayed in Exhibit V-4.

Some activities performed by outsiders cannot be controlled by day to day monitoring. They require an audit approach. Audit techniques are always after-the-fact and include:

- sampling work performed by other organizations for thoroughness, comprehensiveness, and accuracy;

- activity or incident counts of work performed by other organizations taken at regular intervals (e.g., quarterly, monthly).

EXHIBIT V-3

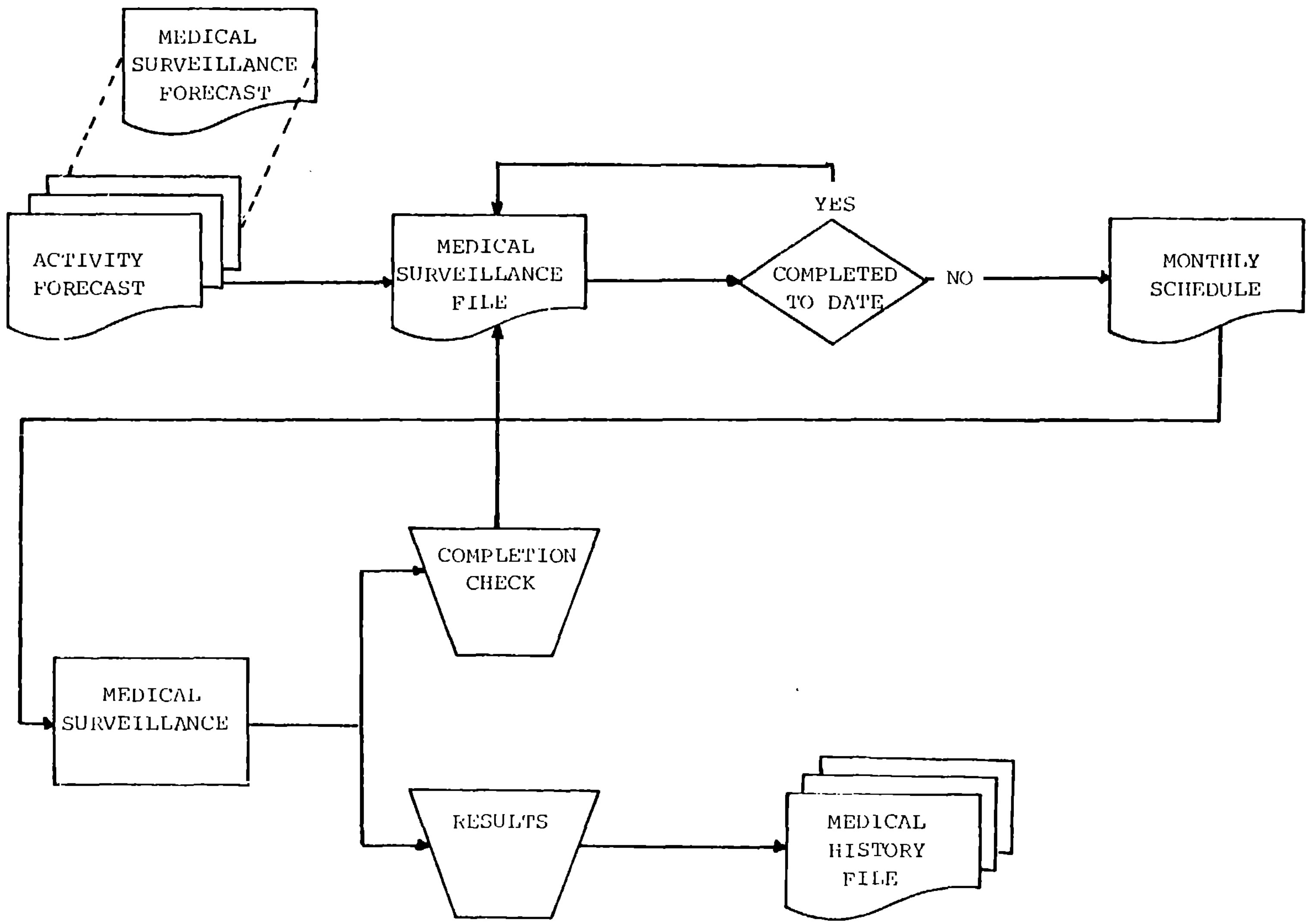
DATA ELEMENTS FOR MEDICAL SURVEILLANCE

- Name
- University address
- Type of research engaged in
- Laboratory location
- Record of exposure to hazardous agents during employment
- Medical history
- Physician's comments from periodic visits
- *Pulmonary function tests
- *Blood tests (e.g., blood count, serological tests)
- *X-ray
- *Audiometric function
- *Immunization records
- *Urinalysis
- *Vision test results
- *Electrocardiogram (dynamic and stationary)
- Accident reports

*As required by nature of research hazard exposure

EXHIBIT V-4

INFORMATION FLOW: MEDICAL SURVEILLANCE SYSTEM



Some additional after-the-fact control mechanisms are discussed in the following chapter on evaluation and can be employed on an interim basis.

SUGGESTED FURTHER READINGS

Ditzel, Roger G. "A Research Equipment Assistance Program." Journal of the Society of Research Administrators, Spring 1976, pp. 26-36.

Ditzel, Roger G. "Research Equipment Assistance Program, Volume I." Report. National Science Foundation, Research Management Improvement Program, Washington, D.C., October 1976.

Porter, W. E., Hunt, C. L. Jr., Bolton, N. E. "A System for Labeling and Control of Toxic Materials in a Large Research Facility." American Industrial Hygiene Journal, January 1977, pp. 51-56.

EVALUATION OF PROGRAM ACTIVITIES

This chapter focuses on the variety of evaluative techniques available to assess the effectiveness and efficiency of the program. The subject matter should be of interest to university administrators other than the occupational safety and health program manager, specifically, the risk manager, the vice president overseeing the program, and those university staff involved in management analysis and systems design. The results of the program evaluation process should represent the needs of the university's top decision makers since these individuals will be more concerned with the effectiveness of the program than with many of the operational details discussed earlier.

MEASUREMENT--OF WHAT?

Program evaluation mechanisms used by most universities encompass five types of measurement factors:

1. Results
2. "Proxy Results"
3. Products
4. Time/Activity
5. Money.

Monetary measures are dealt with in the chapter on financial management; the remaining factors will be discussed here.

Results

Results are the most desirable indicator of program performance. To be a true indicator of results, the measure should fulfill three criteria: first, it should be quantifiable (or able to be measured); second, it should be directly related to the program effort; and third, it should be uninfluenced by any other contributing or conflicting factors. Unfortunately, it is difficult to isolate good results measures for university health and safety programs. Safety offers better opportunities for results measures than health. Many universities measure the number of accidents and accident-related insurance claims with the view that a result of improved safety is fewer accidents. This is probably the best results measure to which the safety effort can be subjected, and yet, even it has flaws. In the short-run, for example, some organizations have found that an increased awareness of safety combined with an improved reporting system -- both of which should be generated by a good safety program -- may result in an immediate upward curve in the numbers of accidents reported. This should not hold true in the long-run. However, in the research safety area other factors preclude relying solely upon accident and claims data to evaluate program performance. For example, the autonomy with which externally funded researchers are allowed to function may make it difficult for the research safety and health program to exert real control over the way in which they actually proceed in terms of safety and health. Even the Center for Disease Control has had incidents which reflect the limitations of any research safety and health program. When a lassa fever spill occurred at the research facility, the following report emerged:

> "The laboratory was designed for maximum security. But the men evidently disregarded a glass-fronted container that officials said was specifically intended to protect researchers against exposure . . . (in case of) accidents.
>
> The researchers were wearing the required gloves, but had on their usual street clothes instead of the scrub suits normally required for such work. . . ."*

Nevertheless, accident reporting is probably the most satisfactory measure of program safety results. However, defining what needs to be reported is a critical factor in creating a measure that meets the three criteria mentioned earlier. Most universities report only those accidents which result in a physical injury sufficient to send the injured person to the university health services. Other organizations, however, combine the interests of the safety and health program, the risk management program, and general management in reporting different classes of accidents. For example, the National Aeronautics and Space Administration (NASA) has expanded the concept of accident reporting into incident reporting. At NASA, there are four categories of situations for which reports are prepared. Two are accident categories, with different degrees of severity, and the other two are "incidents" and "mission failures." An "incident" includes "a near-miss occurrence which could have resulted in an accident." What is significant in these four mishap reporting categories is that they reflect an awareness that some "near-misses" may be as informative as an accident in providing information for evaluation purposes. Another point of interest is that the "mission failure" category reflects the priorities of the line manager as well as those of the occupational safety and health program manager.

*Michael Putzel, Associated Press, "Lab Team Splashes Deadly Fever Virus," The Washington Post, June 21, 1978.

Thus, in a research environment, a containment problem that produced no crises or illness but that affected the schedule for the research project also can be helpful in an evaluative context. Mandating control reports of this nature would probably not be feasible in a university environment; however, cooperative relationships with researchers could be used to encourage them informally to report non-injury or damage causing mishaps that have safety and health implications.

Accident reporting should be closely evaluated by university administrators with the objective of limiting the number of separate reports which are filed per accident. In some cases, OSHA forms, health or worker's compensation forms, property claims forms, health services forms, and others may all result from one accident. One form could be designed to provide all the information required for other kinds of reports. Goddard Space Center, for example, has developed a safety report form that can be used to obtain data that formerly required sixteen separate forms. It includes data on occupational and non-occupational injuries and illnesses and property damage incidents. The one form cannot be used directly to meet reporting requirements of all external agencies. However, the form supports a computerized data base from which data can be transcribed by clerical personnel to external agency forms.

In combining these forms into one form, Goddard fulfilled another concern in accident/incident reporting that should be considered by university administrators: virtually all data is coded. The use of closed-ended questions with coded answers is preferable to open-ended questions because there is less opportunity for injection of supposition or conjecture, which could prove detrimental if a liability suit occurred.

The exhibit on the following page indicates the data covered by the Goddard approach. Note that the Goddard approach permits the gathering of additional evaluative data regarding dollar costs of property damage and impact on work activity. This data enables management to obtain a clearer picture of at least some of the results of the safety and health program. Evaluative results of this kind of reporting can be subjected to epidemiological analysis* as well as effectiveness analysis.

The development of such a reporting approach requires considerable effort and collaboration in order to determine not only the information needs of university administrators but also of outside groups. Input must be obtained from the risk manager/insurance manager, personnel director, administrator in charge of worker's compensation, and director of health services in the process of designing the reporting form.

*Monica H. Schaeffer, "An Evaluation of Epidemiological Studies Related to Accident Prevention," Journal of Safety Research, March, 1976, Vol. 8, No. 1, pp. 19-22.

EXHIBIT VI-1

DATA ELEMENTS INCLUDED IN GODDARD REPORT FORM

Note: All information marked by asterisks is recorded through free format or predetermined alphanumeric coding.

* * Type of report (title is also written)
* * Date and Time
* * Place
* * Person Involved (name is written)
  * * - Social Security No.
  * * - Sex
  * * - Age
  * * - Occupation
  * * - Organization
* * Activity Engaged in
* * Type of Incident
* * Agency Involved (what was used, done, etc.)
* * Result of Incident
* * Nature of Injury/Illness
* * Part of Body Affected
* * Severity of Injury/Illness
* * Human Factor (i.e., human error involved)
* * Physical/Environmental Factor
* * Report Sent to Worker's Compensation Program
* * Action(s) Taken
* * Professional Effort(s)
* * Disposition
* * Property Involved
  - Description (name is written)
  * * - Type
  * * - Ownership
  * * Amount of Loss
  * * Lost Time Data
    * * - Date unable to perform regularly established duties
    * * - Date returned to work (regularly established duties)
    * * - Date returned to work (restricted work activities)
    * * - Date terminated
    * * - Date permanently transferred to alternate duty
    * * - Number of days of restricted activity
    * * - Number of days lost

Narrative Description of event (written)

Corrective action taken or planned (written)

* * - Date Planned

Prepared by (name is written)

- signature (written)
- * - date

Even an enlarged and sophisticated reporting system, such as Goddard's, is inadequate to evaluate the health impact of an occupational safety and health program for research. In fact, the impact of a successful research health program may be difficult to measure. The incidence of contagious disease is one indicator, but since many illnesses with which health programs are concerned are slow to develop, adequate results data may not be available for some time.

Proxy Indicators of Results

The limitations of results measures of program performance has led many universities to augment their examination of results by examining "proxy" measures, i.e., factors which are not results themselves, but can be considered indicators of results. Universities use a variety of proxy indicators in examining program performance.

One frequently used proxy indicator is the result of reviews and inspections performed by objective external agents, such as insurance investigators or funding agency representatives. The interests of inspectors may not be perfectly congruent with the program objectives. However, they should be of interest since the objectives of many universities' occupational safety and health programs include complying with regulations and minimizing insurance rates.

Another proxy indicator which some universities use is client satisfaction, that is, satisfaction of principal investigators and research staff members. Although satisfaction of researchers may not be an explicit objective of the program, the scientific expertise of many university researchers enables them to make highly competent evaluations of the quality of service provided as well as the timeliness of that service. In order to use client satisfaction as a valid measure of program performance, a formal survey process is required. This may be considered too expensive and cumbersome to be utilized on a frequently repetitive basis. However, queries regarding client satisfaction with other types of survey efforts (e.g., a survey of hazardous biological agents) may be more cost effective. Some university administrators have indicated that informal contacts with researchers are a source of evaluative data regarding the safety and health program. Such informal data, however, has little validity and may be misleading regarding actual performance.

A third example of a proxy measure is the historic trend of the university's costs for insurance, both premium and claims costs. This measure is considered a proxy indicator because insurance costs are influenced by a variety of factors outside the university's control; inflation and the claims experiences of other universities are two of the most significant. Short-term relationships between occupational safety and health program efforts and insurance costs would be very tenuous and unlikely to occur.

Moreover, on the health side, the payoff for a good health program for research workers may not be realized in the short run. Ten to twenty years may elapse before cancer and slow-developing illnesses, which might result from research hazards, become evident. The university's volume of claims should show the effect of a good program in the short-run, but this volume will not necessarily be translatable to insurance dollar savings. Thus, long-term trend examination is preferable.

Finally, some universities use researchers' actual substantive knowledge of research safety and health practices as a proxy indicator. This may be more desirable as a needs assessment technique than as an evaluation of effectiveness. To be valid, such an evaluation must be focused only on those research staff members who were trained or impacted by the program. If the total research staff population were included, the results would not be reflective of programmatic effort.

Output Measures and Productivity

The evaluation of effectiveness is balanced by an evaluation of efficiency. Given the lack of good information about the true impact of some health and safety program efforts, the evaluator may be forced to consider the means rather than the ends of program performance. Productivity is one area where data is usually available. Both the program manager and administrators have an interest in the efficiency of the program. Essentially, output measures are simply counts of a particular class of output, for example:

- Number of consultations
- Number of persons trained
- Number of completed inspections
- Number of completed employee medical monitorings
- Number of tests of a particular variety performed.

Only selected critical outputs need to be tracked. They should be determined during the planning process, and the work measurement system and program record-keeping should be set up to facilitate the output counting process.

Time/Activity Measures and Productivity

Time and activity measurement is closely related to output measurement because it also is focused on productivity. However, instead of counting specific output items, these measures are concerned with the way program staff time is used. Some aspects of program effort may not be output-oriented and may be better measured in terms of time expended in different types of activity. A work measurement system is a prerequisite to time/activity recording. Generally, time/activity measures should be used in combination with output measures to provide a more comprehensive view of the way program resources are being utilized.

EVALUATIVE MEASURES ARE USED IN A COMPARATIVE CONTEXT

Each of the four types of measures presented must be used in a comparative context, since as individual data elements they are virtually meaningless. Five types of comparisons are generally used:

- Comparisons against plan
- Comparisons of inputs to outputs
- Comparisons over time
- Comparisons with other institutions or organizations
- Comparisons against standards.

Comparisons Against Plan

Whether or not a formal management-by-objectives system is used, the program planning process should establish specific measurable targets for program performance during the year. At the end of the year, actual performance, in quantitative terms, should be compared with targeted performance. If any single approach to evaluation is to be stressed, it is this one.

Comparisons of Inputs to Outputs

Measures of evaluation should be expressed in input/output form whenever possible. Level of effort or expenditures per university research staff person, program activity, or program staff member are to be preferred over simple input or output figures. Cost/benefit analysis and cost-effectiveness were mentioned within the context of program planning, but these approaches also have applicability in program evaluation. They exemplify the input/output comparison orientation.

Comparisons Over Time

History provides a perspective that most program managers and administrators find useful, particularly when few accepted standards can be applied. In most programs, therefore, performance trend data covering two to five reporting periods should be applied. Caution should be exercised to assure that comparable data is presented; many programs may have undergone extensive change in the mix of program activities over the past few years so that few meaningful comparisons can be made beyond the most recent past.

Comparisons With Others

Comparing the productivity and effectiveness of the university's occupational safety and health program with those of other universities provides useful benchmarks for management appraisal. Again, input/output ratios should be used to eliminate exogenous factors due to size differences among institutions. For example, costs per research person or program staff per research person would provide more accurate comparisons than those based on total university populations.

Comparative data of this type are not routinely available. Therefore, the program manager or some other university administrator will need to establish cooperative relationships with other universities in order to provide for an exchange of performance information. For those universities that have done so, such an exchange has proven to be quite helpful.

Comparison Against Standard

There are few convenient standards of program performance. Those standards which do exist relate to frequency of inspections or monitoring interventions. They are of limited utility in examining overall efficiency or effectiveness, although they are useful for monitoring day-to-day operations.

WHAT ARE MEANINGFUL MEASURES OF PERFORMANCE?

A variety of measures and comparative approaches have been presented. A university probably utilizes all of them, to some extent, in examining different aspects of program performance. Two points deserve mention in regard to selecting an evaluative approach. First, the evaluation should be sufficiently broad-ranging so that: (1) both effectiveness and efficiency are examined, (2) all program component activities are evaluated, and (3) a comparative basis for decision-making is provided. Second, the evaluation process must be compatible with the planning process. In most situations, the measures of performance to be used should be determined during planning and should be known throughout the operational phase. Evaluation provides the critical integrating feedback loop to the management system. Examples of conflict within the management system may be illustrative:

- Staff members who are verbally encouraged to be service-oriented to researchers and assist them with safety and health problems should not be chastised at the end of reporting periods if work measurement data indicates a sharp rise in consulting activities to the detriment of other activities.

- An evaluation based on the number of accidents and incidents reported which showed an upswing in incidents would not necessarily be indicative of program performance if a new comprehensive reporting system were recently initiated.

- An OSHA inspector reports that laboratory fire extinguishers are not fixed at the proper height or painted the right color. Since this item had been a low priority objective during the planning phase, it cannot be held as reflective of program performance in an evaluation context. (If a serious penalty followed, however, it might be reflective of deficiencies in the priority-setting process.)

The process of selecting relevant and challenging objectives, managing a program in order to achieve those objectives, and ultimately evaluating the degree to which they were achieved is the key to a management system. Only if there is this kind of process consistency can a system provide the requisite information support.

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Petersen, Daniel C. Techniques of Safety Management. New York, New York: McGraw-Hill Book Company, 1971.

Schaeffer, Monica H. "An Evaluation of Epidemiologic Studies Related to Accident Prevention." Journal of Safety Research, March 1976, pp. 19-22.

FINANCIAL PLANNING AND MANAGEMENT

This chapter deals with with financial aspects of managing university programs in occupational safety and health. It follows the same three-stage cycle that has been described earlier in the development of programmatic management systems. Thus, financial planning and management parallels that cyclical approach.

In many universities, financial management responsibilities may be handled by staff specialists who are not directly involved in the management of direct or support programs. The integration of programmatic and financial management responsibilities may not occur until an individual reaches a fairly high administrative level, vice president or assistant vice president, for example. Lower level administrators may be responsible for preparing initial budget projections and for operating within assigned budgetary limits, but their involvement in the total financial process management may be limited. Additional financial awareness, however, may be desirable for these individuals to relate more easily to overall university financial concerns. For this reason, it is suggested that both university financial administrators and occupational safety and health program managers may find the financial management information in this chapter useful.

The remainder of this chapter follows a progression through the three stages of financial management: financial planning and budgeting, control of financial operations, and evaluation of financial performance. Although this material is presented in a separate chapter, it is important to note that financial operations are not easily separable from program operations. In fact, successful financial performance should be considered, at all levels, as equally important as program performance in non-financial areas.

FINANCIAL PLANNING PARALLELS PROGRAM PLANNING

Program planning and financial planning should proceed concurrently, since the financial implications of potential program activities will be an influential determinant of their acceptability to the university. This discussion of financial planning is separated into two sections: financing occupational safety and health activities and budgeting for these activities. Financing program activities involves determining from where the funding support for program operations will come. Budgeting, for purposes of this report, is concerned with forecasting anticipated expenditures within various categories. At some universities, program managers may be less familiar with financing than with budgeting, since their responsibilities do not typically require them to locate or acquire the funds that will support program endeavors. Nevertheless, it may be beneficial for them to be familiar with alternative funding sources so that they can participate to some extent in assuring the financial support of the program.

Financing Occupational Safety and Health Programs for Research

On-going operating programs, for example, safety and health programs, are funded through university current funds, both restricted and unrestricted. Normally, universities support a major portion of their safety and health program through unrestricted current funds such as tuition and, in the case of state universities, state appropriations. The budgetary request from safety and health programs must compete with a variety of other programs and organizational units for a share of the current funds. Given the current financial pressure in which many universities now find themselves, this means that the safety and health program is placed in a highly competitive position in seeking a share of the university's general funds.

A significant issue, therefore, in financing safety and health efforts is to minimize financial pressures on existing sources of current unrestricted general funds by one of two strategies: (1) greater utilization of available restricted current funds, whenever that is possible, or (2) acquisition and utilization of additional sources of current unrestricted funds. Each of these strategies is briefly discussed.

Restricted current funds are those funds that can be used to support current operations, but are limited to only certain specific activities. Of greatest interest to the occupational safety and health program manager and program supporters are those restricted funds from government grants for specific research efforts. Government research grants generate two kinds of revenues for universities: revenues generated through reimbursement of direct costs and those generated from indirect costs. Direct cost reimbursements are classified as restricted current income, since the income is only generated as a result of (or in support of) specific activities.

Some research grants include as direct costs the purchase of health and safety services or equipment. The federal government defines "direct" research costs as "those costs which can be identified specifically with a particular project . . . or which can be directly assigned to such activities relatively easily with a high degree of accuracy."* From the standpoint of safety and health, direct research costs may include health or safety personnel who devote full time to a single project, equipment to be used solely for one research project, consultants who are called upon to review health or safety aspects of a particular project, and similar charges. Moreover, if the occupational safety and health program's time and effort reporting system (i.e., the work measurement system for personnel time) enables program staff time to be charged by research grant project, the costs for this time also may be considered as direct costs of a particular research effort. In order to take full advantage of direct cost reimbursements that are available to the institution, it is important that the occupational safety and health program manager work closely with principal investigators, the research administration staff, and university financial administrators to assure that those program activities that can be attributed to specific projects are accounted for properly and included in the grant proposal. Close contact with granting agencies should be maintained if the institution has questions regarding allowable direct costs.

In addition, all parties must, of course, be aware of the competitive situation regarding research funds and recognize the desire of the principal investigator to keep project costs within a competitive range. However, the institution also must be aware that excellence of the technical proposal is of primary concern, and that granting agencies are generally supportive of an institution's efforts to assure that research safety and health standards are met.

Government grants are not the only sources of restricted funds. Private organizations such as foundations or corporations also may provide grants, to which direct program costs can be charged.

Acquiring additional sources of unrestricted funds is another mechanism for broadening the financial support for the research safety and health program. A primary source of unrestricted funds for research universities comes from research grants in the form of reimbursement of indirect costs. The Federal Management Circular (FMC 73-8) outlines the federal definition of indirect costs as follows:

> . . . Indirect costs are those that have been incurred for common or joint objectives and therefore cannot be identified specifically with a particular research project or any other institutional activity.

*General Services Administration, Federal Management Circular 73-8, "Cost Principles for Educational Institutions," p. 6.

In addition to safety and health items directly attributable to specific research efforts, a university is reimbursed for costs incurred to support research in general, but which are not directly attributable to specific projects. The distinction between direct and indirect research costs is one of great importance because large portions of the safety and health program may be attributed to support of research activities without being specifically assignable to particular projects. A number of issues will influence the degree to which indirect costs may be charged against research contracts. They include: (1) the treatment of expenses as either direct or indirect costs; (2) indirect cost allocation methods and procedures; (3) the level of detail of institutional accounting systems; (4) the financial source, location, age and character of research facilities; and (5) the direct cost base on which the rate is computed, i.e., salaries and wages; salaries, wages, and fringe benefits; or modified total direct costs.*

In most universities, a significant portion of radiation safety activity is attributable to research, and should be recovered from research grants as either direct or indirect costs. A similar situation may exist for the biosafety function and other activities of the safety and health program. The safety and health program manager and the financial vice president have a responsibility to assure that, to the extent possible, all health and safety costs attributable to research are recovered from research sponsors. (Some grant and contract awards do not provide for full recovery of indirect costs. At least one university, the University of Washington in Seattle, instituted a policy in 1971 that sets a dollar limit on the extent to which the University will accept grant and contract awards which provide for less than full recovery of indirect costs.)**

In addition to indirect cost recovery, it may be possible to influence other sources of current income to the university. Hospitals and auxiliary enterprises, such as residence halls, athletic facilities, and college stores, generate income from the sales of goods and services. Health and safety services to these income-producing units can be supported by direct charges -- preferably priced to assure full-cost recovery -- thereby bringing additional funds into the university.

Similarly, cooperative arrangements between the safety and health program and the student health service may permit using some student fee funds for appropriate safety and health purposes

*Leonard A. Redecke and Bruce Darling, "The Indirect Cost Predicament," SRA Journal, Fall 1977, pp. 18, 21.

**Donald Baldwin, "Management of Unrecovered Indirect Costs," Society of Research Administration Journal, Fall 1974, pp. 36-37.

(e.g., medical surveillance of graduate research assistants). Students fees could be adjusted to cover the additional costs incurred by the university in providing these services.

Cost recovery from income-generating and fee-supported units within the university should be distinguished from the practice of some university occupational safety and health programs to "charge-back" some operating costs to the university units for which they were incurred. Alternatively, some programs charge for certain kinds of services, for example, waste disposal. In most cases, these charges are simply transfer pricing mechanisms. As such, they do little in terms of broadening financial support. In addition, these transfer pricing mechanisms frequently act as disincentives to use safety and health program services on the part of the organizational unit being charged. This may occur whether the charges are made directly for specific services or charged periodically based on prior usage.

In addition to financing the operating costs of occupational safety and health, to which all of the above factors relate, certain capital expenditures may be necessary for safety and health purposes. The safety and health program manager must work in coordination with the university's capital planning unit to ensure that requisite health and safety components are adequately accounted for in university building and construction plans. It should be noted that such health and safety items used for research may be incorporated into the indirect cost rate.

Program Budgeting and Financial Control

Sources of financial support for the occupational safety and health program may be determined at administrative levels higher than that of the program manager, or the program manager may be involved to a limited extent. Frequently, however, the program manager's major involvement occurs during the preparation of a budget forecast for program expenditures. The forecast must be brought into balance with available revenues. The process, therefore, is usually concommitant with overall program planning and may involve several iterations and revisions before the budget and program plan are established at levels that are synchronized with expected university revenues.

The development of a budget (expenditure) forecast or target for the occupational safety and health program will, of course, occur within the context of the overall university budgetary process. Budgeting documents and approaches developed must be congruent with that process. Generally, it is anticipated that most universities will classify expenditure data at least by function, organizational unit, and object class item. Some universities may also classify expenses by programs -- which cut across organizational and functional lines -- and by project.

Many occupational safety and health programs may be preparing budgets that display only object class expenditure forecasts. Although this may be sufficient for overall university planning purposes, it is suggested that sub-program elements also be considered in developing the budget. Sub-program elements -- i.e., subordinate cost categories within the overall program category of safety and health -- can be used to track program activity of various types. Sub-program elements might be developed according to the nature of the hazard class involved (e.g., radiation, biohazards, general safety, environmental health) or according to the nature of the activity involved (e.g., administration, training, consultation, research and professional development, inspections, surveys, environmental monitoring, and medical and personnel monitoring). The latter structure would probably pose fewer definitional difficulties for most universities. The advantage of this program budgeting approach is that it enables the program manager and the university as a whole to track operating costs that are generally more meaningful for future decision-making.

In order to use sub-program budget accounts, the program also must develop a system of accounts that permits the tracking of expenditures, as they accrue, by sub-program element. Clearly, the work measurement system must be compatible with the sub-program account structure, so that time and effort accounting supports the sub-program element classification process.

In addition to the categorization of program activity by sub-program element, university administrators also may wish to consider the use of sponsored research project accounts for accumulating expenditures and time of research safety and health personnel. Although it may not be practical to prepare the program budget to this level of specificity, the construction of a project account reporting structure would be advantageous to capture program expenditure data by research projects to support direct and indirect cost recovery from grant funding sources. If the university elects to do this, the sponsored research project classification system and the process for recording expenditures by project should be determined during the financial planning process.

When the account structure for the budget has been established, the process of estimating expenditures and allocating them to appropriate accounts can begin. At many universities, the forecasting process is a judgmental process in which managers and administrators combine historical data with their knowledge and hypotheses regarding cost impacts of future events to arrive at financial forecasts. (At some universities, forecasts for primary organizational units may be derived by mathematical models or formulas. However, mathematical models generally are not used at the program level, such as the research safety and health program.)

Two basic approaches to budgeting exist: incremental (traditional) budgeting and zero-base budgeting. Both techniques utilize historic data and judgement for developing forecasts; however, in incremental budgeting the requesting organization is usually required to justify or explain only the deviations in budget between the forecasted year and the current year. Zero-base budgeting requires justification of the entire budget, a process that is structured through the use of "decision packages" describing the objectives, costs, alternatives, measures of performance, benefits, and other aspects of each activity. Zero-base budgeting can be a very complex process, and few organizations use it every year. Review of the basic priorities and consequences of a program, however, is an important aspect of any budgeting process; this can be accomplished without the complexity which the decision package process normally requires.

It is important that the program planning process be integrated closely with the forecasting process. The activity level forecast should be a determining factor in overall program costs. Other factors that should be included are financial adjustments for program costs due to inflation, salary or fringe benefit changes, replacements or modifications to existing equipment, acquisition of new equipment, administrative requirements of additional record-keeping or new procedures, as well as other anticipated cost changes.

FINANCIAL MANAGEMENT DURING PROGRAM OPERATIONS

The successful monitoring of financial operations requires three elements:

- An account structure that facilitates classification of expenditures for management analysis;
- A system of procedures that enables costs to be classified as they accrue; and
- A processing system that produces summary financial information in a timely fashion.

The need for an account structure supportive of management decision-making has been discussed in the above section on financial planning. In order for the classification system to reflect costs accurately, however, procedures must be in effect so that costs can be classified when they are incurred. Without this process, the program can be overwhelmed by the need to allocate costs after-the-fact, an effort which introduces considerable inaccuracy. Again, the use of a work measurement system that provides for time and effort reporting by sub-program element and project code as staff time is expended can do much to facilitate monitoring.

Finally, this data is of little utility unless it is summarized for management analysis with sufficient speed and frequency so that the program manager can respond to financial results as quickly as necessary. Monthly reports seem appropriate for most management decision-making needs.

As is clear from the foregoing discussion, the operating reports with which the program manager and university administrators are concerned usually are reports of expenditures. The development of revenue schedules during operations is less critical to the safety and health program than expenditure projections, simply because revenue analysis is generally performed by the university's chief financial administrator for the institution as a whole.

On the expenditure side, the safety and health program manager has an opportunity to exercise management control. The first step in the process is the development of monthly expenditure projections, based upon the total budget for the year. The expenditure schedule should reflect both object classes and subprogram elements. (If month-by-month projections are infeasible, as is frequently the case, the total budget is simply distributed evenly by month.) Every month, summary reports of expenditures should be compared with projections. Significant deviations in the rate of expenditure, either positive or negative, should be examined and causes identified for correction or adjustment in the program plan or budget.

FINANCIAL EVALUATION

The built-in capacity to quantify financial exchange makes one aspect of financial performance evaluation simpler than that of program performance. Comparison of actual performance against planned performance is a basic approach to financial management that predominates during operational monitoring, but is used also for post-performance evaluation. It has been discussed earlier. Comparisons against previous performance applies the same approach to previous operating cycles. Obviously, in order to make historic comparisons or to identify trends of time, caution must be exercised to assure that comparable activities are being compared. Comparison with other institutions provides a useful mechanism, but again care must be exercised to assure that similar endeavors are being compared and that exogenous factors are not influencing the comparative process. Comparisons against standards are used widely to evaluate the performance of profit-making organizations, however, their utility is limited in the university environment. The only potential area for the kind of analysis that is usually applied at profit-making organizations is the analysis of income from those services for which charges are levied. Depending on the way and purpose for which prices were set (full cost recovery, direct cost recovery, generation of surplus revenues, creation of incentives or disincentives for use), analysis of the revenue-expense relationship, similar to profitability analysis, can determine whether the desired objectives have been met. In general, however, these considerations probably will not apply at most universities.

Overall, meaningful comparative analysis of financial data requires that the impacts of exogenous factors be eliminated. For example, comparisons of per capita expenditures for safety and health programs among several universities is not a highly valid measure because research staff size -- not student population -- is the primary determinant of expenditure volume. The comparison should be based upon program dollars spent per research person (faculty plus research staff). The inputs of inflation and variations in program activity also may be exogenous factors in some forms of comparison.

A valuable technique which eliminates the impact of exogenous factors is the comparison of program expenditures with the value of the benefits generated by the program. The cost-benefit approach was discussed in the program planning chapter in regard to developing program priorities. During the planning process, there may be great uncertainty about the dollar levels of costs and benefits. In the evaluation phase more precise computations can be made, particularly of costs. (Some safety and health program activities will span more than one fiscal period, however, so all uncertainty is not elimated.)

The costs of some aspects of the occupational safety and health program may be expected to be offset by reduced costs (or benefits) in other areas. These areas would include such costs as:

- Worker's compensation costs. These costs include appropriate insurance premiums and the costs of administering claims.
- Cost of damage to material or equipment.
- Cost of wages paid for time lost by the injured employee, other than workers' compensation payments.
- Extra cost of overtime work necessitated by the accident.
- Uninsured medical or other costs borne by the institution.
- Cost of time spent by administrative and clerical employees on investigations or in the processing of compensation application forms.

In order to make cost reduction comparisons, the university must have available accurate historical cost data covering the items under investigation.

Feedback to Future Program and Financial Planning Cycles

To be valuable, financial evaluation results should influence future plans. For example, the level or mix of activity may need to be altered if cost trends are projected as escalating too rapidly. Comparisons with other universities may indicate that disproportionate or insufficient resources are being allocated to the program. Comparisons of projected to actual performance may indicate bad forecsasting or inefficiency. Comparisons of costs to benefits may influence future program priorities.

A number of specific financial comparisons can be made, but the purpose of this document is not to enumerate each specific ratio or analysis which may be useful. Testing a variety of findings may be the most satisfactory approach. Only significant results, obviously, need to be reported to upper level administrators and should influence future plans.

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INTEGRATING THE MANAGEMENT ELEMENTS

A variety of system elements have been presented for systematizing the management process during program planning, operations, and evaluation and financial planning and management. These elements must be integrated to be a viable system. The opening chapter to this document indicated that the detailed effort of designing a managment system would need to be performed by each university, addressing its specific management needs and utilizing its own infrastructure, data, and human resources for meeting these needs. This design effort would include the following kinds of activities:

- Development of specific rules governing reporting relationships: what is to be reported, when, by whom, and to whom;
- Design of standard forms for data input and output purposes and, in the case of manual systems, on-going record-keeping;
- Definition of file contents for both manual and automated data bases;
- Definition of activity categorization and coding procedures for a work measurement system;
- Definition of sub-program accounts and research project accounts for a program budgeting system; and
- Establishment of specific quantitative performance measures.

Other issues, such as the establishment of informal relationships or job procedures, may not be part of a specific system design effort but would be reviewed for compatibility with and support of the system.

A BASIC SYSTEM

Exhibit VIII-1 indicates the basic elements for an elementary program management system. Three types of elements are displayed: (1) external information sources, (2) internal systems, and (3) integrative techniques. Note that not every technique presented in this document is included; this table represents only those components specifically required for a basic systems approach.

EXHIBIT VIII-1

ELEMENTS OF A BASIC MANAGEMENT SYSTEM FOR A UNIVERSITY RESEARCH SAFETY & HEALTH PROGRAM

EXTERNAL INFORMATION SOURCES	INTERNAL PROGRAM MONITORING SYSTEMS	INTEGRATIVE TECHNIQUES	OUTPUT LINKAGES
Exception Reporting Relationships:	Work measurement system	Risk/return analysis process	PROGRAM PLANS & BUDGET (INCLUDING STRUCTURE FOR EVALUATION)
Procurement Office University Health Services Facilities Planning	Program budgeting system Accident/mishap reporting system	Performance measures	↓
Data Base Information Sharing:	Inspection/survey scheduling & tracking systems	Management-by-objectives (or equivalent structure of measurable objectives)	DAY-TO-DAY MONITORING TO MEET PLANS & BUDGETS
Research Administration Risk Management/Insurance Accounting	Training scheduling & tracking system Medical surveillance scheduling & tracking system		↓ EVALUATION OF PROGRAM PERFORMANCE ↓ → FEEDBACK
Other Information Sources: Laboratory safety & health coordinator network Research safety & health committee structure External agency requirements, regulations, & standards	Inventory control system		

Under external information sources, the basic system would involve data reported on an exception basis (but according to stipulated requirements) from procurement, university health services, and facilities planning. These data will be used to develop a hazard identification data base for occupational safety and health planning and operations. Modifications of data bases or major alteration of work procedures of these units would not be required to accommodate the occupational safety and health program needs. However, in other cases data base information-sharing is involved (for research administration, risk management/insurance, and accounting). In these cases, both the needs of the information-providing function and those of the occupational safety and health program must be considered in developing input, filing, and output systems.

The second column indicates the internal data base elements upon which a program management information system can be constructed. The seven elements indicated are basic operational systems to track the effort of the program in terms of activity, expenditures, and results.

The integration of the elements in columns one and two requires certain basic techniques. Those that this document considers essential are:

- A rationale process for evaluating risks and returns to the university in order to prioritize activities and expenditures to be undertaken;
- The use of selected performance measures, to be established during planning and used throughout the operational and evaluative part of the cycle;
- The construction of a management-by-objectives system or equivalent structure for program performance targets.

Ultimately, the whole system feeds into the program management process.

The System Design Process

In the first chapter of this report, it was suggested that a program management system should be introduced incrementally. Both the program manager and others in the university may wonder where or how the process should begin. Two considerations are relevant: (1) select an area of the program operation that requires a significant amount of data handling or for which data is sorely needed, and (2) avoid the temptation to computerize unless the volume or complexity of work demands it, either presently or in the near future.

In regard to the first point, some university administrators and program managers may feel that obtaining work measurement data for program management may be a pressing need. In other cases, the volume of record-keeping for accident records or medical surveillance may require that activity monitoring systems be established first.

Management Control Should Be Focused

University administrators and program managers must be fully cognizant of the costs of information and control systems. All information costs money. It is expensive to fill out forms, to program software, to store data on a computer, to retrieve and analyze data, either automatically or manually, and to collaborate and communicate with other units of the university. Some of these costs are direct and identifiable; others are hidden. In some cases, the hidden costs are opportunity costs; that is, the cost of doing one thing is the loss of opportunity for doing something else. For example, storing medical surveillance data on a computer file means that the storage space will not be available for other university purposes.

In addition to the actual costs of information, there are psychic costs associated with over-control. Program staff, university administrative staff, and researchers will resist too many administrative controls. Some of this resistance may be unrealistic: personnel in non-profit organizations tend to be unaccustomed to the amount of reporting and analysis that is considered commonplace in the private sector. This is a result of an historic lack of a management orientation in these institutions. On the other hand, management techniques which are, in fact, burdensome may provoke a degree of animosity and uncooperativeness that the program cannot tolerate.

One way of circumventing this problem is through wider participation in the system design process. A recurring debate surrounding system design concerns whether it should proceed from a top-down or bottom-up approach. It is unlikely that any system can succeed without the support of the top administrator. In the case of university occupational safety and health programs, support of the president would be desirable if the university were small and the president were involved in day-to-day operations. If, as is often the case, the president's responsibilities are focused on activities outside the actual operations of the university, e.g., fund-raising, meeting with state budget officials, etc., then the vice president having responsibility for the safety and health program must provide this support. Without this support, it is unlikely that the system design will incorporate the needs of top management or, of equal importance, administrators in other areas of the university. University administrators whose participation--particularly in terms of information needs--is critical to the system design process include:

- the vice president for business and finance,
- the risk manager/insurance manager,
- the vice president or other administrator for research administration,
- the academic vice president (representing the interests of faculty and principal investigators),
- the director of health services,
- the administrative and medical director of the university hospital (if any),
- the director of information services or computer center, and
- the director of personnel.

Participation does not necessarily mean direct involvement in the system design process. Rather, it means that the needs and interests of these individuals should be surveyed and incorporated during the system design process. The actual design of forms, selection of mechanism, etc., may be performed by an information systems staff group, or much of the design work can be performed by the program manager and the administrators above him, including the vice president.

Programs and Organizations Are Dynamic

One common criticism of management systems is that they impede organizational adaptability to environments, and organizations must be responsive to survive. The occupational safety and health program must be continually alert to changes in its environment. For this reason, the planning process, particularly hazard identification, must be a continuous effort, so that the program can respond to new needs. When new needs, either functions or hazards, are identified, the program manager and his administrator should be willing to re-evaluate and change objectives, if necessary. Thus, the management system should assist administrators in identifying and responding to change, not in suppressing it.

Emphasis on "scientific" management with its concomitant reliance on mathematical models, systems, and large data bases, may fail to reflect the fluidity and lack of predictability inherent in many managerial/administrative processes. This document is an attempt to assist university administrators in structuring occupational safety and health programs in order to make the decision alternatives more explicit and comprehensible; at the same time, there is no substitute for informed and timely judgment. In this context, it is worthwhile to consider the program management function as an on-going, long-term process, as opposed to an activity whose life span ends with a fiscal year. As the chapter on operational controls indicated, some conclusions and results are only clearly discernible through experience.

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