

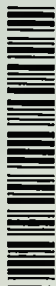
FILE NAME: Ford (FD)

DATE: 1982 Oct

DOC#: FD302

DOCUMENT DESCRIPTION: Journal Article - The Ford Motor Company
Environmental Health Surveillance System

Texas Womans University ILL



ILLiad TN: 247369

Borrower: IHS

Lending String:

*IWU, TXH, IXA, OKH, TXJLF, OUU, SHH, IUA, TMV, L
NM, TML, LTM, LMS, TYR, IUA

Patron:

Journal Title: Journal of occupational medicine :
official publication of the Industrial Medical
Association.

Volume: 24 **Issue:**

Month/Year: October 1982**Pages:**

Article Author: Stephen J. Kuritz

Article Title: The Ford Motor Company
Environmental Health Surveillance System

ILL Number: 212448074



Call #: 78.61A

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The Ford Motor Company Environmental Health Surveillance System

Stephen J. Kuritz

The Employee Health Services Department of the Ford Motor Company has responsibility for protecting worker health and for ensuring company compliance with various governmental regulations regarding employee health and safety. Additional department responsibilities are to identify and evaluate emerging regulatory issues, to enhance the management and monitoring of health and safety programs and to respond to potential problems in a timely and efficient manner. Given these goals and a work force of 250,000 employees to be covered, a company-wide computerized health records system became essential. Thus was born (in-house beginning in 1977) the Environmental Health Surveillance System (EHSS).

The EHSS is a group of subsystems designed to encompass the basic components of an occupational health and safety surveillance system: (1) exposure data; (2) health and safety status/effects data; and (3) worker status/history data.

A detailed description of each subsystem would be too lengthy to be presented here. Instead attention is concentrated on those subsystems believed to have special interest and unique aspects, while the others are discussed briefly.

Materials and Toxicology

Exposure data are included in two of the EHSS subsystems. The Materials and Toxicology (MATS) subsystem contains a hazardous materials catalogue to provide rapid retrieval of information on hazardous/toxic/critical chemicals in products associated with the company and assistance in ensuring compliance with the regulations issued by agencies such as the Occupational Safety and Health Administration (OSHA), the Department of Transportation (DOT), and the Environmental Protection Agency (EPA), and with legislation such as the Toxic Substances Control Act (TOSCA). This is an on-line system with all file maintenance performed by corporate staff. Input information is

obtained from material and safety data sheets. Retrieval capability exists at the plant level through local terminals.

Industrial Hygiene

The Industrial Hygiene subsystem contains information obtained from all environmental sampling that is performed. This includes exposure to physical and chemical agents in the workplace. This (and every other) subsystem is operated in batch mode. Input information is obtained from forms completed by the hygienists and keyed onto computer tape, which is used to update the industrial hygiene master file. The Industrial Hygiene and MATS subsystems, when utilized together, can provide insight regarding particular exposure. For example, the MATS subsystem can show in what products a specific chemical is used and in which plants it can be found. The Industrial Hygiene subsystem can then reveal the exposure levels noted on all occasions when appropriate sampling was performed.

Safety

Health and safety status/effects data reside in five of the EHSS subsystems. The Safety subsystem is currently in the planning stage. OSHA requires that all "recordable" injuries and illnesses be reported on a log that is open for inspection. A primary objective of the Safety subsystem is to ensure that this mandated activity is being carried out correctly and accurately. In addition, a work injury experience report will be generated automatically, showing incidence and severity data for each location.

Biological Monitoring

The Biological Monitoring subsystem is used to record the results of all tests (performed on employees) for the body burden of biological contaminants. Over 90% of this subsystem, however, is dedicated to the monitoring of one contaminant — blood lead. Specimen analysis, formerly done within the company, is now performed by an outside contractor. Forms are completed by the plant medical facility and forwarded, with the specimens, to the contractor. Test results and accompanying information are keyed onto a computer tape that is sent to corporate staff on a

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weekly basis (a hard copy result form goes immediately from the contractor to the plant medical facility). This tape is run through a special conversion program to make it compatible with the already existing biological monitoring update program.

This subsystem is utilized heavily both to monitor the blood lead status of company employees and to comply with the OSHA blood lead standard. An example of the first use is the blood lead summary report. This report shows, for each job classification in each plant location, the number of tests results within a range of values and provides certain summary statistics of interest. An example of the second type of use of the file is medical surveillance scheduling.

Medical Records

The Medical Records subsystem is the storehouse of medical data (history and physical findings) for employees in plant locations utilizing the subsystem. Currently about half of the company locations are included. All employees receiving a physical examination at these plant medical facilities must complete a health history form. When appropriate, the physician completes a health screen form. Copies of these forms are sent to the corporate health group where they are reviewed and International Classification of Diseases (ICD)-9-CM codes are assigned to the diagnoses. On a weekly basis these forms are keypunched onto tape that updates the medical records master file. The history portion of an employee's record is of fixed length and is written over by each succeeding history. A part of the history form, the return-to-work portion, is completed for all employees taking personal medical leaves of three or more days. The health screen is a variable length record that is maintained in historical fashion.

The return-to-work summary report is a good example of the utilization of data from the Medical Records subsystem. This report analyzes the primary reasons for employees' medical leaves in a statistical summary. Included are incidence and severity rates for each diagnosis code at every location included in the subsystem. In addition, medical record information is vital to the functioning of the Medical Surveillance subsystem.

Medical Surveillance

The Medical Surveillance subsystem is essentially responsible for maintaining a massive appointment calendar. With automatic input from the Medical Records and Biological Monitoring subsystems and manual input from plant medical facilities, the Medical Surveillance subsystem produces monthly schedules identifying all employees due for each type of screen (involving a unique series of medical tests) and providing certain work status information and the last-performed date for that screen. This is a relatively new subsystem, which to date covers only six plants. It is hoped that this subsystem will reduce substantially the time and effort that have been required for manual scheduling and auditing of these examinations.

Mortality

The purpose of the Mortality subsystem is to provide a database containing pertinent information on the deaths of all active and retired employees. Input information is ob-

tained through an agreement with the company's life insurance carrier, which sends to corporate health staff on a monthly basis copies of the death certificates and claim forms for all eligible employees on whom a benefit claim has been made. The death certificates are then sent to the Michigan Department of Health where the underlying cause of death is coded according to the ICD (9th revision). The company's data are coded by the same nosologists who code the mortality data for the state, and thus consistency and uniformity in coding are achieved. This lends added confidence to comparisons of the company's data with Michigan standards.

Records of approximately 10,000 deaths are currently in the database, which is growing at a rate of about 4,000 records per year. The data are analyzed by cause of death and location of last employment as well as by age, race and sex. In addition, life-table analysis programs purchased from Harvard University have been valuable in performing preliminary analyses (PMR studies) on the data.

Work History

The worker status/history data are maintained in one subsystem. The Work History subsystem is the largest and most complex of all those in the EHSS. Because of the difficulties involved in the design, implementation and maintenance of such a subsystem, and the enormous volumes of records it must be capable of handling, the Work History subsystem is of particular interest.

The Work History subsystem is designed to capture and maintain work-related information for both hourly and salaried employees. It is the heart of Ford's surveillance system, providing information to and retrieving information from almost every other component. Initially, it serves an edit checking function as it verifies that the social security number of a particular transaction is that of a valid Ford employee. When a match occurs, selected portions of the file are fed to the querying subsystem. Maintaining such information (i.e., birth date, department, job classification code) in a single subsystem is thought to be more efficient than regenerating and correcting these data within each of the other databases and has significantly reduced the developmental and maintenance costs of the system as a whole. In addition to providing data for other files, the Work History subsystem (containing longitudinal employment information) is very useful for other purposes. Epidemiologic studies often use work history information in conjunction with that from other files, while certain special requests can be addressed through the work history database alone. One of the reports generated from the work history file is the annual company census, which provides statistics on (1) active and inactive employees at each plant, grouped by age, sex, race and Michigan v non-Michigan work locations; (2) the same, in each division; (3) the same for the total company; and (4) the number of workers per job type within a given plant and department, their average age and their average seniority.

The Work History subsystem and update processing flow contain some unique features (Fig. 1). A work history master record consists of both demographic information of a fairly stable nature and work-related information of a highly variable nature. For this reason it was decided to partition the master record into three segments. The first,

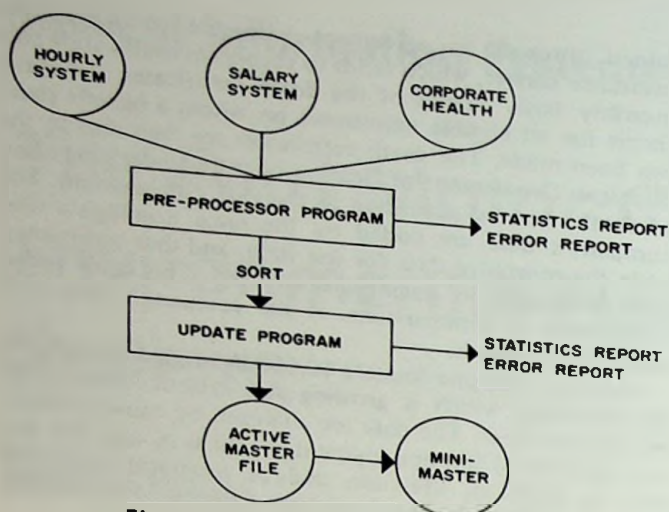


Fig. 1 - Work history monthly processing.

or employee, segment has only one occurrence and is unique for each employee. This segment identifies the worker as an individual by containing information such as social security number, name, birth date, company service date, sex/race code, hourly or salaried code, and home zip code. The second, or plant, segment has up to 999 occurrences for each employee. This segment contains a plant code, a division code and a seniority date. Every time an employee moves to a new plant, an additional plant segment record is created as part of his master record. The third, or job, segment also has up to 999 occurrences for each employee. Contained within the job segment are department code, roll status code, job classification code and effective date. When one or more of these items change for an employee, an additional job segment record is created as part of his master record.

Input to the Work History subsystem comes from extracts of two primary sources created by payroll functions: an hourly work force profile and a salaried personnel master. The capability for manual input from corporate health personnel is also present. Both the hourly and salaried files used as input generate transactions by comparing their current week's store of information with that of the previous week and noting any differences. These transactions are then moved to the first stage of the Work History subsystem's monthly updating procedure, the pre-processing program.

The preprocessor launders and tailors the data so it will be acceptable to the update program (the second stage of monthly processing). It edits field by field all the data in the generated transactions. In a sense, the preprocessor is unique in that it edits data that have already been edited by its originating system. The preprocessor performs six major functions: (1) edits input transactions; (2) provides an error report; (3) converts certain fields to assure uniformity; (4) generates specific fields; (5) sets pointers to determine necessary action for a transaction; and (6) outputs a uniform file to the update program.

On completion of the preprocessor function, the newly created uniform file is ordered through a sort routine and then passed on to the update program. This program's primary function is to update the work history master file

based on the incoming transactions, and is run on a monthly basis. In addition, an update error report is produced detailing all transactional errors (such as unmatched changes or deletions or attempts to add a social security number already on the file).

All successful updating (the result of a transaction being processed) is issued on microfiche for the corporate health staff. The update program also maintains file integrity through the use of header and trailer records.

Thus, each month the work history master file is updated with new transactions. However, when the size of the work force is considered together with the number of segments (each a separate record) possible for every employee, the volume of records (already in the millions) to be maintained and processed quickly becomes a major concern. This has been dealt with through several approaches.

Since, as described earlier, the other subsystems are matching against work history information on a regular weekly or monthly basis, an alternative to reading the full master file was desired. When these other subsystems are being updated, they require only information on the most current status of any employee and would pass over all historical plant and job segments. To eliminate this unnecessary passing of all records each time, the work history mini-master was devised. Each month, after the master file has been updated, the mini-master is created by taking a snapshot of each active employee's current location record. In essence, the mini-master is a replica of the master file containing for each employee segment only the most recent plant and job segments. Thus, it is actually the mini-master that is used to perform the edit checking and data transmittal functions of work history for the updating of the other subsystems. Whereas the size of the master file will continually increase with the addition of new plant and job segments, the size of the mini-master will stay relatively constant, and therefore the cost and efficiency savings realized will continue to grow. Each quarter the mini-master is issued on microfiche for the corporate health staff. This has proven to be invaluable for quick and easy reference to an employee's status.

Epidemiology

The Work History subsystem provides the means for tracking an employee's job and plant status throughout his career with the company. It is the Epidemiology subsystem, however, that provides the means for utilizing this information. Acting (in a sense) as a database manager for the other subsystems, Epidemiology was created to permit investigations into the incidence, distribution and control of disease and related problems within the company's active and retired work force.

The Epidemiology subsystem is actually a collection of file definitions and utility programs that can be used to select, sort, list, and create extract files. The Mark IV reporting system is used. Thus, unlike the other subsystems, Epidemiology has no base master file of its own, but will extract data from the others and create special temporary study files for specific analyses. This subsystem was designed so that simple select and list requests from a single master file (the bulk of the requests) may be user operated without the support of a programmer/analyst. For example, a user might request from the medical records master file

the mortality file and add on all the work history and medical record information available for them. Many of epidemiology's capabilities in this area have yet to be fully utilized.

Summary

Ford's EHSS is a complex interaction of several sub-systems (Fig. 2). MATS and Industrial Hygiene provide exposure data; Medical Records and Surveillance, Biological Monitoring, Mortality and projected Safety provide health and safety effects data; Work History provides what its name indicates; and Epidemiology coordinates the effective use of all the others. Highlights have been presented here, but it should not be assumed that either the creation or maintenance of such a vast system is without problems. No project of this magnitude could possibly avoid them and systems and programming work is ongoing to correct problems as they arise.

Efforts to improve the system are already under way. These include plans to make Industrial Hygiene and MATS more compatible so that better communication is possible and to make Epidemiology even more user-oriented. Keeping a computerized medical information system in working order to the user's satisfaction requires a great deal of time and money, but such a system is invaluable in comparison with the alternative of manual effort. This is especially true in view of the number of federal (and local) health regulations passed and pending and the current level of worker awareness of the priority of occupational health issues.

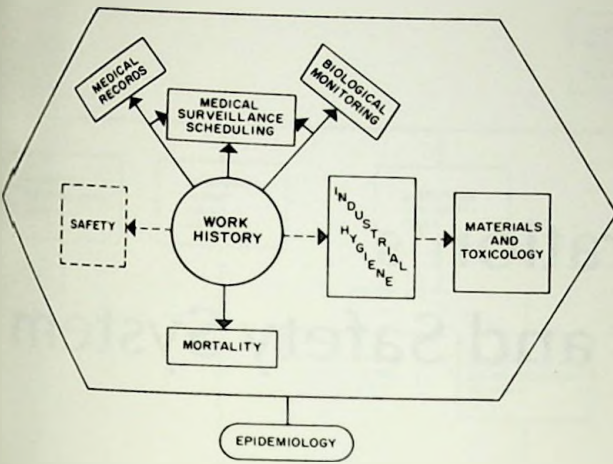


Fig. 2 - Environmental health surveillance system - overview.

records for all employees who answered "yes" to smoking on the health history form. This would assist in providing a very crude estimate of the number of smokers in the company.

In addition to select and list capabilities, Epidemiology offers the user the flexibility of choosing portions of several master files to combine in a temporary work file for special study purposes, such as conducting mortality studies. Epidemiology could provide a list of employees with specific causes of death, and some matched controls, from