DOCUMENT RESUME

ED 078 156 VT 020 319

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|---|---|
| TITLE | Health Services Mobility Study. First Progress Report for Phase Four for the Period April 1, 1972 to March 15, 1973. |
| INSTITUTION | City Univ. of New York, N.Y. |
| SPONS AGENCY | Manpower Administration (DOL), Washington, D.C.; National Institutes of Health (DHEW), Bethesda, Md. Div. of Allied Health Manpower. |
| REPORT NO | TR-12 |
| PUB DATE | 73 |
| NOTE | 89p. |
| EDRS PRICE | MF-$0.65 HC-$3.29 |
| DESCRIPTORS | *Career Ladders; Curriculum Development; *Educational Mobility; Health Occupations; Methodology; *Occupational Mobility; Research Projects; Sequential Learning; *Task Analysis |

ABSTRACT

This report describes the overall work of the project and the first 10 months of its current demonstration phase, Phase IV. It presents an overview of the project's history and objectives, a description of the methodologies involved, the steps taken in applying the methodologies in task analysis and curriculum design, the approach to implementation of the research results, and the plans to disseminate the study work. The developmental work for task analysis was covered in the first three phases of the project. In Phase IV, the task analysis method is applied in the functional area of radiology and related services at a major hospital. Results of this application will be documented and disseminated as end points in the process are reached. Phase IV also includes the development of the curriculum analysis and design methodology and its application to the task data already collected at the ambulatory care center and currently being collected in radiology and related services. Plans for future work in the study are outlined. (MF)

HEALTH SERVICES
MOBILITY
STUDY

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# FIRST PROGRESS REPORT FOR PHASE FOUR

April 1972 - March 1973



Technical Report No. 12

# HEALTH SERVICES MOBILITY STUDY

## FIRST PROGRESS REPORT FOR PHASE FOUR
For the Period April 1, 1972 to
March 15, 1973

Technical Report No. 12

OSMP Contract No. 82-34-69-34
Manpower Administration
US Department of Labor

and

Memorandum of Agreement with
Division of Allied Health Manpower
Bureau of Health Manpower Education, NIH
Department of Health, Education and Welfare

Sponsored by
Hunter College and
The Research Foundation, City University of New York

The research reported herein was performed pursuant to: a Special Manpower Project contract with the Manpower Administration, U.S. Department of Labor under the authority of the Manpower Development and Training Act; and a Memorandum of Agreement between OSMP and the Division of Allied Health Manpower, Bureau of Health Manpower Education, National Institutes of Health, Department of Health, Education and Welfare.

CONTENTS

# CHAPTER 1

## PROJECT BACKGROUND

This report describes the overall work of the Health Services Mobility Study and the first ten months of its current demonstration phase (Phase IV). It is addressed to the reader who wants to know about the overall objectives of the Health Services Mobility Study, what it has done, its current work, and its future plans. It is meant to be both a progress report and an introduction to the Project.

Chapter 1 provides an overview of the Project's history and objectives. It also summarizes the work in terms of the stages involved, the methodological areas covered, and the funding phases into which the work is divided.

Chapter 2 is devoted to a description of our work in methodology. It describes the developmental work already done in task analysis, the work currently underway in curriculum design, and the work planned for performance evaluation. The chapter also provides brief reviews of the methodologies involved.

Chapter 3 summarizes the steps taken in applying the methodologies in task analysis and curriculum design. It also presents a description of the work being covered in the current period.

Chapter 4 describes the work of the Project that deals with the implementation of our research results. It also covers our plans to disseminate the results.

DERIVATION OF OBJECTIVES

The Health Services Mobility Study (HSMS), since 1967, has been involved in research in the health manpower field, and has developed methodologies which can be of use to health care delivery systems and to the educational institutions which train health manpower at all levels. The Study is sponsored by the City University of New York (CUNY) through its Research Foundation and the Hunter College Institute of Health Sciences.[1]

At its inception, the Project was designed to review the structure of occupations in health services and to find what obstacles exist to upward mobility in the institutions involved, with emphasis on the New York City Municipal Hospitals.

During Phase I, HSMS concluded that the institutions which provide health services are characterized by serious shortages in some titles and functions. These titles require credentialed, educationally-

1 Phases I, II and III were funded by the Office of Economic Opportunity. For Phases II and III, OEO was joined by the Health Services and Mental Health Administration of HEW and the Manpower Administration of the Department of Labor. Phase IV is currently funded by the Manpower Administration, DOL, and the Division of Allied Health Manpower, NIH. The Study's Director, Dr. Eleanor Gilpatrick, holds the rank of Associate Professor at the Hunter College Institute of Health Sciences, City University of New York.

based skill and knowledge training. Few long-term manpower shortages were found at entry levels.

HSMS found that the employment structure in health services delivery institutions (primarily hospitals and ambulatory care centers) is shaped like a pyramid. There are large numbers of semi-skilled employees found at entry levels,with the numbers declining at higher job levels. In contrast, the shortage structure in hospitals is shaped like a pyramid resting on its apex, with the largest numbers of shortages near the top. This set of circumstances should make these institutions ideal for the development of upward mobility programs that would utilize existing labor forces; yet almost all health occupations are at dead ends. We concluded that artificial institutional and educational barriers have, up to the present, inhibited the upward mobility possible in the field of health manpower.

Health care delivery institutions provide some internal training for their manpower needs. However, as new functions and occupational titles have been developed, and as professional associations have moved to represent the new titles, entry has been increasingly hedged with credential barriers such as licensure or certification requirements. These credential requirements have been developed in isolation from,and without consideration of,the relationships of the new functions to existing occupational titles and functions.

It also has become increasingly necessary for health manpower to be trained in educational programs accredited by the professional organizations in order to be employed. The developments in education have seen a proliferation of credentialed health care curricula which overlap and duplicate requirements, as the jobs and titles duplicate functions. When employment in health care titles requires formal, accredited training, one finds that the programs, in most cases, assume no prior experience or training in health care. Therefore, there is enormous overlap across educational programs. In addition, individuals do not receive transferable academic credits for relevant job experience or training when moving from one program or occupation to another.

When individuals decide to undergo all that is required in order to move from one credentialed job to another, the burden falls on them to obtain the required, often redundant, accredited training and credentialing needed for the new job.

The irony is that, once an individual has obtained the credentials, there is no guarantee that the newly acquired training will be relevant or fully utilized in the new institution or job, because the proliferation of credential barriers has been accompanied by institutional adaptations of actual job functions to internal needs.

HSMS also concluded that the greatest social cost in health services lies in the education and training of health manpower, while there are shortages of schools and of properly trained skilled and professional personnel. In the face of rising costs and the demand for quality patient care, the greatest wastes lie in the improper allocation of functions to personnel and in the redundancy of training requirements.

## Overall Objectives

Given the related problems of manpower shortages, scarce educational resources, lack of mobility, and redundancy in credential requirements, HSMS concluded that what is needed is a solution acceptable to employers, employees, and society, which would make possible the attainment of efficient manpower utilization, the elimination of occupational shortages, and the promotion of upward mobility. HSMS set as its long-run objective the achievement of such a solution by the design of job ladders which would build systematically on learnable, related skills and knowledges. This would involve the design of jobs in promotional sequences in which each job would utilize a body of skill and knowled aining at a given level, to perform interrelated work activities. Each succeeding job in a promotional ladder would build on the related skills and knowledges needed at the lower level, but would require higher levels of the same skills and knowledges as well as additional skills and knowledges. Thus, the job ladders to be designed would minimize the educational requirements needed to move from one rung on a ladder to another, and would thereby minimize time and costs.

To make possible the implementation of job ladders and to facilitate upward mobility, the relevant education for the jobs would have to be provided in educational ladders. An educational ladder would be a sequence of educational programs at sequential academic levels. Each program in a sequence would allow the student access to a job at the exit point for that program; the program would also prepare the student to continue with the education needed for jobs at higher levels on the ladder (and higher in academic terms). Each educational program would take account of the training already received, the requirements for the exit job at that level, and the requirements needed for jobs to be attained at higher levels. HSMS set the design of educational ladders as its second major objective.

To make possible the most objective selection of trainees for upward mobility and to evaluate the adequacy of educational ladders requires a means of relating work performance and student performance to objectively stated work standards. Instruments for performance evaluation can provide the links between education, institutional work performance, and the validation of tests designed to compare individual attainment with job requirements and standards. When current performance in a given job on a ladder is used as a criterion for selecting trainees for upgrading to the next step on a ladder, performance evaluation can also be used as a means of motivating individuals to improve work performance. HSMS set as its third major objective the design of performance evaluation instruments.

The design of job ladders, educational ladders, and performance evaluation instruments are objectives which might be met in isolation from the real world. However, from its inception, the HSMS was aware that, if its proposals were to be implemented, it would require the support and cooperation of employers (hospitals and ambulatory care centers), professional associations, unions, educational institutions, and the federal, state and local government agencies involved with licensure and/or accreditation. Therefore, a subsidiary objective has been that the work of the HSMS would be conducted in functioning delivery institutions with the cooperation of all the appropriate related institutions and with critical review by the employers, educators and professional organizations.

Thus, the Health Services Mobility Study set itself the overall objective of creating the basic methodologies which would make possible the design of job ladders, curriculum ladders and performance evaluation instruments which would be practical and implementable.

Objectives for Task Analysis and Job Ladder Design Methodology

The HSMS views the work needed to produce health services as a total set of activities. For each activity manpower is used to combine existing technological knowledge, materials, and equipment to produce health services. Each work activity can be treated as a unit of analysis. In the HSMS approach, the unit of work activity is the task. Its definition can be used to identify similar units of work activity regardless of the jobs or occupational titles to which it is assigned in any given institution. With such an approach, we can ascertain the education needed to perform tasks, unencumbered by what is thought to be required in programs designed for given occupational titles.

The HSMS objectives for a task analysis methodology require that the unit of analysis (task) be defined in such a way that it can be moved from one job to another, that it can be analyzed in terms of its required, learnable skills and knowledges, and that the tasks identified can be clustered into hierarchies of related tasks. The HSMS objectives further require that the skills and knowledges needed for task performance be expressed as part of a predetermined taxonomy that can be expressed as scales in order that the data be amenable to statistical analysis. Only such a method can produce inputs for the design of job ladders, for the design of educational ladders, and for the design of performance evaluation instruments. These objectives were met in Phase III.

Objectives for Curriculum Analysis and Educational Ladder Design

The HSMS objectives for a curriculum analysis and design methodology require that curriculum guidelines be produced which utilize the task descriptions and the skill and knowledge scale data used in the design of job ladders, and that it produce curriculum guidelines which can be organized into educational ladders.

The task analysis methodology and the curriculum design methodology both assume that a deep, broad understanding of a given knowledge area can be reached in successive, incremental steps, beginning with a shallow understanding and narrow amounts of information. They further assume that skills, though learned through practice, can also be learned in incremental steps. Thus, the concept of additivity as expressed in the scales and taxonomic categories underlies the design of job ladders and educational ladders.

In Phase IV the HSMS is developing a methodology for writing curriculum guidelines stated in the form of "objectives" for educational programs. These will combine the behavioral language of the tasks with the skills and knowledge taxonomies needed for the performance of the tasks. Such "curriculum objectives" will be organized into the guidelines for the sequence of programs which will become the steps in an educational ladder that will parallel a job ladder. The "curriculum objectives" will also be usable to subject current curriculum requirements to critical review and/or to identify overlap in existing curricula.

## Objectives For Performance Evaluation Methodology

The HSMS objectives for a methodology to design performance evaluation instruments require that instruments be produced that can provide objective ratings of work performance. This would require the use of a common set of objectively stated task activities, skills, and knowledges, and/or the outputs produced in the tasks. This would also involve reference to objective standards of output quality or task performance, and would require the design of rating scales for comparing specific work performance with given acceptable standards.

These objectives can be achieved by utilizing the HSMS task data and taxonomies in combination with data on objectively stated standards and with properly designed rating scales.

Proficiency tests that are designed to be administered as paper and pencil tests on a national basis are potentially usable for placing individuals into existing or future educational programs with advanced standing and/or into job titles. However, the validity of such tests could be in question unless the test items were validated against relevant work performance criteria.[2]

The HSMS methodology for the creation of performance evaluation instruments will be able to provide such objective work performance criteria for the validation of items in proficiency tests. The performance evaluation instruments are to be designed for use in evaluating the work performance of job incumbents and/or graduates of educational programs. The ratings of incumbents on the instruments could be correlated with scores on proposed test items in proficiency tests. Thus, test items could be selected that would demonstrate mastery of the skills and knowledges needed for actual task performance. The basis would then be laid for use of such tests to place individuals in educational programs as well as into jobs.

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[2] Equivalency tests attempt to measure the individual's mastery of academic subject matter. Proficiency tests attempt to measure the individual's mastery of work content. Performance evaluation attempts to rate the individual on actual performance in the job.

## ORGANIZATION OF THE WORK

The work of the Health Services Mobility Study may be viewed in terms of three methodological areas and three stages, as represented in Chart 1. The three methodological areas are:

1. Task analysis and job ladder design.
2. Curriculum analysis and design of guidelines for educational ladders.
3. Determination of standards and design of instruments for performance evaluation.

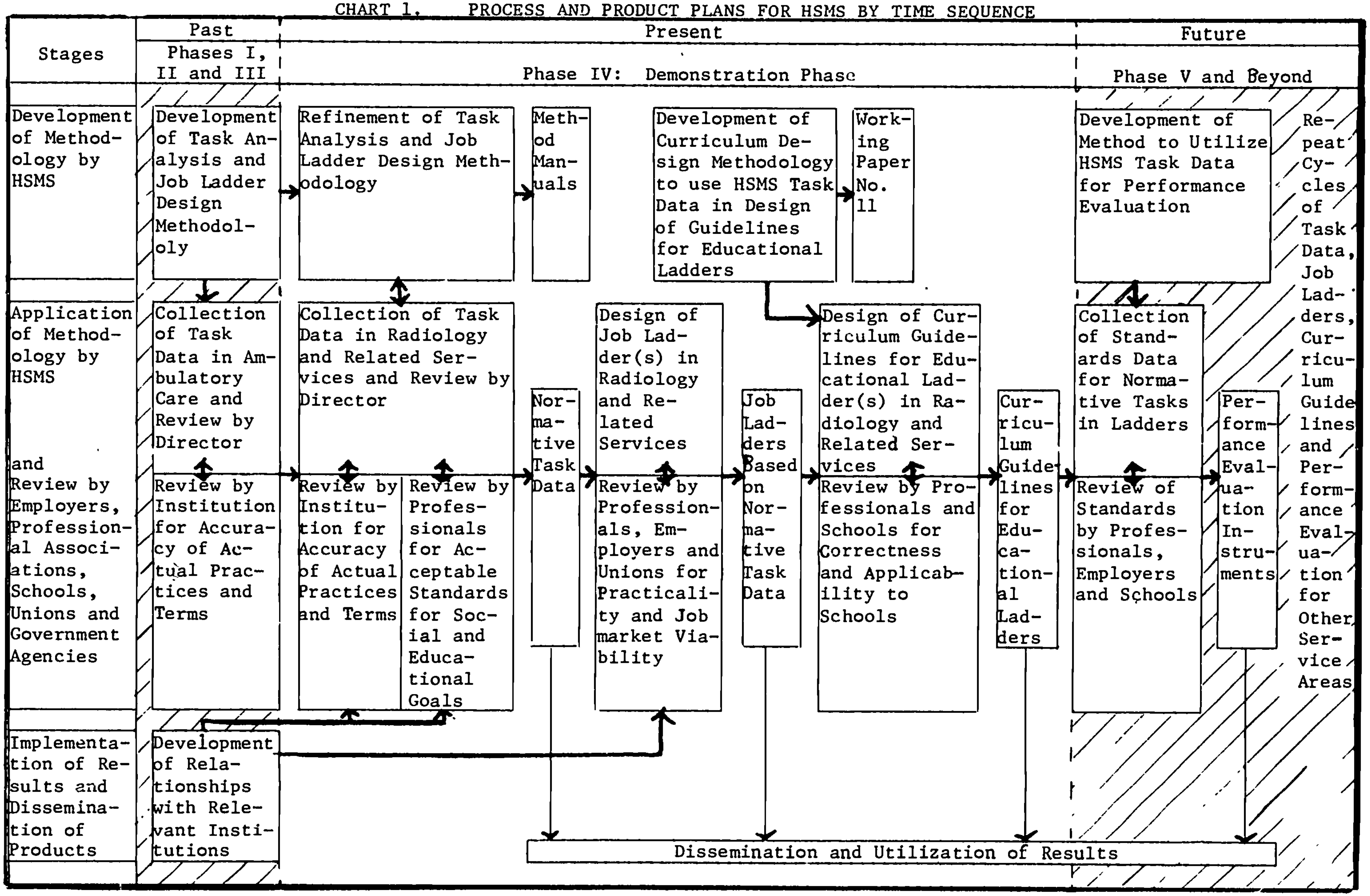
For each area, the work follows three stages:

1. Development of the methodology (includes field testing).
2. Application of the methodology to a given health service area at a delivery institution (includes review by appropriate experts).
3. Implementation of the results by institutions (includes dissemination of reports and assistance in utilization by HSMS).

As can be seen from Chart 1, the developmental work for task analysis was covered in Phases I, II and III. During the pilot test, task data were collected in 12 job titles in an ambulatory care center and application of the methodology was undertaken. Contacts were made with major institutions, and these initial contacts laid the basis for subsequent cooperative work.

In the current phase, the task analysis method is being applied in the functional area of radiology and related services at a major hospital. The results will be written up and disseminated as we reach end points in the process. Phase IV also includes the development

CHART 1. PROCESS AND PRODUCT PLANS FOR HSMS BY TIME SEQUENCE



of the curriculum analysis and design methodology and its application to the task data already collected at the ambulatory care center and currently being collected in radiology and related services.

In a future funding period we hope to develop the performance evaluation methodology and apply it to the data in radiology and related services. At that time, the results in the area of curriculum design would be disseminated and, it is hoped, implemented. We would enter a new health service area for task collection and subsequent curriculum design.

Thus, the cycles would continue while there was funding, until all the major health services were covered. Ultimately, there would be job ladders designed for each area. There would also be the possibility of identifying alternative lateral or diagonal job lattice pathways relating job ladders. The guidelines for the educational ladders to parallel the job ladders would be designed. There would also be the possibility of identifying core curriculum units across ladders. Instruments to measure performance in specific jobs would be designed. There would also be the ability to identify performance standards needed for more than one health service area.

Chapters 2, 3 and 4 more fully describe the work already done in Phases I, II, and III, detail the progress of work in the current period, and describe the products expected. As Table 1 indicates, current staff are responsible for task data collection and curriculum design; future staffing may have to be provided to cover data collection in performance evaluation.

Table 1.

HSMS STAFF AS OF FEBRUARY 28, 1973

| | |
|---|---|
| Director | Dr. Eleanor Gilpatrick |
| Senior Research Associate<br>(Director of Field Work; Job Analyst Trainer) | Irene Seifer |
| Junior Research Associates<br>(Curriculum Analysts) | Christina Gullion<br>Saul Helfenbein |
| Senior Research Assistants<br>(Job Analysts) | Jeanne Bertelle<br>Albertine Brown<br>J. Patrick Butler<br>Sue Fong<br>Lynn Johnson<br>Sandra M. Ostling<br>Manuel Ramos-Otero<br>Claudia Sherman<br>Lawrence Steinhorn |
| Executive Secretary | Julia M. Caldwell |
| Research Secretary and Librarian | Raye Rush |

# CHAPTER 2

## DEVELOPMENT OF METHODOLOGY

The Health Services Mobility Study has been involved in methodological work in three areas: task analysis and the design of job ladders; curriculum analysis and the design of educational ladders; and determination of output and performance standards and the design of performance evaluation instruments. This chapter reports on the work accomplished so far, expected in the current period, and planned for the future in each of these areas.

### TASK ANALYSIS AND JOB LADDERS

The basic methodology for task analysis was designed and tested in Phases I, II and III. The methodology has five essential components:

Task Data Design

1. Task identification (creation of a definition of a task).
2. Skill scaling of tasks (creation of skill scales).
3. Knowledge identification for tasks and scaling of knowledge (creation of a knowledge taxonomy and scale).

Job Ladder Design

4. Statistical analysis (for the creation of families of tasks related by skills and knowledges).
5. Assignment of tasks to levels and jobs (creation of job ladders).

During Phases I, II and III, the task definition was developed and tested for inter-rater reliability in several hospitals. The skill scales and the knowledge scale were developed, and "Thurstone scaling" was applied (a method of assigning numerical values to descriptors on the scales, based on the concept of equal appearing intervals, so that the scale values can be treated statistically). The scales were also field tested for inter-rater reliability. The Knowledge Classification System was developed and tried out in the field. At the same time, the computer programs to be utilized for job ladder design were adapted to our needs and made ready for use.[3]

By March of 1971, HSMS was ready to run a pilot test of the method. (Chapter 3 presents the details of the pilot test.) The pilot test was the first time that all the components of the HSMS method of task analysis were applied in a given institution; it may have been the first method of job analysis to include physicians and to cover data on specific knowledge requirements. The results of the test proved that the HSMS method works as a system and produces reliable task data and meaningful job ladders. It was possible not only to derive important insights about the current job structures, but also to draw conclusions about the nature of the task activities involved. Research Report Nos. 4 and 5, issued as a final report for Phase III, explains how the

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[3] Technical Report No. 11 reports on how the methodology was developed, includes a literature review, and summarizes the work of Phases I, II and III. It can be obtained as follows:

Eleanor Gilpatrick, Health Services Mobility Study, <u>Final Report For The Period October 1967 Through March 1972</u>, Technical Report No. 11. Document numbers R190 or R332. Write to:
Educational Resources Information Center (ERIC); The Center for Vocational and Technical Education; The Ohio State University; 1900 Kenny Road; Columbus, Ohio 43210

method was applied, the details of the pilot test,and the conclusions drawn about job ladders and curricula.[4]

The pilot test was also useful in pinpointing methodological areas needing further refinement. These included the following:

1. Efficient training of job analysts.
2. Specific guidelines for the writing up of task descriptions.
3. Revision of the Knowledge System based on experience.

Needed revisions have already been made in the current period (Phase IV). We have established a method of training for our job analysts that combines reading of manuals, in-house training, and supervised field work. This combination results in the most rapid exposure to the actual work, and also guarantees that accurate data are collected even while the analysts are still in training. The Knowledge System has been sharpened for this year's needs, and models for task descriptions are being created. These modifications will be described in training manuals to be produced during Phase IV. (They will be revisions of manuals produced as parts of Research Report No. 3, which is not now being distributed.) The following section presents a brief review of the chief characteristics of the methodology.

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[4] Eleanor Gilpatrick, Suggestions for Job and Curriculum Ladders in Health Center Ambulatory Care: A Pilot Test of the Health Services Mobility Study Methodology, Research Reports 4 and 5. Available from ERIC; document numbers R327 or R331. (See footnote 3 for address.)

SUMMARY OF TASK ANALYSIS AND JOB LADDER METHODOLOGY

The Task

In the HSMS method, tasks found in jobs are the basic units of analysis. The definition of a task is designed to result in the identification of a unit of work which can be moved from one job to another without disrupting other activities. The task is thus a unit of work which is smaller than that of a job as a whole or, in most cases, than that needed to produce an entire product, such as a health service or a manufactured item. The task **may** refer to individual work activities which are steps leading to, or assisting in, the production of a final product. The task definition is geared to the performer's output rather than the institution's product. (Products are the units which are purchased or contracted for.)

The task is composed of elements. The element is smaller than the task and is involved in describing the task. The elements of a task are the smallest possible meaningful units of work requiring physical and/or mental activity. Unlike the task, an element does not have an identifiable, usable output which can independently be consumed or used, or which can serve as an input in a further stage of production by an individual other than the performer.

The HSMS Definition of a Task

A task is a series or set of work activities (elements) that are needed to produce an identifiable output that can be independently consumed or used, or that can be used as an input in a further stage of production by an individual who may or may not be the performer of the task. The definition is further elaborated as follows:

1. In principle, someone other than the performer of the task must be able to use or consume the output of the task.

2. Theoretically, it should be possible for there to be an elapse of time between tasks.

3. A task includes all the possible conditions or circumstances which a single performer is expected to deal with in connection with a single production stage.

4. A task includes all the elements that require continuous judgment or assessment by the same performer in order to assure the quality of the output.

5. A task includes all of the elements needed to produce an output which can be independently used or acted upon without special explanations to the next performer in the next stage of production.

6. A task includes all the elements needed to complete an output to a point at which another performer (who would continue with the next production sequence) would not have to redo any elements in order to continue.

7. A task includes all the elements needed to complete an output to a point at which another performer, in order to continue with the next stage of production, need not perform extra steps.

8. The task must not require that, for another performer to continue with the next stage in a production sequence, current institutional arrangements would have to be changed.

9. A task must be sufficiently broad in statement that it can be rated on its frequency of occurrence.

A task is uniquely identified in terms of its output, what is used, and the kind of recipients, respondents or co-workers to which its performance is restricted. These terms are used as follows:

1. The "output" of a task is the result of an independent stage in a larger process of production in an institution, assuming the current organization of work activities.

2. "What is used" in a task includes all the things which the performer is expected to be able to use or choose from to produce the identified output.

3. The "recipient, respondent or co-worker" involved in a task reflects the special characteristics or condition of the people with which the performer must be trained to deal.

Two tasks are the same if their elements result in the same output, require the same things to be used (including the alternative materials or equipment to be chosen among), and if the kind of recipient, respondent or co-worker involved is the same in terms of what the performer needs to know in order to deal with them. Two tasks which are the same are called overlaps if they occur in **different job titles.**

The HSMS task definition permits the acknowledgment that many professional-level assignments include or cover emergency or contingency situations which must be reflected in task identifications. Since the definition also permits the identification of tasks in which the performer does not handle emergencies but notifies a higher-level performer of any emergency signs, the task definition helps prevent incorrect conclusions about the existence of task overlaps across titles.

The task descriptions provide a good deal of information about the work as it is done. Each task is described on a Task Identification Summary Sheet (Figure 1). The "Name of the Task," Item 5, provides a brief but full summary of the task. "The List of Elements" is found in the right-hand column. It describes the steps of the task in detail and in the sequence in which they are performed. In a complicated or high-level task, the List of Elements may be long and is continued on additional pages. (Figure 1 requires two pages.) The elements include initiating and terminating actions and any decisions, record keeping, or delegation of duties which are part of the task. When there are choices, all the alternatives are specified.

The major characteristics of the task, used for identifying overlaps, are found on the left-hand side of the Task Identification Summary Sheet. Items 1, 2, 3 and 4 cover the output, what is used, and the recipient, respondent or co-workers involved in the task. Two tasks that are overlaps have the same code number. The task's code number appears in the upper left of the Task Identification Summary Sheet.

Skills, Knowledge and Scales

Each task requires that its performer utilize skills and knowledge at particular levels of achievement in order to carry it out. The HSMS methodology includes a taxonomy of skills and a taxonomy of knowledge categories which provide a set of variables for describing task requirements. Each skill or knowledge category can be identified

Figure 1

SAMPLE TASK IDENTIFICATION SUMMARY SHEET

This is task 4 of 12 for this performer.
This is page 1 of 2 for this task.

Code 262

Performer's Name__________________ Analyst(s)__________________ Dept.________
Job Title__________________ Institution__________________ Date________

1. What is the output of this task? (Be sure this is broad enough to be repeatable.)

An electrocardiogram taken; EKG with patient's identification information attached to request form; MD notified of emergency signs in patient; EKG and request form placed for processing.

2. What is used in performing this task? (Note if only certain items must be used. If there is choice, include everything or the kinds of things chosen among.)

EKG request with MD orders;
EKG machine with electrodes,
and/or baby electrode, amputee clamp;
table or wheel chair; electrode pads;
pencil or pen; telephone

3. Is there a recipient, respondent or co-worker involved in the task? Yes...(X) No...( )

4. If "Yes" to q. 3: Name the kind of recipient, respondent or co-worker involved, with descriptions to indicate the relevant condition; include the kind with whom the performer is not allowed to deal if relevant to knowledge requirements or legal restrictions.

Any patient; physician; adult with pediatric patient; co-worker

5. Name the task so that the answers to questions 1-4 are reflected. Underline essential words.

Taking an electrocardiogram of any patient as ordered or determined, by preparing patient, administering exercise as ordered; taking standard readings or as ordered; marking strips with location code; tearing off strip and writing patient identification information; attaching to request form and placing for processing; notifying physician of emergency signs in patient.

List Elements Fully

Performer takes electrocardiograms of patients as a result of:

a. Request of co-worker.
b. Regular assignment.

1. If regular procedure or request, reads EKG request form and checks identification information with patient; fills in age and other information or corrects if necessary. Reads physician's orders.

    a. Checks whether performer is to give patient exercises to do as specified by MD, or, if own decision to do EKG, reviews exercises decided on.
    b. Notes whether patient is on medication and related instructions.

2. Administers exercise to patient as specified or decided, before and/or after regular procedure, as ordered.

3. Has patient lie on table or sit in wheel chair. May assist. May have adult help with child. Makes patient comfortable; explains procedures to patient or accompanying adult. Exposes patient's wrists, ankles and chest or has this done.

4. Wets patient's chest with electrode pads or other medium; straps electrodes to extremities.

    a. With baby uses an additional lead and, following

6. Check here if this is a master sheet..(X)

Figure 1 (continued)

SAMPLE TASK IDENTIFICATION SUMMARY SHEET (continued)

This is task 4 of 12 for this performer.
This is page 2 of 2 for this task.

| Performer's Name ____ | Analyst(s) ____ | Dept. ____ |
|---|---|---|
| Job Title ____ | Institution ____ | Date ____ |

| List Elements Fully | List Elements Fully |
|---|---|
| physician's orders, uses baby chest electrode.<br>b. If amputee, uses clamp to attach electrodes to stump.<br><br>5. Checks machine by plugging cord into outlet (if not already done). Turns on power switch. Presses start button and observes whether paper roller and needle move. Checks standardization by pressing special button and noting whether the needle movement and tracing is within acceptable designated range. Checks that machine has enough cardiograph paper. May replace if needed or ask co-worker to replace.<br><br>If machine is out of order, performer switches to another machine, if available, and/or reports problem.<br><br>6. Performer takes EKG readings. Uses marker button to designate six different limb leads according to prearranged code.<br><br>7. Places electrodes on chest while operating machine, having located proper position on chest for this. Takes six different readings. Marks each chest recording with marker button according to prearranged code.<br><br>8. Tears cardiogram off machine; writes patient's name and chart number on it, and attaches to patient's EKG request form. Places in designated location.<br><br>9. Throughout procedure, performer remains alert to patient's condition and notifies appropriate physician of signs of emergency. | |

for any task, and, thus, common requirements can be identified. In addition, each skill or knowledge category is expressed as a scale. The scales permit tasks to be compared to one another in terms of levels of the skills and knowledges required. (The scales permit sophisticated types of statistical analysis, such as factor analysis.) The skills and knowledge categories have the property of being learnable (unlike aptitudes), so that all the rungs on the job ladders to be created can be reached through training and education.

A skill, as defined in the HSMS method, is displayed in action, in the carrying out of a mental or physical activity; it can be evaluated in terms of its degree or its level. Knowing how or why things function or what to do to things to make them work is knowledge. Using the knowledge requires skills. That is, one may know how something works, the principles of why it works, or what to do to it to make it work, but one needs skills in the act of applying the knowledge in a job task.

The critical distinction between skill and knowledge, given that they are both treated as learnable, is that skills require practice if they are to be learned. Knowledge is learned primarily through didactic means. Skills may sometimes be introduced in an instructional setting, such as in a classroom or lecture room, but actual learning does not take place until there is practice.

Each scale used in the HSMS method has a name, an overall statement of its content, and an indication of the criteria (scaling principles) which are to be used to differentiate each of its various numerical levels. Each numerical scale value (which can range from 0.0 to 9.0) is accompanied by a statement (descriptor) which indicates the behavior warranting that descriptor's scale value. The descriptors are arranged in rising combinations of the scaling principles. They use generic language, so they can be used for any task.

The first descriptor for each scale is at the zero point. This descriptor contains more than the simple statement that the particular skill is not involved. Each defines the minimum condition which must be met before a task can be rated above zero on the scale. The minimum conditions for non-zero levels of the skill scales describe levels above expected, common behavior,attainable with maturation. This is true for each zero point descriptor on each scale. Thus, the zero point descriptor assures that non-zero values on the scales represent learnable attributes that are needed at levels sufficient for use in curriculum design.

## HSMS Skill Scales

The HSMS method identifies sixteen learnable skills, each represented by a scale. Of these, three are manual; two are interpersonal; three relate to precision in the use of language; two deal with decision making; four cover general intellectual skills; and two are responsibility skills which relate to the recognition of the consequences of error in task performance. The job analysts rate each task on each of the sixteen skill scales.

The HSMS method identifies three manual skills which appear to be learnable through practice. They each deal with precision and coordination in the use of the body or its parts, and are essentially psychomotor skills. Locomotion deals with the body's movement through space; Object Manipulation deals with the movement, control, and placement of objects; and Guiding or Steering deals with the control of objects moving in space in relation to external stimuli.

The HSMS method includes two interpersonal skills. One deals with Human Interaction. It is exercised whenever a task requires the performer to come into contact with or interact with other persons. The second deals with Leadership, and is exercised whenever a task requires the performer to relate to subordinates so as to influence their work behavior. Both of these scales have scaling principles which describe the circumstances under which the skills must be exercised, rather than the nature of the skills. This is because interpersonal skills may be exercised in ways which are unique to the performer and reflect his individual personality. (The skills can be taught independently of individual differences by emphasizing the circumstances that require them.)

There are three HSMS language skills: Oral Use of a Relevant Language, Reading Use of a Relevant Language, and Written Use of a Relevant Language. The language skills refer to the precision with which language of varying complexity must be used or understood to convey or comprehend meaning. The skills are rated independently of the knowledge of technical vocabulary; they do not refer to the precision with which directions must be followed, but rather the precision needed in the understanding of the language.

The HSMS method includes two decision making skills which relate to the degree of latitude a performer has in how he does his tasks and his varying degrees of latitude in the quality of his task performance. Decision Making on Methods applies if the performer has any choice about how to do a task or what to use. Decision Making on Quality applies if the performer can choose to affect and can affect the quality of the task's output within the framework of correct performance.

The HSMS method includes four general intellectual skills. They deal with (1) the mental manipulation of the size, shape or form of things to achieve a figural standard: Figural Skills; (2) the mental manipulation of abstract symbols which are parts of systems of notation: Symbolic Skills; (3) the conscious application of, or creation of, conceptual classifying or organizing principles: Taxonomic Skills; and, (4) the drawing of non-obvious conclusions or inferences from information: Implicative Skills. Since general intellectual skills are usually learned and exercised in the application of knowledge, they may be confused with knowledge. Actually, the knowledge serves as a vehicle through which the skills are practiced. Tasks which require different knowledge or subject matter may have some of the general intellectual skills in common.

A performer may make errors in carrying out a task. The awareness of the seriousness of possible errors serves to keep the performer alert in the performance of the task. This sense of responsibility is learnable, and, as such, is treated as a skill. The HSMS method includes two such skills. One is Financial Consequences of Error; the second is Consequences of Error to Humans. Both scales describe levels of seriousness of the consequences of error. Each scale is applied separately for each task. In the procedure used for scaling a task for each of the two error consequences skills, the analysts establish the most serious error (including omission)which it is likely that a qualified performer could commit in relation to each scale. The consequence of each error is rated on its respective scale.

## The Knowledge Classification System

The HSMS Knowledge Classification System and its Knowledge Scale reflect the method's need to treat knowledge categories as variables which can be identified as required in task performance and which can be scaled in a manner similar to that of scaling tasks for skills.

While "knowledge" in general can be considered to include all types of information, the HSMS Knowledge Classification System has a more limited approach. It is a specialized taxonomy of knowledge categories.

Each category represents a subject area which can be conceived of in incremental, transferable units, so that the application of the category in a task can be scaled with the Knowledge Scale according to specified scaling principles. The categories (at any scale level) require a sufficient learning effort for them to be accounted for in the design of curriculum and include only subject areas which may be required for use in work situations.

The Knowledge Classification System does not cover all possible areas of knowledge. Excluded as categories are procedures which are statements of "first you do this and then you do that" without links to broader bodies of learning. Also excluded as categories are procedures unique to an institution (orientation knowledge). These types of knowledge are either represented at particular scale levels in broader categories, or are not scalable and are therefore not included at all. Though all must be accounted for in a curriculum,only scalable knowledge categories are usable as variables for the clustering of tasks into ladders.

The categories found in the Knowledge Classification System are arranged in outline form, with each category assigned an eight-digit code which reflects the category's degree of indentation in the outline. Categories are arranged in relevant contexts in the outline, and each category appears in only one location in the System,even if it is appropriate in more than one part of the outline.

In the HSMS method, knowledge identification is the assignment to each task of all the categories from the Knowledge System that are actually required for the performance of the task(at a scale value above zero on the Knowledge Scale).

## The Knowledge Scale

The HSMS method uses a single scale for measuring the levels of all knowledge categories in the System. It is similar in concept to the skill scales.

The minimum condition needed for a category to be identified for a task at a non-zero level on the Knowledge Scale is that the knowledge in the subject category must be consciously applied in the task and must represent a sufficient learning effort to be considered for curriculum purposes. What is meant by "consciously applied" is that the performer must be able to explain how the knowledge in the category is used in the task. However, this need not mean that the performer must think about the use of the knowledge each time the task is done. He may normally apply the knowledge automatically because of practice, but he must be able to articulate the use of the knowledge in the task.

There are two scaling principles for the Knowledge Scale. These are: (1) breadth of knowledge and (2) depth of understanding.

Breadth of knowledge refers to the amount of detailed knowledge the performer must know about the category. This covers the varieties of discrete information which are organized within the category such as facts, terms, definitions, special procedures, and the use of related equipment. Depth of understanding, the second principle, refers to knowledge of the conceptual structure of the category named. The nature of the category determines the way depth of understanding is manifested, but depth of understanding always refers to the comprehension of the "hows" "whys" and "for whats" of the detailed information covered by the category.

In the HSMS method, the analysts assign a scale value to each knowledge category identified for a task at the level required for acceptable task performance.

Job Ladder Design

When a group of job titles is being studied, all of the tasks found in those titles are the data base. Whenever a task overlap is found, the task is included only once. Each task is skill-scaled; its required knowledge (in terms of the Knowledge System) is identified, and the categories are scaled. Thus, for a given set of tasks, there will be scale value data on 16 skill variables and on an unknown number of knowledge category variables (equal to the number of categories identified for the entire set of tasks).

This set of data is subjected to factor analysis. The result is a set of task families in which the tasks that share regularly associated skills and knowledges are arranged in hierarchies and levels. Each level includes tasks which require related skills and knowledges at similar scale values.

These groupings of tasks are the raw materials from which idealized jobs are constructed. The jobs are the rungs on job ladders. Each job is related to the job above and the job below on the ladder because the jobs require related skills and knowledges. Lower-level jobs require lower scale levels and fewer categories; higher-level jobs require higher scale levels and more categories.

## CURRICULUM ANALYSIS AND EDUCATIONAL LADDERS

The HSMS is currently developing a methodology for the design of educational ladders which will utilize the HSMS task data. Our objective for educational ladder design is to arrange for sequences of educational programs that provide the cumulative education needed for the high-level jobs in a job ladder, and also provide the education needed for the lowest level jobs in the ladder which are to be reachable through exit points in the educational sequence. The academic credits earned at each stage would permit optional re-entry into the next stage.

### Issues

In reviewing the methodological problems to be faced in the design of educational ladders, the HSMS uncovered a set of issues which must be dealt with in the design of educational ladders.

The first issue involves the contrasts between the approach taken in training programs and in educational programs. The concept of transferability of training, both vertically and laterally, is involved, as well as the concept of the relevance of training. A related issue which contrasts "training" and "education" is the question of academic credits and their accumulation in the educational process.

A second major issue is the complexity of the structures involved in the accreditation of programs and/or the licensure or certification of individuals. This leads to redundancy of requirements both within and across programs and institutions. A related issue is that of non-uniform terminology in curriculum guidelines and in statements of requirements.

## Education versus Training

To the layman, and in common professional usage, education and training mean the same thing. However, for the purpose of this immediate discussion, we refer to "education" as the student's experience obtained in a general academic framework, in which subjects in programs are taught within the contexts of their broader disciplines, and in which academic credits are accumulated for time spent in course work. In contrast, for the purpose of this discussion, we refer to "training" as the experience obtained in a work-oriented framework in which the specific procedures for given work contexts are taught, and for which no academic credits are accumulated. Thus, clinical practice or occupational programs may be found in either an educational or a training setting.

On-the-job training (hospital-based training) or purely technical training is provided for most entry level jobs, and is the form in which preparation for many emerging specialties first appears. The training teaches students what to do in the immediate context and under the specific conditions of the given institution or the given equipment. It is generally designed so that the performer will be able to carry out routine procedures by rote.

While such training is certainly related to work performance, we maintain that it is not adequate for use in connection with job ladders and cannot be proposed for educational ladder design. Training for the rote performance of narrowly conceived task procedures (which is offered by many who design curricula for paraprofessionals), does not properly prepare the student.

1. "Training" does not prepare the student to deal with contingencies that may arise, such as emergencies, since the student does not learn why he or she is doing a given act or what principles are involved. Thus, the student does not learn enough to be able to function responsibly.

2. "Training" does not prepare the student to apply the activity in a different work situation where, if the principles were understood, the same learning would apply, or to a different set of materials or equipment where, if the reasons were understood, the same procedures would apply. Thus, the student's learning is not transferable laterally.

3. "Training" does not prepare the student with the conceptual groundwork upon which later learning for higher level tasks must be based. The rote learning is not additive and, therefore, is not transferable vertically.

4. "Training" does not provide the student with transferable academic credits, since it is not academically based, or is provided as terminal, technical education. Thus, the time spent in training is wasted if the student aspires to any upward mobility that requires the accumulation of academic credits.

Educational programs in academic institutions which provide occupational preparation stress the disciplines upon which technical work is founded and provide implicitly for transferability of learning as well as accumulation of credits. The current major objections to such programs are that many course requirements are irrelevant, obsolete, or taught in a manner so removed from the contexts in which they are to be applied that they are not useful preparation for work.

Our conclusion is that occupational preparation must emphasize transferability of training and must also be job-relevant and additive.

1. The education must permit for transferability of knowledge across specific work contexts or as technology changes, and must prepare the student to deal with contingencies or emergencies. This requires that knowledges needed in work performance be comprehended in the context of the larger disciplines in which they are found.

2. The education must present the academic disciplines and general skills in contexts which will be relevant to the jobs for which they are preparation by referring to the work behaviors in which they are to be applied.

3. The educational programs must present the skills and knowledges in a manner that is, and in units that are, additive, so that each level provides the groundwork that will be needed for later learning.

Redundancy and Institutional Barriers

Accreditation is the process whereby an agency, organization, or government body grants recognition to a program or institution based on a set of standards or qualifications. The complexity of the procedures and structures which determine accreditation requirements produce lack of uniformity among educational programs for the same occupation, redundancies of requirements for educational programs which prepare students for different but related occupations, and redundancies of requirements within individual programs for a given occupation.

Lack of uniformity in requirements for a given occupation reflects the fact that students wishing to enter many health occupations may take their preparation at hospital-based, non-degree granting programs, or in associate degree programs, or in baccalaureate programs. In addition, standards differ from state to state and from institution to institution.

Reduncancies in programs which prepare students for different but related occupations are partly a result of non-uniform terminology in course descriptions, in requirements, and in standards, where the actual work would be the same. This reflects differences from state to state and the different (and sometimes conflicting) professional organizations that are involved with accreditation. Redundancies also reflect the relative isolation in which the planning is done for new programs, especially planning for new occupations. Because agencies that set up the requirements for degree granting programs may be different from those for occupational programs, there may be redundancy of requirements within any given educational program. (In addition, the nature of topic outline curriculum guidelines is such that redundancies emerge.)

To highlight the complexities involved, let us consider the accreditation of an occupational, degree program in New York State:

1. Any school wishing to grant a degree must be accredited by its State Department of Education and/or an association of schools such as that for junior colleges.

2. Any program for an occupation which is licensed by the state must be accredited by the State Department of Education in cooperation with the appropriate state bureau covering the occupation. (Three states currently license radiologic technologists: California, New Jersy and New York.)

3. Any program for most health occupations must have accreditation by the American Medical Association (AMA) if it is expected to turn out graduates who can be active in the occupation.

The AMA accredits the major portion of health occupation programs outside of nursing and dentistry.[5] The course content requirements (that is, the curriculum guidelines by subject area, the number of hours for each, and the division of hours into didactic and clinical

[5] In the field of radiologic technology the Joint Review Committee on Education for Radiologic Technology deals with the accreditation of programs for Radiologic Technologists (and is recognized by the U. S. Office of Education) and for Radiation Therapy Technologists. The American College of Radiology and the American Society of Radiologic Technologists collaborate with the Council on Medical Education of the AMA and are involved in the selection of representatives to serve on the review bodies and in the establishment of "*Essentials*" for the programs. The field of nuclear medicine technology has a Joint Review Committee on Educational Programs in Nuclear Medicine Technology which covers programs for Nuclear Medicine Technologists and Nuclear Medicine Technicians. The collaborating agencies include the American College of Radiology, the American Society of Clinical Pathologists, The American Society for Medical Technology, the American Society of Radiologic Technologists, the Society of Nuclear Medicine Technologists and the Society of Nuclear Medicine.

training) are part of the overall accreditation requirements and are called "*Essentials*" by the AMA and its cooperating organizations.

AMA accreditation is required before most professional associations will accept a candidate for membership or before a candidate is permitted to sit for an examination leading to certification.[6] (The examination leading to licensure is different from the one leading to certification. The former is set by the State, and one must have completed a state accredited program in order to sit for the licensure examination.)

The problem of possible curriculum overlap across programs is evident in AMA "*Essentials*" in areas as related as Radiologic Technology, Radiation Therapy Technology and Nuclear Medicine Technology. The *Essentials* are written as topic outlines, but use different language to describe what may be the same content in given fields. Since there is no taxonomy of subject areas, the *Essentials* cannot reflect an awareness or recognition that there may be overlap involved. As a result, the programs may be redundant for someone wishing to go from one occupational area to another.

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6 If a student wishes to join the American Society of Radiologic Technologists, he must be sure that he is eligible to take the examination of the American Registry of Radiologic Technologists. The American Registry of Radiologic Technologists certifies Radiologic Technologists, Radiation Therapy Technologists and Nuclear Medical Technologists. (The Registry is sponsored by the American College of Radiology and the American Society of Radiologic Technologists.) The Registry of Medical Technologists also certifies Nuclear Medicine Technologists.

Academic programs which provide occupational training present another set of problems because the degree granting requirements are determined independently of the occupational requirements. This leads to a type of curriculum redundancy <u>within</u> programs, not in the specific content, but in the general area. For example, a year of physiology or anatomy required for an associate degree in science may not be appropriate for the specific needs of a radiologic technologist. If the course covering physiology or anatomy prescribed by the accrediting body for the occupation is a different one, it may have to be taken in addition to the irrelevant one prescribed for the degree.

Educational ladders make sense if they eliminate redundant training as one moves from level to level in a program sequence that is arranged to parallel a job ladder. Educational ladders can be created by the design of new programs, or when one educational institution or program will acknowledge the areas of curriculum overlap with another institution or program. When a student receives credit or advanced standing for course work already taken in a program already completed upward educational mobility is facilitated.

The process of curriculum review needed to create educational ladders will most likely uncover irrelevant as well as redundant requirements that can be removed as obstacles to upward mobility. Educational inadequacies may also be perceived and corrected.

Our conclusion is that curriculum guidelines must be objectively stated and clearly defined if they are to be used to design educational ladders, to identify overlap, or to pinpoint irrelevancies or gaps in existing programs.

Use of HSMS Data

The HSMS set itself the goal of providing curriculum guidelines for educational ladders. These would utilize the task data which were collected and used for the design of job ladders. It is our opinion that the HSMS data are appropriate for dealing with most of the issues presented in this chapter.

The HSMS task descriptions(as found in the "List of Elements") and the task definition provide the basis for designing a curriculum that is job relevant and that is preparation for responsible performance. The task descriptions provide the language for describing how knowledge and skills are applied. The definition and the descriptions cover contingencies and alternatives. This not only pinpoints the responsible behavior needed,but guarantees that the skills and knowledges needed for the contingencies will be identified and properly scaled.

The HSMS taxonomies help highlight distinctions between what must be taught with respect to skills (which must be practiced), and knowledge (which must be learned and applied). The knowledge taxonomy helps assure that task activities will not be presented as procedures to be learned by rote, but will be taught within the context of the academic disciplines involved. The task data also make it possible to separate required knowledge from irrelevant knowledge.

The HSMS scales for skills and knowledge reflect our assumption of additive units and allow for the design of sequences of programs.

The combination of task descriptions and a predetermined taxonomy provides the raw materials for the design of curriculum guidelines which can be objectively stated, reviewed, and used as common frames of reference.

The grouping of related tasks into families and levels provides for the following information and insights, all of which are derived from the task data:

1. For each job level within a ladder it is known which tasks are included. It is known which skills are required and at what scale levels. It is known what knowledge categories are required and at what scale levels. It is also known what procedural information is needed, because of the full accounting of the steps of the tasks.

2. For each job level within a ladder it is possible to investigate higher levels to see how or whether skills, knowledges, and procedures needed at that level will be required or will have to be added to for higher level jobs.

3. For each job level within a ladder it is possible to investigate lower levels to see how or whether skills, knowledges and procedures needed at that level were already covered for lower job levels.

## The Conceptual Framework

The methodological work for the development of educational ladders using HSMS data is being conducted within Phase IV, the current period. Working Paper No. 10, written during Phase III, attempted to raise and deal with the methodological issues involved, but we were essentially sidetracked by a confusion of the following three areas:

1. Curriculum (content) development deals with the specification of subject matter that must be taught. A curriculum is generally expressed in statements about educational objectives and in syllabi, usually written in topic outline form. These are also called curriculum guidelines. The inputs to this area are determined by the institutions of society, among them accrediting bodies.

2. Educational methods deal with the transmission of instructional content to the student in such a manner that learning takes place. The inputs to this area usually come from educational psychology, learning theory (as a branch of psychology), or from individuals in other disciplines.

3. Instructional planning deals with the translation of syllabus requirements and course outlines into the day-to-day process of teaching. The inputs to this area come from curriculum development and from educational methods.

Working Paper No. 10 was primarily concerned with finding the definition for a unit of analysis that would be analogous to the definition of task. By confusing the process of curriculum development (which should have been its focus) with instructional planning, it concluded that the conceptual size of the unit would rarely correspond with Knowledge System categories, and that HSMS data could not be used as direct inputs to curriculum design. Our confusion led us to focus on behavioral objectives. In the field of education, behavioral objectives are usually used for instructional planning and not for curriculum development.

While instructional units do not necessarily correspond to the HSMS taxonomic categories, there is no reason that units for curriculum guidelines cannot correspond to HSMS taxonomic categories. Once this was understood, we could say that the HSMS task data could be direct inputs into curriculum development. We can also say that curriculum guidelines are as amenable as instructional plans to being stated in behavioral terms, and that the literature on behavioral objectives can be adapted to our needs.

We see our function as researchers to be as follows:

1. Articulation of a model describing the process of curriculum development for occupational programs in general, and, specifically, for use with HSMS data for the purpose of educational ladder design.

2. Development of a process whereby the task data are converted into statements called (by us) "curriculum objectives." These will name the relevant skill or knowledge category, and will name the activities of the task(s) in which the category or skill is applied.

   These statements will provide the inputs for (1) identification of curriculum overlap; (2) the elimination of unnecessary requirements or the recognition of absent requirements; and (3) the design of curriculum guidelines for educational ladders.

3. Recommendations to educators and institutions about instruction made evident by the task data.

We do not consider ourselves competent to design instruction or to prescribe for the intermediary process of program design, such as the allocation of curriculum objectives to courses, the assignment of credits to courses, or the sequencing of instructional units. However, we will be able to make recommendations based on insights gained from the data.

Process Models and Working Paper No. 11

Our work has progressed sufficiently for us to be able to describe the procedures in rough outline:

1. The task data will be reviewed by professionals in the relevant associations, educational institutions and delivery institutions. The object will be to convert the task descriptions, skill scale values, knowledge identification and scale values from data which tell what is being done to data that reflect judgments about acceptable standards.

   For example, decisions may be needed about the inclusion of task elements assuring full protection to patients from excessive or unnecessary exposure to ionizing radiation or infection. It may also be decided that, to insure greater sensitivity to patients, higher scale levels for the Human Interaction skill should be required.

2. The curriculum objectives will be written by HSMS staff after the jobs in the ladders are designed, using the data produced in item 1, above. The statements will be written in behavioral terms, and will meet the accepted requirements of behavioral objectives: an observable, demonstrable activity will be described; the conditions under which the behavior will be demonstrated will be stated;and,when possible, the standards for such behavior will be stated. (Standards will be dealt with in the section on performance evaluation.)

3. Where the data have obvious implications for instruction, these will be noted. For example, reference may be made to later applications further up the ladder. If the skills are taught directly, this may affect the way the knowledge categories can be presented, and this may be noted.

Working Paper No. 11 will be written during Phase IV, and will present the methodological work in curriculum analysis and design. It will provide a literature review which covers the conceptual problems, the existing methods in use in the design of curricula for occupational training using task data, the relevant material from professional curriculum designers, and the work of those involved in relevant education theory.

Working Paper No. 11 will present a generic process model for curriculum development. It will also present the model's specific use with HSMS data and will describe the steps in the transformation of HSMS task data into a structured set of curriculum guidelines for use in educational ladders.

We plan to report, as well, on the "real world" procedures involved in the introduction and implementation of educational ladders (including the introduction of new programs or the modification of existing ones).

We believe that it may be possible to directly influence accreditation requirements such as the "*Essentials*." Our curriculum objectives will be able to state requirements in a manner that permits the recognition of overlap as well as the clarification, where appropriate, that overlap does not exist. In addition, we may be able to suggest unnecessary overlap within current program requirements, pinpoint unnecessary subject areas, and indicate areas currently being neglected. If we accomplish these ends, we will have provided objective information usable by the accreditation bodies and educational institutions.

PERFORMANCE EVALUATION INSTRUMENTS

Performance evaluation is the third major application of HSMS task data. It is most clearly appropriate for the following uses:

1. To enable an institution to evaluate the quality of its own work, covering individuals within the institution.

2. To compare groups of employees. For example, the success of an educational ladder paralleling a job ladder can be measured by applying performance evaluation instruments to incumbents trained in conventional programs and to newly placed incumbents trained in the new programs. A comparison can then be made between the two groups.

3. To evaluate the adequacy of occupational programs. If curriculum objectives are derived from task activities, the adequacy of individual programs can be ascertained by reference to the performance of the tasks in actual work situations.

4. To determine when students have successfully reached standards of completion of program requirements in laboratory or clinical work independent of time requirements. If performance evaluation were used to determine student readiness to pass from laboratory to clinical or to ascertain when clinical work was successfully completed, there might be greater safety to the patients who are involved in the clinical practice. Performance evaluation would make it possible to save on laboratory and/or clinical training time when not needed by proficient students or to prescribe additional training for students performing below par.

5. To be used alone or in conjunction with proficiency or equivalency examinations to evaluate an individual's readiness to be accepted with advanced standing in existing programs, into job titles, or to sit for licensure or certification examinations.[7]

6. To be used to validate test items in proficiency examinations. Currently, incumbents' scores on proficiency test items are used to validate test items, but the items are not tested for job relevance. Performance evaluation instruments can be used to validate test items, to thus provide for job relevant test items.

[7] See footnote 2.

Work in Phase III

During Phase III, HSMS produced a document which developed models for the use of HSMS task data in performance evaluation and trainee selection (Research Report No. 6). They were designed independently of the work in curriculum, and for that reason several of the applications described above were not fully recognized.

Research Report No. 6 recognized the need to transform task data as found in the field into normative task data describing acceptable levels of performance. At that time it was not recognized that this step is also a prerequisite for curriculum design. After curriculum objectives have been written using the HSMS model, they can be used as inputs to performance evaluation instruments when statements presenting the standards which the outputs of the tasks must meet are added.

It is now clear that the standards which would complete the statement of a fully developed behavioral objective (used for our curriculum guidelines), will be the same standards which must be applied to evaluate the output of a task or the performance of a task. Such standards are usable as inputs in the design of performance evaluation instruments.

Research Report No. 6 reported on the design of a general methodology for the construction of performance evaluation instruments which will require very little change to be useful in the development of specific instruments, such as for radiologic technology. Two models were designed, one for use with tasks which have outputs that are easily evaluated (Model A), and one for tasks whose outputs are not easily evaluated (Model B).

In Model A, a set of standards or criteria are identified for evaluating the output(s) of the task performances to be studied. These criteria are presented together with descriptions of the tasks. A selection is then made of appropriate raters who evaluate the outputs produced by the performers of the tasks. (The raters could be supervisors, co-workers, patients, or other persons deemed appropriate for the tasks, or a combination of these.) The raters are presented with the task descriptions and the output criteria. They are instructed to rate each performer's respective outputs, using a rating scale which compares their outputs with the acceptable criteria. The scale ranges from highly unacceptable ("distinctly inferior"), to much better than acceptable ("distinctly superior") ratings. These ratings provide data usable to describe the distribution of output quality around the acceptable level. The distribution of ratings for each task tells the institution about its overall levels of performance and pinpoints the "problem tasks." Model B, presented below, is then used to diagnose which skill or knowledge deficiencies are causing the "problem tasks."

Model B is also used alone, with all those tasks that do not lend themselves to easy specification of output criteria (when Model A cannot be used). Some tasks have outputs for which criteria are not easily stated. This would be the case when the output cannot be separwith the step of selecting output criteria and then evaluating outputs.

In Model B, the raters are selected as in A, but they are immediately asked to rate all the performers in the sample against the skills and knowledge categories in the HSMS taxonomy at the scale levels required for the tasks. The instrument presents the given scale levels as performance standards. The rating scales refer to varying degrees of acceptability in application of the skills and knowledges.

In Model B, the "problem tasks" emerge at the same time that the diagnosis of what is causing the "problem tasks" emerges.

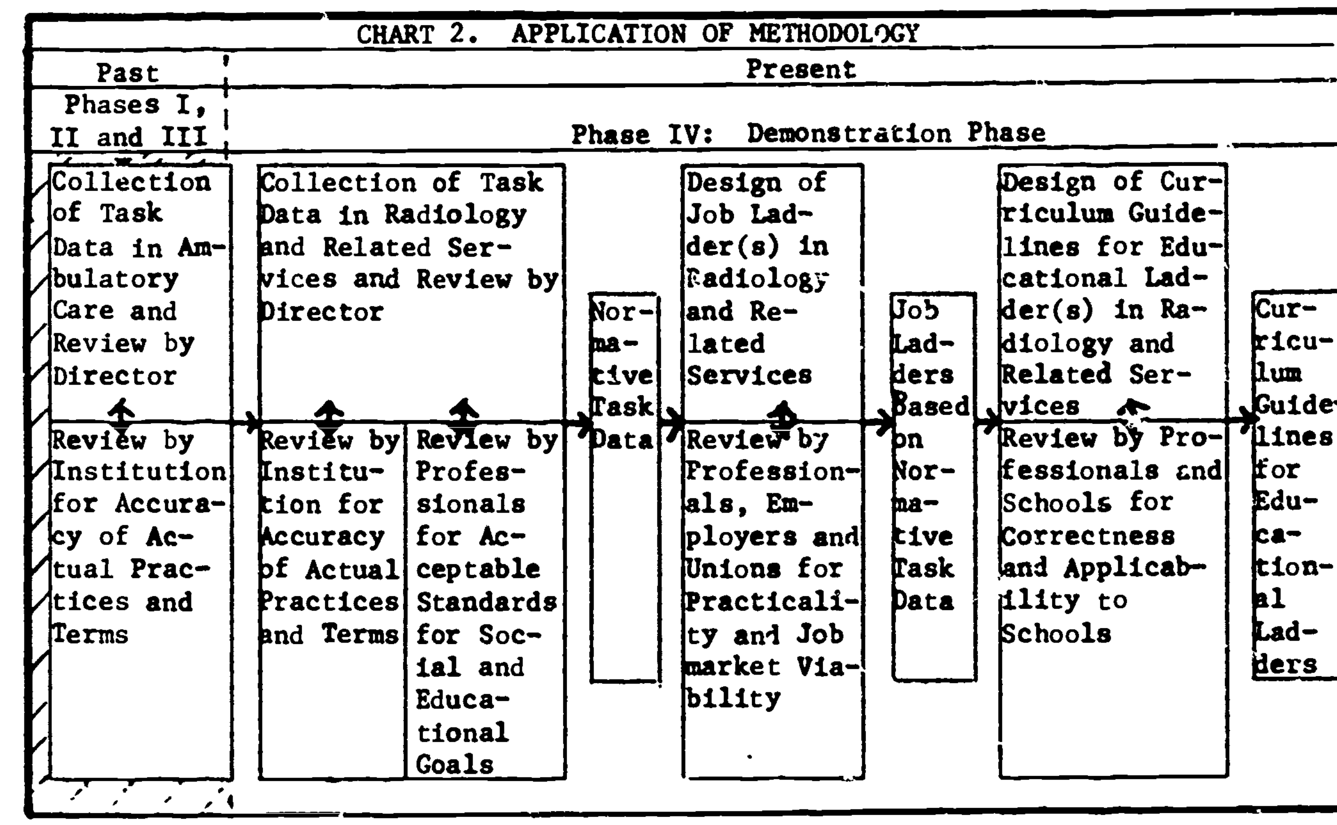
Future Work

What will be needed in the future is the adaptation of the two Research Report No. 6 models to show how to use the task and curriculum data as inputs for the design of performance evaluation instruments or validation of proficiency tests. HSMS data dan provide the basis for objective,work-related criteria with which to evaluate proficiency or to compare current performance across groups or in relation to institutional objectives.



scribes the sequences of events involved, covering the pilot test (Phase III) and the current period (Phase IV).

As indicated in Chart 2, the application stages involve a sequence of events which result in usable products at three points in the




for whether they represent acceptable, normative scale levels. (The reviewers are provided with our skill scales and instructions for their use.) Suggested corrections are reviewed and incorporated into approved, normative-task skill scale values.

The key functions listed in the instructions are as follows:

1. Evaluate skill scale levels in terms of levels needed for <u>acceptable performance</u> rather than superior performance or current performance.

2. For each scale value presented for which there is agreement, place a check mark next to the value on the Master Task Skill Profile Sheet.

3. If a higher or lower scale value for a given skill on a given task is selected, cross out the one which appears and insert the scale value selected. A brief note can be written on the Sheet to explain the reason.

The task descriptions are again returned, this time with the knowledge category and scale data included. The knowledge categories and scale values that were assigned to the tasks are reviewed for whether

2. Compare selected categories with those on the appropriate Master Task Knowledge Profile Sheet for the task.

   a. Decide if the non-zero condition is met for each category identified. Wherever the category is not required above zero for the task, it should be crossed out on the Knowledge Profile Sheet.

   b. For each category agreed with, place a check mark next to the name on the Master Task Knowledge Profile Sheet.

   c. If any categories have been omitted which are required above zero for competent performance of the task, these should be inserted with their selected scale values directly on the Knowledge Profile Sheet. A note to explain the reasons can be included.

3. Select scale values (or review the ones presented) for each category identified (including the new ones added) by applying the rules for use of the Knowledge Scale.

4. Compare selected scale values with those on the Master Task Knowledge Profile Sheet for the task.

   a. For each scale value agreed with, place a check mark next to the value on the Master Task Knowledge Profile Sheet.

   b. If a higher or lower scale value for a given category process. Throughout, there is provision for constant feedback from the relevant specialists in the hospitals, schools, and professional organizations. They provide checks on the accuracy of the data and make important contributions with regard to standards, and the evaluation of the usefulness of the products.

## COLLECTION OF TASK DATA

In the collection of task data for job ladder design, several early decisions are made based on several requirements inherent in the methodology. First, the concept of a job ladder requires that we look at the work performed by all levels of personnel in any type of service function where the ladder is sought.

For example, if one sought to design a ladder in radiologic technology, it would be both logical and necessary to examine all the technical functions carried out in diagnostic radiology, therapeutic radiology and in nuclear medicine as well. We would also include housekeeping and nursing functions. It would be equally necessary to include all the higher-level functions, such as those of the residents in radiology, the physicist, and the attending radiologists.

Every work activity must be picked up, regardless of the job title to which it is assigned in a given institution. Since we are not concerned with how tasks are assigned to titles, the use of survey technique is not required. We do wish to cover <u>all</u> the activities, however, and we therefore need experts to tell us if we have left anything out.

Our computer programs indicate the relationships among the tasks. Later analysis permits us to recommend efficient assignment of tasks to job levels. Institutions will have the opportunity to select their own job structures, but are given full information about the hierarchical relationships among the tasks involved.

Thus, the first decision to be made in task data collection is the selection of the service area in which the job ladder is sought.

Another requirement is that the actual set of tasks used for the data base in the computer analysis include a large number of varied tasks, at varying levels, in various service areas. The reason is that, since the object is to find skill and knowledge factors to be translated into families of related tasks, the ladder sought can only be derived from a factor structure that produces two or more factors, at least one of which will reflect the area under study.

Thus, the second decision is the selection of tasks from other service areas to use as part of the data base. The source of these data is provided once the cycle of data collection has begun, since tasks collected in any initial study are reusable in later studies.

Titles Studied in Pilot Test (Phase III)

The pilot test of the HSMS method provides us with the data base for this year's demonstration in radiologic technology. The pilot test was conducted in Phase III, at the Dr. Martin Luther King, Jr. Health Center, which is an entity of the Montefiore Hospital and Medical Center in the Bronx. The Center is an OEO ambulatory care community health center that has pioneered in the provision of family-oriented medical care. It was agreed that the Study would analyze job titles in the Family Health Team and several other titles in addition. The pilot test included the tasks of twelve performers in as many titles, as follows:

Radiologist
Obstetrician - Gynecologist
Internist
Pediatrician
Nurse Practitioner
Lead X-ray Technician (and X-ray Technician)
Family Health Worker
Licensed Practical Nurse -- Emergency Room
Licensed Practical Nurse - Treatment Unit
EKG Technician (Medical Assistant)
Treatment Unit Medical Assistant
Dark Room Aide

The pilot test resulted in six obvious skill and knowledge factors. We made suggestions for four job ladders. (See footnote 4.)

Titles Currently Being Studied (Phase IV)

One of the ladders identified in the pilot test was a rather truncated one in radiologic technology and radiology. It was obvious that only a tiny portion of the work in this area was represented in the test, but some interesting results were already apparent.

The first interesting result was that EKG tasks and peripheral technical tasks in the X-ray department enter the ladder below the actual radiographic tasks of the technician. The second point of interest was that the tasks of the radiologist, even though restricted to those performed in an ambulatory care setting, could be assigned to two different academic levels.

It was decided that we would explore this promising avenue in the demonstration phase. Having been invited to apply our work at the Montefiore Hospital and Medical Center, we decided to concentrate on radiology and related services.

Table 2 presents the departments, job titles and/or specialty areas to be covered. The reader will note that three hospital departments are involved. These functions may not be so arranged in other institutions. Since the unit of analysis is the task, the allocation to departments is not critically important. Obstetrical radiography is not covered at Montefiore; therefore,we have current plans to study this and related functions at another major voluntary hospital in the area.

The functions in EKG, EEG and cardiac catheterization are related enough to be worth covering. However, since the number of performers whom we must cover in radiology is greater than previously antici-

Table 2. TASK ACTIVITIES TO BE COVERED IN PHASE FOUR

| Department, Job Title and/or Specialty Areas | Location[a] MLK | Mnt | AH |
|---|---|---|---|
| DIAGNOSTIC RADIOLOGY | | | |
| Attending Radiologists | | | |
| Neuroradiology | | X | |
| Lymphangiography | | X | |
| Coronary, Non-cardiac and Cardioangiography | | X | |
| Pediatric Radiology | | X | |
| Gastrointestinal Radiology | X | X | |
| Urogenital and Obstetrical Radiology | X | X | X |
| Bronchography | | X | |
| Cholecystography and Cholangiography | | X | |
| Mammography | | X | |
| Radiography of Skeletal System and Joints | | X | |
| Ultrasound Scanning | | X | |
| Miscellaneous areas not included above | | X | |
| Resident in Diagnostic Radiology (only tasks not already covered by attending radiologists) | | X | |
| Radiologic Technologists | | | |
| Supervisory Functions (technical) | X | X | |
| Quality Control | X | X | |
| Special Procedures | | X | X |
| Common Procedures Using Contrast Media | X | X | X |
| Routine Examinations | X | X | |
| Nursing Procedures | X | X | |
| Dark Room Procedures | X | X | |
| | | | |
| RADIOTHERAPY | | | |
| Attending Radiologist | | X | |
| Resident in Radiotherapy (only tasks not already covered by attending radiologists) | | X | |
| Physicist (covering functions in all three departments) | | X | |
| Junior Physicist | | X | |
| Radiotherapy Technologists | | | |
| Supervisory Functions (technical) | | X | |
| Procedures | | X | |
| Nursing or Clinical Procedures | | X | |
| | | | |
| NUCLEAR MEDICINE | | | |
| Attending Radiologist | | X | |
| Resident in Nuclear Medicine (only tasks not already covered by attending radiologist) | | X | |
| Nuclear Medicine Technologist | | X | |
| Assistant Physicist | | X | |
| Nursing or Clinical Procedures | | X | |
| | | | |
| EKG | X | X | |
| EEG[b] | | X | |
| Cardiac Catheterization[b] | | X | |

[a] MLK = Martin Luther King Jr., Health Center (work done in Phase Three is being revised); Mnt = Montefiore Hospital (primary location for current work); AH = Additional Voluntary Hospital (for activities not covered elsewhere).

[b] If time permits.

pated, we may not get to these in Phase IV. The Martin Luther King EKG tasks, however, will be included in the data base.

Setting Up the Work at the Institution(s)

We follow a procedure designed to make the fewest waves at the institution(s) being studied. First, HSMS is invited in. Then the HSMS director meets with the highest level authorities in administration, medicine,and personnel at the institution. They are acquainted with the way the work is to be done, the results expected, and our needs with respect to interview time and interview locations.

The next step is the identification of the departments to be covered, the job titles that may be relevant, and the names of department heads. We request a letter of introduction from the highest administrative level which explains that we are invited in at management's request. The letter asks that departmental supervisors cooperate in permitting us interview time with their staff and assures management that we are prepared to cooperate in scheduling to avoid undue disruption of normal work flows.

We identify which titles are covered by union contract and/or professional organizations. We obtain a letter from the union(s) involved which asks that employees cooperate with our study. We inform the professional organizations of our plans and indicate our intent to keep them informed or to involve them in review of the work.

Concurrently, we approach the educational institutions most likely to be hosts for the various educational levels in a ladder. Currently, we expect a ladder to go from the junior college to the senior college, and on into the medical school. We hope to find exit points at the 1, 2, 3, 4, 5 and 6 year levels, but, at this stage, it is not possible to make a firm prediction. Our closest tie with an educational institution is the Hostos Community College, CUNY.

The HSMS director meets with the hospital's department heads to present the Project. (We never leave this important step for persons at the institution to handle alone, and always explain the Project at every point of contact.) At this stage we learn how many job titles must be covered to account for all the relevant work activity we wish to study. We then determine how many performers in each title must be covered to account for the work. We obtain the names of the supervisory individuals whom the job analysts must contact in order to schedule interview time with the performers. We also obtain the names of the staff persons who will be asked to review our task data for correct use of terms and accuracy in describing the procedures at the institution. (We call them "resource persons.") At this point the work moves into the hands of the HSMS teams of job analysts.

The teams (once they are trained and functioning independently) arrange for their own scheduling. They present the Project to the scheduling supervisors and explain their needs in interviewing performers. When the performers are selected, the teams also explain the Project to the performers. Teams always indicate that a large number of interviews are normally needed with performers over a period of time. They usually attempt to schedule interviews of one to two hours. Observations are scheduled only for activities that are hard to describe.

## Preparation of Job Analysts

The HSMS methodology is designed to be usable by persons w ) are not themselves incumbents in the occupations to be studied. This makes it possible for the analysts to study any type of job. The design requires that the analysts be trained in the needs of the methodology and its definitions, and in interview techniques (knowing how to question the performer to obtain the information needed). We collect a library of documents describing the work, terminology, and disciplines relevant to the jobs to be studied. This literature is used to familiarize the analysts with the fields to be covered prior to their entry into the institution. Teams are then able to deal intelligently with the material that they encounter.

The analysts are trained in three stages. First, there is didactic classroom activity using HSMS manuals and classroom discussion. Included are practice sessions using task material already collected. Next, there is in-house role playing to develop the skills involved. Finally, the new analysts go into the field as a single team under the leadership of the instructor. They engage in regular data collection, with each new analyst preparing the data independently. The data actually turned in are approved by the instructor. Thus, data collection and training can occur simultaneously. As the analysts demonstrate the ability to achieve reliable and accurate results, they are assigned to teams of two, and from then on work independently as a team. (A team must consist of two or more analysts to ensure reliable and accurate data. The data's reliability is insured because the analysts on a team are expected to agree on the data they submit.)

Steps in Collecting Task Data

In the first series of interviews the analysts find out about all the work covered by the performer. After each interview they attempt to divide the activities into discrete tasks. The analysts are encouraged to refer to models of similar tasks already developed whenever possible when writing task descriptions on the Task Identification Summary Sheets. This helps insure that all relevant information will be included.

When all the tasks have been identified for the performer and written up, the Task ID Sheets go to typing and then to the HSMS director.

The Director reviews the tasks for conformity to the HSMS definitions and for clarity of presentation. She indicates areas needing expansion or more information. At the current time, the Director also determines whether the new tasks overlap with tasks already on file. (A table using brief task names and task code numbers serves as a reference for this.) The same code number is assigned to overlap tasks. New tasks receive new code numbers.

After the analysts get complete information for the tasks and the tasks are approved by the Director, tasks are submitted to the appropriate "resource person" at the institution. The tasks are reviewed for correctness in use of terminology, in the presentation of procedures, for the correctness of sequences, and for omission of activities.

After the resource person's corrections (or questions) are accounted for, the analysts return to the performer. Before the analysts collect the next set of information, the tasks are reviewed by the performer for accuracy in regard to his or her actual experience in the tasks.

The analysts then scale each task on each of the skill scales; they identify the Knowledge Classification System categories needed to perform each task and assign a scale value to each category using the Knowledge Scale. (We find that it is most efficient to have the analysts do their identification and scaling prior to meeting with the performer. They then interview the performer to confirm their data or obtain the information found to be lacking.)

This process continues for each of the performers to be studied. In cases where the same tasks appear for more than one performer, the tasks are treated independently and separate data are collected. The overlap data make it possible to refine the task descriptions and to provide reliable skill and knowledge data, since the data sheets are compared and discrepancies can be investigated.

## NORMATIVE REVIEW OF TASK DATA

The task data at this point represent how the work is being done. We do not assume that the procedures are the best or even acceptable. The next stage of work is the transformation of the task data into forms that reflect acceptable procedures for the purpose of education and performance evaluation. For this stage of the work we enlist the help of experts in the service areas being covered, primarily educators with "hands-on" work experience. We generally enlist experts from institutions that are interested in utilizing the curriculum guidelines that we are in the process of developing. We consider it important also to involve individuals who are concerned with accreditation.

For Phase IV we now have almost a full complement of reviewers. We call them "resource respondents." We attempt to have two or more experts review every job title or educational level involved; we may later expand the review process.

### The Work of the Resource Respondents

We generally meet with the resource respondents to present an overview of what the work will require. We emphasize that this is the opportunity to develop task descriptions for how the work should be carried out, as well as task descriptions that reflect current work standards.

The task data are submitted to their appropriate resource respondent in three stages. (By the time the work is done, the resource respondents have become experienced in the use of the method, except for the interview techniques involved.)

First, the task descriptions are submitted for review of the appropriateness of the descriptions. Tasks are evaluated for whether they represent acceptable procedures. Suggested corrections are reviewed by HSMS and incorporated into approved "normative tasks." The resource respondents are encouraged to suggest any activities which seem to have been omitted from tasks or, at the end of the work, any tasks which have been omitted from the data base.

The resource respondents are provided with the HSMS task definition. The key functions listed in the instructions are as follows:

1. Decide whether the task, as described, presents an acceptable set of procedures, and uses appropriate equipment to achieve the output(s) of the task. If not, indicate what changes are necessary on the Summary Sheets or use separate blank Summary Sheets (which are provided).

2. Correct any misuse of terms or inversions of sequences.

3. If the task is totally inappropriate, please recommend an alternative task and describe its procedures and equipment on a separate Sheet, and explain the reasons. Later, when asked whether whole tasks have been omitted, write up omitted tasks in a similar manner.

After the task descriptions have been revised by HSMS, they are returned to the reviewers for reference, and the skill scale data are evaluated. The skill scale values assigned to the tasks are reviewed of information involved. The data will be made available on request and may be offered for publication or as an appendix to a final document. Several hundred tasks will probably be involved. The data will also be available in summary form based on Item 5 (the task name) of the Task ID Sheets; lists of still briefer task names will be available as well.

DESIGN OF JOB LADDERS

The normative task data will be submitted to keypunching and then will be subjected to statistical analysis.

The HSMS Edit program receives the data cards in any task order; however, the cards for a given task are always in numerical order by card number, beginning with the first card. The Edit program then performs the following functions:

1. A check is made to be sure that all scale values are in the correct range; i.e., gross keypunch errors are flagged.

2. A check is made to be sure that no task appears more than once; i.e., that only one set of data per task ID number will be "read in" to the computer.

3. The program "reads in" the tasks' scale values for the skill variables from a fixed format, and assigns ID numbers from 1 to 16 to the skill variables.

4. The program "reads in" the tasks' knowledge category values. This is done in a process which acknowledges and assigns a location to each different 8-digit knowledge category identification code, and assigns a variable number to each different one, starting from 17. For all categories identified in the data base but not needed for a given task, scale values of zero are assigned by the computer.

5. The program produces a printed output which indicates what the variables are, covering the skills and the knowledge

categories. It also shows the task locations and scale values for each knowledge category identified. The program allows the user to delete knowledge categories that do not appear on a sufficient number of tasks or to delete specific categories.

6. The program provides the user with the option of utilizing a procedure which "normalizes" the data statistically. A nonlinear transformation is performed on the data to bring them into a closer approximation to a "normal distribution." The statistical problems encountered with a proliferation of zeros (when a large number of knowledge categories scale at zero for many tasks) is then avoided, but no major distortion of the data is involved.

7. The program places the final data onto tape files, where they are then inputs for the actual steps of factor analysis.

Factor Analysis of Variables (Skills and Knowledges)

The HSMS use of factor analysis deals with tasks, and skill and knowledge variables. Factor analysis examines the statistical relationship of every variable with every other variable, and is used to group variables into "factors" of associated variables which best account for all the variability represented by the scale values of all the tasks on all the variables. A "factor solution" is a statistical grouping of related variables which explain the data with fewer concepts than the sum of the original variables. Any given factor essentially replaces a group of interrelated variables with a single construct which expresses the interrelationship within the group. Factor analysis usually results in the creation of two or more factors from a much larger number of variables. The number of factors in a "solution" is a choice which is made by the user after inspection of various factor solutions.

The first stage of the factor analysis creates our "variable factors." These are determined by those skills and knowledges which tend to be interrelated and therefore can be expected to rise and fall together. (This means that, for the purpose of instruction, variables which factor together should ideally be taught together, since they are usually needed for interrelated activities.)

Every variable has a "loading" or value on every factor. Variables can load on factors within the range of ±.99. Variables which are positively interrelated on a factor will have the same sign. (The + or - has no other intrinsic meaning.) What determines a "variable factor" are those variables which "load high" on the factor.

An acceptable factor solution has an optimum number of factors for the purposes involved and, preferably, much fewer than the original n ber of variables. One criterion for choosing a factor solution is that most of the variables in the data base have high loadings on only one factor, and that each factor have several variables which load high on it. Another criterion is that the factors chosen show stability in their high-loading variables across several factor solutions. The most important criterion, however, is that the factors make sense in terms of content.

Factor Analysis of Tasks

The procedure used for clustering the tasks is a modified version of the Tucker-Messick procedure for factoring an individual differences matrix.[8] The HSMS version is a new application and modification of the original technique.[9] We dubbed this method with the name "two-mode" factor analysis; we call the simple factoring of variables "simple" factor analysis.

The decision regarding the number of factors in the simple factoring of the variables determines the number of factors for the tasks. In fact, it is the interrelationships among the variables on a variable factor that determine a task's loading on a given "task factor."

The "two-mode" program results in a print-out of the desired variable factors and the counter-rotated task factor solution. The output lists the tasks by code number; it provides each task's loading on each factor.

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8 The procedure was developed at the University of Illinois by E. E. Davis, H. C. Triandis, and L. Tucker. See, Tucker, Ledyard R., and Messick, Samuel, "An Individual Differences Model for Multidimensional Scaling," Psychometrika, Vol. 28, December, 1963, 333-367. See also, Tucker, L. R., "Some Mathematical Notes on Three-Mode Factor Analysis," Psychometrika, Vol. 31, 1966, 279-311.

9 Davis, E. E., Triandis, H. C., An Exploratory Study of Intercultural Negotiations, Technical Report #26, ONR Contract #177-472, Nonr-1834(36), Urbana: University of Illinois, 1965.

The program's essential feature is that it permits the extraction of principal axis factors for both tasks and variables (two modes), based on a co-variance or a correlation matrix of variables. It is then possible to rotate the variable mode to "simple structure" by a Varimax routine, and "counter-rotate" the task mode. Counter rotation is accomplished by obtaining the transformed characteristic vectors of the observation (task) mode induced by the Varimax rotations of the variable mode.

Assignment of Tasks to Factors

The loadings of the tasks on factors can be interpreted as follows. A task's loading on a factor is determined by the combination of the variables required for the task, the loading of the variables on the corresponding "variable factor," and the scale values assigned to the variables for the given task. A task has a loading on every factor, but, since different variables determine different factors, it is possible to observe on which factor a task has its highest relative loading. Some high-level tasks may load high on several factors, while most low-level tasks load relatively low on all factors, since they require few variables and at low levels.

A task is assigned to the factor where it has its highest loading and to more than one factor if it loads high on more than one factor and makes sense in each. However, most tasks are clearly assignable to only one factor. (The assignment of tasks to more than one factor provides a basis for constructing job lattices at a later stage.)

Once tasks are assigned to factors, the tasks of each factor are arranged in rank order according to their factor loadings on the factor. The results are sets of task hierarchies (rank-ordered tasks for each factor).

A task's loading on a factor determines its rank order on the factor; but the task may require a good many other skills and knowledge categories beyond those determining the factor. The concept of sequences of educational steps is the reason for arranging the tasks into hierarchies by factor. However, tasks in each rank ordering are inspected to see if any tasks should not be on the factor by virtue of requiring too many skills or knowledge categories not required by the other tasks in the factor. As a result of this inspection, the number of tasks assigned to individual factors may be somewhat reduced.

## Assignment of Tasks to Job and Educational Levels by Factor

Although the factor loadings for the tasks permit easy assignment of tasks to factors, the meaning of a difference in loading of, for example, .83 and .44 is hard to judge in educational terms. Since the objective is to identify rungs on a ladder, stages in a sequence, or comparable levels for tasks -- all of these being interchangeable concepts -- it is necessary to do one further type of analysis.

The tasks of a factor are laid out in rank order of their loadings on the factor, from low to high, and the skills and knowledges are laid out in the order of when they appear, given the arrangement of the tasks. This matrix permits identification of the major cut-off points between tasks. Cut-offs are chosen where there are marked increases in scale levels and/or the addition of large blocks of new knowledge categories. This information is used to determine which tasks within a factor are at the same relative level. The task level groupings across factors correspond to broad educational levels.

Idealized Jobs and Job Ladder Recommendations

The tasks assigned to any given level within a factor will be representative of the central tasks of a job. Naturally, any job will also include certain peripheral tasks (not on the factor) which reflect institutional idiosyncrasies and tasks covering paper work, conferences, etc., usually associated with any job. For the purposes of a job or educational ladder, however, the tasks at a given level within a factor suggest the most rational assignment of major duties, since they represent the maximum application of a given educational investment.

At this stage, HSMS will produce recommendations with respect to the allocation of tasks to jobs in a given ladder. (The job ladders will also suggest lattice relationships.[10]) Each job on a ladder will be related to its higher and lower level rungs through the variables which determined the task factor.

The job ladder proposals will be presented to major employers, relevant trade unions,and the professional associations for evaluation.

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10 Job lattices allow for linkages across ladders both horizontally and diagonally. Where there is transferability of skills and knowledge at a given level, there can be crossover options and a choice of promotional pathways. The principle involved is that the skills and knowledges used for a given job level may serve as a basis for more than one specialty (factor). A given specialty may build on more than one kind of prior preparation, and the entry to sp[illegible]ic professional jobs can thus be reached in a lattice by more than sequence. Conversely, a given sequence level can be a step towards more than one specialty. Tasks which load high on more than one factor may suggest the most logical lattice possibilities.

We will be asking the questions: Do the job structures presented make sense to you as viable slots in a job market? Would you redesign current jobs to reflect these suggestions? Would you hire people to serve in such functions? Are these practical suggestions?

We may discover that employers want jobs to cover wider responsibilites than a given ladder provides. This would suggest that we combine tasks at the same level across ladders (or factors). We may discover that employers want jobs to cover the tasks in more than one level. This would suggest that tasks in adjacent vertical levels in a ladder be combined. In either case, we would reflect these wishes in our final report, but would retain the original suggestions for those readers who, at some later date, would like to make use of the finer distinctions.

## Job Ladders Based on Normative Task Data

Once we have a set of employer-approved job ladder designs, we will have our second final product. The approved job ladder recommendations will become inputs in the design of curriculum guidelines for educational ladders, and they also will be of interest to the general public. The recommendations and the descriptions on which they are based will be presented in a report. Supporting data will also be available on request.

## DESIGN OF CURRICULUM GUIDELINES

Our next activity will be the design of curriculum objectives to provide guidelines for the educational content needed for each job on the ladder. The guidelines will be used to design educational ladders.

The objectives, when written as described in Chapter 2, and as Working Paper No. 11 will indicate, will also be usable as checklists to discern curriculum overlap and to help in the modification of accreditation guidelines.

Throughout the process,the professionals and educators will be involved in writing and review. Finally, guidelines for actual curricula will be submitted to the interested schools and accrediting bodies for review.

The revised curriculum guidelines will be our third final product. These, together with the task data, will be submitted for publication and dissemination.

## FUTURE PLANS

The work in curriculum will progress from design to implementation. The work in task data and job ladder design will progress to a new service area. This will be followed, in turn, by curriculum work. The work with performance evaluation will then follow. These plans are, of course, contingent on future funding.

CHAPTER 4

# IMPLEMENTATION AND UTILIZATION

This chapter describes our approach to implementation and our current experience in dissemination of our work.

## APPROACH TO IMPLEMENTATION

In a manpower area as complex as the health occupations, implementation of job ladders and educational ladders requires many cooperative processes and a willingness to develop communication among the diverse individual institutions involved. Among these, the institution which provides health services is the key decision maker in economic terms, since it has the power to employ or not employ health manpower. That is, the employer makes the final decision about who will be employed and with what prerequisite qualifications; it decides on the tasks to be assigned to job titles, and whether jobs will be arranged in a promotional sequence. (We refer to the hospital or health center, rather than the physician's private practice office.)

While the power of the employer is decisive in economic terms, it is less than absolute in real-world terms. Where trade unions are involved, for example, there can be restrictions on the allocation of task to titles. Employees have been known to refuse to do tasks not considered part of their responsibility within labor-management agreements. Unions are now becoming concerned about upward mobility. Recently, in New York

City, the two unions which cover the bulk of the allied health occupations have won agreements which provide finances for training employees for upward mobility.[11]

In addition, since most hospitals seek accreditation, they must comply with approved practices in the assignment of duties and the utilization of specific occupations. Further, were the individual hospital to embark on an upward mobility program, it would need funds, facilities and personnel for the training of staff. The existence of hospital-based programs is not new, but the sensible requirement that academic credits be accumulated with training increasingly forces the hospitals to look to the educators for help.

The educational institutions, as has been noted, are very much influenced by restrictions with respect to accreditation requirements, both for the academic degrees and for occupational preparation. In addition, most schools can justify new occupational programs only by showing that there is a job market for the graduates.

The educational institutions add to restrictions on individuals. In the absence of counter-pressures, the tendency in degree programs is to place academic and related prerequisite restrictions on student entry to the programs to guarantee successful graduates. It also seems that

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[11] Local 1199 of the Drug and Hospital Union, RWDSU, AFL-CIO, covering the League of Voluntary Hospitals, and District Council 37, American Federation of State, County and Municipal Employees, AFL-CIO, covering the Municipal Hospitals, both have employer-contributed funds for training.

there is a tendency in associate degree and baccalaureate health occupation programs to teach the required liberal arts and science courses early in the programs so as to screen out students. As a result, the students who fail do not have enough occupational training to qualify in a job market.

The accrediting bodies now carry the responsibility for setting requirements and guidelines which spell out the profession's view on what is needed for education in the occupations. Their relationships with the hospitals, schools and cooperating organizations are, at best, ambivalent.

It is obvious that most of the problems could be reduced if the relative isolation of the various institutions were somewhat reduced. Thus, when the HSMS designs job ladders and the curriculum guidelines for educational ladders, it will be concerned with the real problems of implementation and communication among the institutions. We conceive our contribution to be as follows:

1. Produce objective data that can be evaluated objectively.
2. Involve the relevant parties in the review of the material as it is gathered.
3. Make recommend tions that are practical and reflect professional and social standards.
4. Provide a bridge for communicating about job and educational mobility, involving all the institutions concerned.
5. Provide models which can affect employment patterns, educational patterns, and accreditation requirements.

## Objective Data

Chapters 2 and 3 indicate that our methodologies produce objective descriptions of task relationships and curriculum relationships. These are the basis of our recommendations, and stem from the nature of our task descriptions, skill data and knowledge data. These data are, in turn, objective and reliable, and can provide common frames of reference.

## Involvement of the Parties

The HSMS methodology requires the involvement of the institutions <u>before</u> final products are produced. In the collection of the task data, the institutions where the task data are collected have inputs in review. In the transformation of the data into normative standards, and in the design of curriculum guidelines, the educators who have immediate interest in the results, the organizations involved in accreditation, and the educational institutions which may house the first implementations of the programs, make direct inputs or are kept fully informed. The results, therefore, should be able to meet the standards of various types of institutions.

## Practical Recommendations

The employers and unions who are immediately concerned with any given job ladder will be consulted on the practicality of the job ladder recommendations. The HSMS staff are also currently examining the vari s stages required for approval and implementation of the educational ladders.

We expect to provide recommendations which take into consideration the various steps needed for implementation.

In addition, by working in cooperation with the accrediting bodies, we hope to be able to submit proposals in regard to existing accreditation requirements where appropriate.

Communication Among Parties

We believe that through working with the institutions involved with employment, education, and accreditation, we may be able to foster the communications needed among the various parties to bring about the upward mobility objectives that all already subscribe to. As a result of our continued relationships, we, in turn, expect to learn more about the actual problems facing the institutions.

The most logical way in which the parties can cooperate is through consortia of hospitals, educational institutions, unions, and other interested organizations who join together to promote mutual interests. The movement towards regional consortia seeks to make possible planning for the equitable provision of health services to a community or region. It can help to eliminate the duplication of efforts and promote the efficient use of scarce resources.

A consortium can also provide the powe  needed for the rational development and utilization of health manpower. The scope of consortium coverage is usually sufficiently large to dominate the regional market for health manpower. Thus, the employers and educators have a forum in which to talk to one another and plan for mutual needs. They have adequate scope to implement major programs.

In a consortium, employers can make known their needs to educational institutions; the educational institutions can, in turn, develop the required programs in educational ladders. A junior college can design a program in collaboration with a senior college so that AA graduates will be able to enter baccalaureate programs with their prior preparation fully accepted. There can be agreement about credit for overlaps in existing programs. The medical schools can discuss entry with advanced standing for students emerging from new graduate programs, and can even plan for their own programs with exit points before the MD.

## Generic Models

Immediate implementation is most likely to occur in the institutions directly involved in the application of HSMS methodologies. However, the final products will include the normative task data, the proposals for job ladders, and the curriculum guidelines for educational ladders. These will serve as generic models for dissemination and use. The models will be explicit enough for users to select those portions which are of most interest to their own institutions. If we have a direct effect on accreditation requirements, our results will have even more widespread use.

CURRENT TIES

Possible Implementation of Phase IV Work

The current work at Montefiore Hospital and Medical Center will be of interest to the hospital itself; it will also be offered to the New York City League of Voluntary Hospitals and Local 1199. The leadership of both these organizations have been informed of the HSMS work from its inception. Member institutions have provided assistance in our field-test phases and have sent us letters of support and expressions of interest in our results. The two organizations are also interested in the use of our data to produce uniform job descriptions. The New York City Health and Hospitals Corporation and District Council 37 have also been interested in seeing the results of our work.

Interest in our work has also been manifested in regional planning currently underway which includes Montefiore Hospital. The work of the HSMS was included in a proposal by the Albert Einstein College of Medicine of Yeshiva University to create three Area Health Education Centers in the Bronx. While the status of that proposal is in limbo at the moment, the proposal indicates the serious interest of the institutions involved.

The Bronx Health Manpower Consortium has been in existence for about eight months. Last year it submitted a proposal for an operational consortium, but its financial future is in doubt. A letter from the Director of one of the Consortium projects indicates that there is:

> great interest [in]... Research Report #4 and #5 based on [HSMS] work at the Martin Luther King, Jr. Health Center

.... Clearly, it relates to many of the concerns expressed by members of our consortium committee and I hope at some point in the future we could call upon you as a resource.

The HSMS has been working very closely with Hostos Community College, CUNY. The directors of the program in radiologic technology, Dean Leroy Sparks and Ms. Gertrude Dourdounas, are planning to utilize our work and also are serving as resource respondents. They have enlisted other resource respondents for us from the Mount Sinai Hospital and Lenox Hill Hospital.

We are currently developing ties with two senior colleges and two medical schools in the New York City area in anticipation of educational ladders which will have exit points appropriate for their institutions. We are also in touch with the appropriate departments at the State level.

As a result of our work, we also have developed strong ties with the New Haven Institute of Allied Health Careers, which is a consortium for the New Haven area.[12] As a result of visits from the Institute to HSMS, and a return visit by the HSMS Director to New Haven, the HSMS now has resource respondents from the Veterans Administration Hospital and an ongoing

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12 Charles Turner, Executive Director. Includes Albertus Magnus College, Black Coalition, Hospital of St. Raphael, Inner City Manpower Consortium, New Haven Public Schools, Quinnipiac College, South Central Community College, Southern Connecticut State College, University of New Haven, Veterans Administration Hospital, Yale-New Haven Hospital, and the Yale University School of Medicine.

relationship with the Institute's Board. The Executive Director of the Institute has written:

> The hours you spent carefully explaining your work thus far and your future plans will be invaluable to us as we work here to bring about job ladders and modular curriculum in the health professions. We also look forward to very real possibilities of cooperation and mutual development between the Health Services Mobility Study and the institutions providing health services and educating health professionals in the New Haven area.

Ferris State College in Michigan, which is devoted to occupational education, has long subscribed to the educational ladder approach. Deans Aaron L. Andrews and Arlene Hoover, of the School of Health Sciences and Arts at Ferris State, have expressed interest in our work and are awaiting our results.

HSMS is also involved with a project at The Medical School of Northwestern University.[13] Dr. Richard H. Kessler, who is Associate Dean of the Medical School and in charge of the project, wrote us:

> The translation from data to educational objectives which you discussed is crucial to the success of our project. We look forward to continuing development in this area and would gladly assist in some sort of sounding board function if that is desirable.

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13 The project on Education in the Health Sciences is being sponsored by the American Association for the Advancement of Sciences through its Committee on Science in the Promotion of Human Welfare. It is funded partially through the AAAS and the Commonwealth Fund. Its overall goal is the design and implementation of a comprehensive Medical Sciences School.

As a result of a very pleasant correspondence, Dean K̈essler is now one of our resource respondents.

Our relationships with the professional organizations have also been progressing in very fruitful directions. We are now in contact with every major organization involved with professional accreditation in radiology and related services. The American Society of Radiologic Technologists and the American College of Radiology have been invited to provide resource respondents. The Director of HSMS has made a presentation to representatives of these groups, and all have been given detailed information about our study. We have been in regular touch with the American Hospital Association's Bureau of Manpower and Education.

Mr. Ralph C. Kuhli, Director of the Department of Allied Medical Professions and Services, Division of Medical Education, of the American Medical Association has encouraged us as follows:

> Your participation would be most welcome to assist [the AMA sponsored] national allied health and medical specialty organizations in developing national programs. For example, we are interested in revising *Essentials* in behavioral terms. If you want the Health Services Mobility Study to be a participant in the work of these organizations and groups, I am sure they would welcome your materials, suggestions and work.

Utilization and Dissemination of Phase III Reports

The two major reports of Phase III were Research Report 4 and 5 and Technical Report No.11 (see footnotes 3 and 4). About 600 copies of these documents have been distributed by the HSMS. They are now available through ERIC documents. While it is impossible to know the actual impact of work which has philosophic, methodological and practical aspects, we have had some requests which indicate some of the ways in which last year's work has been utilized.

We have had a request from the Soci ˡ and Rehabilitation Service, HEW, for our "nowledge Classification System for possible use in a system to record the "knowledge levels of ... professional staff."

We have had a request from the American Public Health Association for our work to be used in connection with:

> [a] task analysis questionnaire for the thirteen participating medi‹‹l schools' new professional health personnel. The initial goal is ... to provide the new professionals with a computer printout of their training and skills. Hopefully we will be able to go on to analyze jobs and job categories in the projects in order to develop new systems and training programs .... preliminary scanning indicates that the work you have done is very closely related to what we have in mind.

A consortium in southeastern Wisconsin is interested in developing a "data base from which equivalency agreements will be developed between member institutions."

> In order that a student may plan a multi-institutional education in a health care field, a  rriculum analysis is planned from which equivalency agreements will be derived. As equivalency agreements are developed, this information will be made available to the high school and college counselors and other agencies able to disseminate the information to potential students. Since consortium institutions have both academic and hospital-based programs, it is also planned that equivalency agreements will be the basis for the development of career ladders within the consortium institutions.

The HSMS work was requested by Dr. Jack E. Thomson, Director of the Division for Health Professions Education, The Medical College of

Wisconsin. He will try to determine whether the project described above can make use of our approach.

We have developed a cordial relationship with the Educational Testing Service which may result in future cooperative work related to ETS's in rest in proficiency test design.

We have had a request from the Office of Educational Planning in the Health Sciences of the College of Physicians and Surgeons of Columbia University, New York City, to send our Reports to be used for:

> [a] project to develop curricula for allied health workers o a baccalaureate level .... The work ... is to develop generic job descriptions for allied health specialists who are oriented toward community health practice so that curricula for the baccalaureate preparation of these specialists can be cooperatively formulated by personnel in the Columbia University School of General Studies, Columbia College of Physicians & Surgeons, and Columbia School of Public Health & Administrative Medicine.

Cooperative :k done last year with Family Health, Inc. (formerly Family Planning, Inc as resulted in a number of agencies having written to us to discover ether our approach can add to their current work which utilizes another task analysis methodology. Included were the Human Services Manpower Career Center of Chicago and the Division of Family Services, Department of Health and Social Services of the State of Wisconsin. We have been informed that our materials and approaches as well as our conversations with staff have been helpful.

We have had inquiries from other city, state and institutional bodies which indicate an interest in our approach. They regret that we are not now offering training programs for job analysts, have not already covered many functional areas, or have not already turned out new job and/or curriculum guidelines.

In addition to providing in-house presentations for interested institutions, we have also provided speakers for two conferences during Phase IV:

1. Dr. Gilpatrick spoke to a conference for Michigan Allied Health Educators at Ferris State College in May, 1972.

2. Irene Seifer (Sr. Research Associate) led a workshop on task analysis at a Michigan Career Education Convention in Grand Rapids in August, 1972.

Future Plans

As the Phase IV work is completed we will be cooperating with all interested institutions in the dissemination of our results. We have been encouraged to submit curriculum work for publication, and hope to be successful in that endeavor.

We believe that the general approach of the HSMS has already gained wide acceptance and has aided in the development of a climate for change. We hope to be able to continue to make contributions which will provide for future change.