The last facet of the Canadian Occupational Analysis is the quality factor. With TI/CODAP, many different qualitative measurements can be used. For example, task difficulty has had some merit (c.f. Mead, 1970a; 1970b; Mead & Christal, 1970). It is defined as the amount of time it takes for individuals to learn to perform a task adequately. Research has shown that supervisors, experts working in the field, can agree on relative difficulty of tasks within an occupation. This variable can be clustered by CODAP the same way that relative time spent is. Many of the quality factors in the current Canadian system are really the performance of task to a standard. As mentioned earlier, the standard belongs in the task statement. However, task difficulty has many uses as a way to weight emphasis for curriculum building. Because CODAP is such a flexible software package, variables such as task difficulty can be added to other variables to create hybrid variables for occupational analysis. For example, the cross products of task difficulty and time spent can be summed across all tasks for an entire inventory. Career ladders can be computed with this statistic. These ladders indicate the range of task complexity and difficulty that make up a job family. Both vocational counseling and mobility assessment can be facilitated with this type of analysis.

Career Ladder Development

As discussed by Christal (1974):

> ...most career ladders contain several types of jobs which may vary in difficulty. The CODAP analysis system can be used to identify these job types, and difficulty indexes can be used to determine which job types might be shredded out into new management units for performance by lower aptitude personnel. The task difficulty indexes can also be used to identify tasks which might be pulled out of existing jobs and engineered into new jobs for performance by less talented individuals. However, in order to build the most meaningful contingency plans, what is needed is a method for comparing aptitude requirement levels for jobs across all career ladders.

This approach can be outlined in general terms.

Step 1. Select a set of career ladders requiring the same type of aptitudes, for which job inventories and recent occupational survey data are available.

Step 2. Collect ratings from supervisors to determine the relative difficulty levels of all tasks within each ladder.

Step 3. Select 30 to 40 tasks at various difficulty levels from each ladder. This will form the benchmark set. Reliability of final results will be enhanced if the tasks selected for the benchmark set are well known or easily observed.

Step 4. Obtain relative aptitude requirement ratings for tasks in the benchmark set from knowledgeable behavioral scientists.

Step 5. Within each ladder, compute least squares regression equations to predict task aptitude requirements from task difficulty levels.

Step 6. Apply the equations developed in Step 5 to re-scale all tasks in all ladders into a common aptitude requirements framework (the benchmark scale).

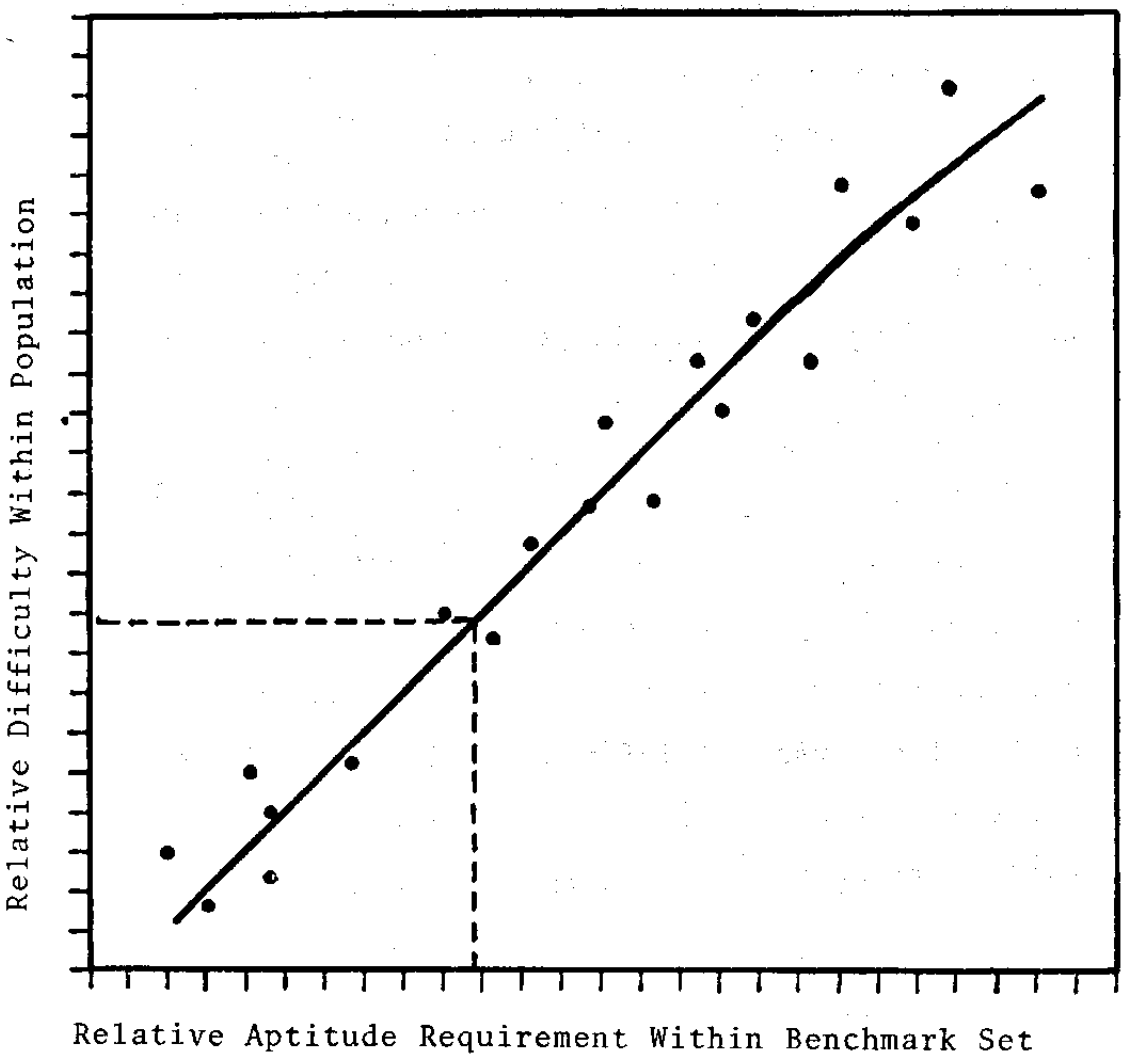
(Exhibit 9) presents 20 points representing 20 tasks on a particular career ladder which were included in the benchmark set. The position of a task on the vertical axis represents its difficulty level relative to all other tasks in its own career ladder. Its position on the horizontal axis represents its aptitude requirement level relative to other tasks in the benchmark set of tasks. A line of best fit has been drawn through the points. Using this graph, the relative difficulty index values can be converted into aptitude requirement levels for all tasks in the career ladder. If this procedure is repeated for all ladders having tasks represented in the benchmark set, the final product is a set of values indicating the relative aptitude requirement levels for all tasks in all ladders.

(Exhibit 10, about here)

Manpower Modelling in the U.S. Navy

The challenge to the Naval manpower planner is accurately to staff the technical needs of positions and to efficiently manage the human resources available to meet those needs. To accomplish this, managers have always been faced with a need for the best assignment of people to jobs. This function, of matching people to jobs so that the resulting organization makes optimal use of the personnel available, is addressed by the multi-

Exhibit 10



Resource: Christal, R. E., op cit., p. 29

attribute assignment model developed by the Office of Civilian Manpower Management (OCMM) in conjunction with the University of Texas at Austin. Long-range research plans are to construct a dynamic model, which would be able to take into account the effect of training and experience gained in each assignment. The implementation of such a model, however, is a complex undertaking, and so the first step began by working on a static model called MODS for Models for Organizational Design and Staffing (Charnes, Cooper, Niehaus & Stedry, 1968).

Overview of Model

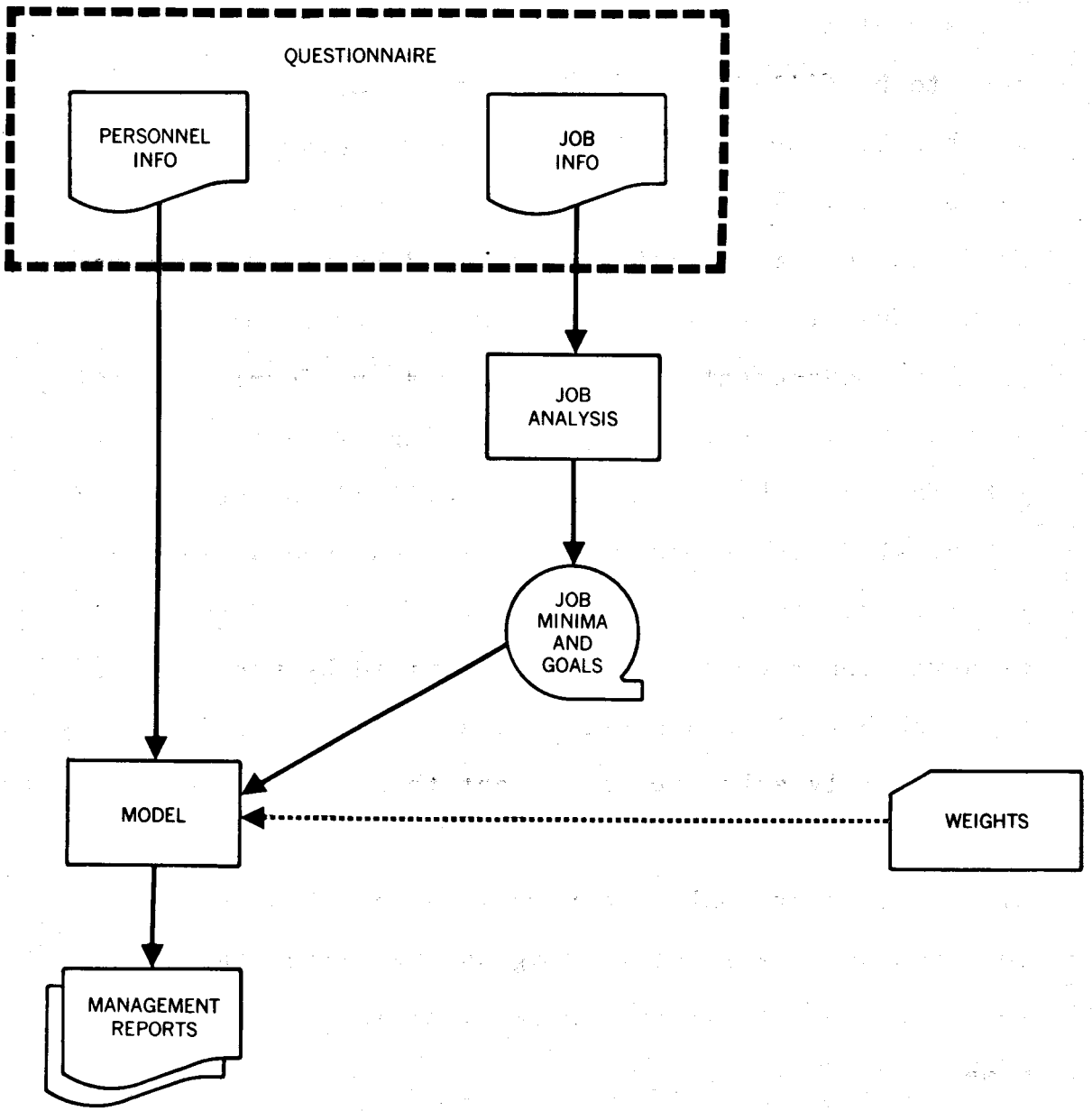
Exhibit 11 shows, in a general way, that the two principal types of input--the descriptions of the personnel and the requirements of the jobs--are derived from the TI. The personnel information is ready to be fed directly into the assignment model, but the job information must first be analyzed to produce a minimum acceptable level for each task comprised in each position, as well as the desired, or goal, level. It is also possible to specify weights to indicate that some goals are more important than others.

(Exhibit 11, about here)

For the central computer program, a preliminary pass eliminates any man-job combinations in which a

Exhibit 11

Models for Organizational Design and Staffing - MODS



Source: Moore, B.E., et al, "Using Task Surveys in Assigning People," The Journal of Navy Civilian Manpower Management, No. 4, Winter, 1974

given person cannot meet the minimum requirements for that job. The computerized model then looks simultaneously at all of the remaining personnel described and jobs to be filled, and finds that set of assignments which will result in all of the goals being met as nearly as possible. The distribution routine which actually finds the optimum match was provided by Dr. D. Klingman of the University of Texas at Austin (1972).

The management reports produced are four: a listing of the optimal assignments, a listing by person of all jobs for which he is minimally qualified, a register by job of all persons minimally qualified, and a training requirements report which lists the tasks and the degree of deviation from the standard required by management.

Exhibit 12 is a section of an actual task inventory. Step 1 merely asks the respondent to check whether he does the task or not. The purpose is to review the entire list before making any ratings; at this juncture, job incumbents are recognizing and recalling the tasks they perform. Additions to the list may occur at this time.

(Exhibit 12, about here)

Step 2 in Exhibit 12 asks for the now familiar relative time spent on each task performed. Once we have relative time ratings for tasks performed, the ratings can be converted into estimated percentage of

Exhibit 12

MACHINE TOOL FAMILY

3400

Each step should be performed for the full list of tasks before proceeding to next numbered step

STEP 1.

DESCRIBE YOUR PRESENT JOB BY CHECKING (✓) ONLY THOSE TASKS IN YOUR PRESENT JOB.

STEP 2.

INDICATE RELATIVE TIME ON EACH TASK IN PRESENT JOB. ONLY ENTER TIME FOR TASKS YOU CHECKED ON STEP 1. USE NUMBER CODE 1-7 AS BELOW. (TIME DOES NOT NECESSARILY = IMPORTANCE)

1. VERY MUCH BELOW AVERAGE TIME ON THIS TASK.
2. BELOW AVERAGE TIME.
3. SLIGHTLY BELOW AVERAGE TIME.
4. AVERAGE TIME.
5. SLIGHTLY ABOVE AVERAGE TIME.
6. ABOVE AVERAGE TIME.
7. VERY MUCH ABOVE AVERAGE TIME ON THIS TASK.

STEP 3.

ENTER YOUR QUALIFICATION FOR ALL TASKS IN MACHINE TOOL FAMILY. USE LETTER CODE A-E, AND N AS BELOW.

A. LIMITED EXPERIENCE, NEED INITIAL TRAINING OR ASSISTANCE.
B. SOME KNOWLEDGE AND EXPERIENCE NEED OCCASIONAL ASSISTANCE.
C. CAN PERFORM ALL NORMAL WORK IN THIS TASK.
D. BROAD EXPERIENCE, CAN ASSIST OTHERS.
E. ABLE TO INSTRUCT AND DO DIFFICULT WORK.
N. NOT IN MY FIELD.

STEP 3. ENTER OWN QUALIFICATION FOR EACH TASK		STEP 1. CHECK OWN JOB TASKS	STEP 2. ENTER TIME CODE
	DUTY A- READING BLUEPRINTS, MECHANICAL DRAWINGS, AND SKETCHES		
E	1. READ SKETCHES AND SINGLE VIEW BLUEPRINTS.	✓	6
E	2. INTERPRET SIMPLE TWO OR THREE VIEW SKETCHES.	✓	7
D	3. INTERPRET ASSEMBLY DRAWINGS AND LAYOUT DETAILS WHEN NO DETAIL DRAWINGS ARE AVAILABLE.	✓	5
D	4. READ AND INTERPRET COMPLEX DRAWINGS FOR THREE VIEWS WITH CUTAWAY SECTIONS.	✓	3
C	5. READ DESIGN SYMBOLS AND SPECIFICATIONS REQUIRED TO LAY OUT SKETCH TYPE DRAWINGS, USING THREE VIEWS—TOP, FRONT, AND SIDE.	✓	2
C	6. IDENTIFY SHAPES, TOLERANCES, DIMENSIONS, FINISHES, AND TOOLING POINTS FROM COMPLEX BLUEPRINTS AND MECHANICAL DRAWINGS.		
	ADDITIONAL TASKS: ADD ANY SIGNIFICANT TASKS IN YOUR PRESENT JOB WHICH ARE NOT LISTED.		
	_____		
	_____		

time values. These data can then be analyzed by CODAP to find the degree of overlap of two or more jobs. The identification of similar task clusters leads to the definition of job-types--a form of job description. These job-types are behavioral job descriptions, which is to say that they do not represent what people ought to be doing, but rather just what they actually report themselves to be doing.

In Step 3 of Exhibit 12, the job incumbent indicates his proficiency in a given task, ranging from A (limited) to E (expert). In agreement with Campbell, Dunnette, and Arvey (1973), personnel assessment ought to focus on meaningful samples of work behavior rather than signs or indicators. The better predictors of proficiency (potential or actual) should be samples of the work behavior in terms reflecting the context of work, i.e., the task. Also, in the new era of equal employment opportunity (EEO), all organizations must be able to prove that personnel measures are related to satisfactory levels of productive human performance. This is equally true for promotion as well as entry level screening procedures. What the MODS is investigating as a meaningful sample of work behavior is reflected in Exhibit 12. The effectiveness of job proficiency measures is highly dependent on the accuracy and completeness of job information. Therefore, personnel proficiency is to

be measured as it is related to a specific task statement of job behavior. Since a current job may not call for all the proficiencies the incumbent has, it is quite possible a largernumber of proficiencies will be scored. Retention of this information for a skills inventory is one of the by-products the assignment model offers. Notice that task 6 of Exhibit 11 is marked for proficiency, but not the job. The job doesn't currently call for this task, but the information is stored in the skills bank of MODS.

As a first test of validity of the TI, supervisors were presented with clusters of relative time spent in certain tasks and were asked to identify the men associated with these clusters. This they found easy to do within their departments.

Later, convergent validation was assessed statistically. Each supervisor vouchered all subordinates' ratings of task performance for the MODS independently. Subordinates' ratings (close to 200 tasks) were subtracted from the supervisors' independent ratings of each subordinate. Clearly, perfect agreement equals zero; e.g., low subordinate rating of 2 minus low supervisor's rating of 2 equals zero. Our data analysis for one job family shows 63% agreement (N=79). Item analysis shows that four task statements caused widespread disagreement.