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OCCUPATIONAL ANALYSIS

MACHINE SHOP

ENTRY - LEVEL

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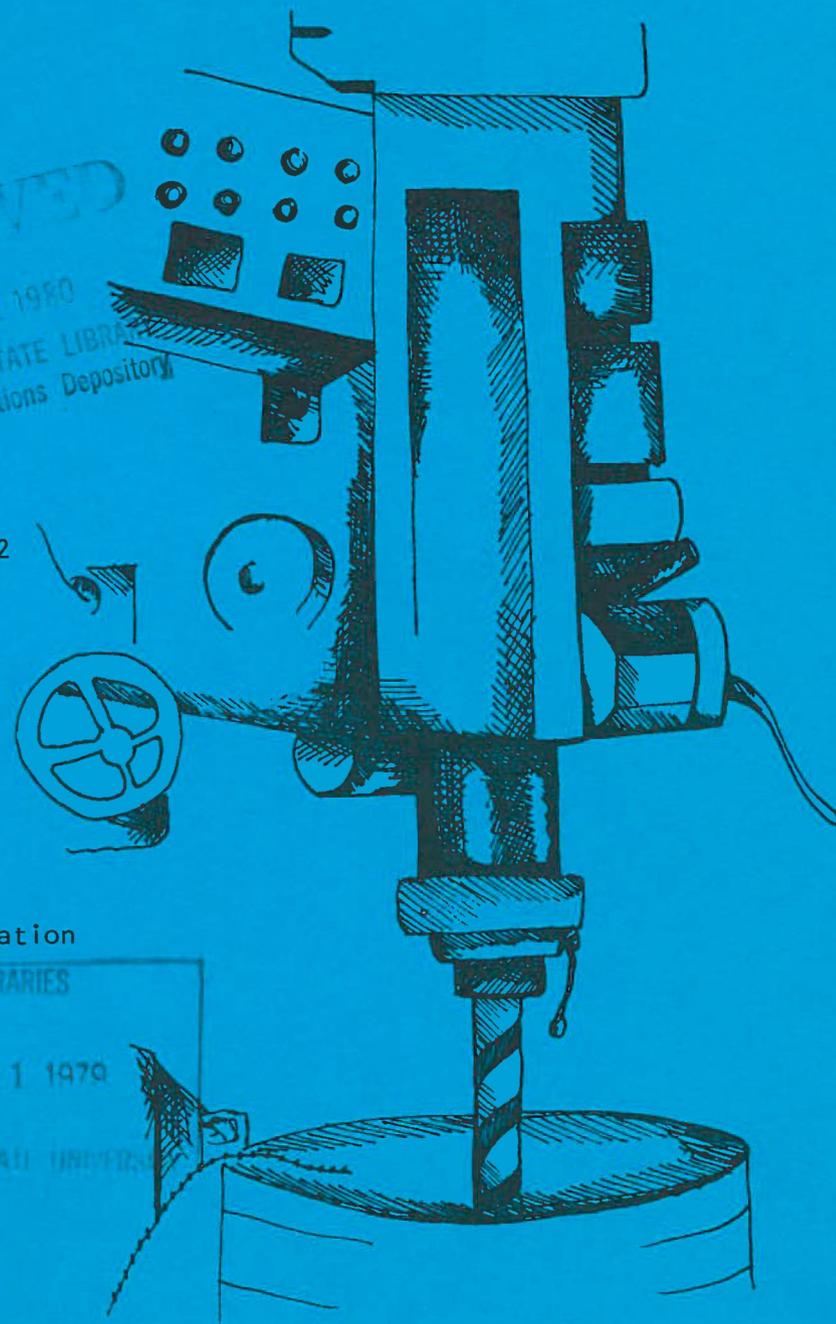
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OCCUPATIONAL ANALYSIS

MACHINE SHOP

ENTRY-LEVEL

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INTRODUCTION

A continuing problem in curriculum development is the determination of what should be taught. This problem has a direct impact on everyday instruction. In vocational education, this problem takes on an added dimension. If an occupational field were to remain stabilized in terms of invention, technique and specialization, few changes would be anticipated, and the instructional development process would be greatly simplified. However, there are few occupational fields which are not experiencing rapid, if not almost continual change.

It is not enough to simply identify and select for inclusion in the instructional program the skills and knowledge a worker has needed in the past. The rapid pace of technical and occupational change necessitates frequent if not continual upgrading and restructuring of the instructional program. In order for occupational instruction to be relevant, it is necessary for the vocational educator to base instruction on the actual skills, knowledge and attitudes that are currently needed on the job.

This publication is designed to assist the vocational educator in keeping abreast of developments in the occupational area of machine shop occupations. The occupational information included is current and has been identified and validated by persons employed in the occupational area. Through use of the information, it is hoped that instruction can be improved by enabling educators to devote less time to determining what should be taught and to give greater consideration to teaching methodology. Information presented herein is oriented toward the entry-level machinist--an individual who has been employed for not less than six months nor more than eighteen months.



OCCUPATIONAL ANALYSIS

Occupational analysis is the process of examining an occupation or a group of occupations and identifying the various activities performed by the workers involved. Through this process, the duties and tasks which relate what the workers do are specified. The analysis presented in this publication reflects those duties and tasks performed by an entry-level machinist--one who has been on the job between six and eighteen months. When planning an educational program for preparing entry-level machinists, the duties and tasks identified in this document should be considered.

In preparing the statewide analysis presented later, project personnel generated a comprehensive initial duty and task listing using available relevant analyses and other literature. A panel composed of ten individuals associated with the occupational area then reviewed the listing and suggested ways in which it should be refined. Using the input provided by members of the panel, project personnel prepared a revised listing. This revised listing then underwent field review. Twenty individuals--ten entry-level machinists and ten supervisors of entry-level machinists--participated in the field review by rating 182 tasks using the five-point scale presented below.

- 0 Irrelevant or not important
- 1 Little importance
- 2 Average importance
- 3 Very important
- 4 Critical importance

A mean of the ratings of each task was computed.

A decision was then made as to whether each task was to be included in the final task listing. This decision was primarily based upon the mean of the ratings assigned to a particular task. If the mean was 1.50 or greater, the task was designated for inclusion in

the final listing. If the mean was 1.49 or less (rated irrelevant or minor), the task was excluded from the final task listing. Of the 182 tasks rated by the respondents, one was rejected.

The 181 tasks identified for inclusion in the final listing were then evaluated on the basis of written comments on the respondents' data forms. Terminology changes were made in the task statements if the changes did not alter the concepts expressed in the original statements. For example, brand names were eliminated; occupational terms were used; grammar, spelling and punctuation were corrected; and sex bias was eliminated.

A final statewide machinist listing which contains 181 statements is presented in the form of an occupational analysis chart on page 7. Duty statements are sequenced from top to bottom along the left side of the chart according to the importance of those duties as perceived by members of the panel and/or the sequence in which they were performed. Tasks relevant to each duty are sequenced from left to right on the same bases.

Means of the degree of significance ratings of the task statements are included on the chart to aid educators in making program decisions but no mention is made of the number of respondents rating each item. This was considered unnecessary as 100 percent of the respondents participating in the field review rated each task statement, thereby giving a solid basis for using the means of the ratings to make relevant program decisions.

OCCUPATIONAL DESCRIPTION

An entry-level machinist is prepared for entry into machine shop occupations--those which involve the shaping of metal, plastic, and other materials. The entry-level worker is prepared to:

1. interpret drawings;
2. operate lathes, milling machines, grinders, drill presses, and power saws;
3. use hand tools;
4. use precision tools; and
5. use shop math.

Work activities involve applying a knowledge of machine capabilities, properties of materials, and shop practices to situations requiring the setting up of machines for operation. Typically, the machinist will plan the order of successive operations, install and adjust cutting tools and other machine components, and adjust the position of the workpieces or materials. This worker must be conversant with mechanical principles and technical data and skilled in the use of precision gauges and measuring instruments.

The entry-level machinist should exhibit a preference for working with machinery; an attention to detail; visual acuity; the ability to comprehend and apply mechanical principles and technical data; the facility to apply basic mathematics; eye-hand coordination; manual and finger dexterity; physical stamina and agility; and the ability to adapt to fluctuating situations. The ability to understand and follow written and oral instructions is of prime importance.

Working conditions in the machine shop occupations vary with the size and scope of the business. While the entry-level machinist may work alone, this individual will generally work

under the supervision of an experienced worker.

Machine shop occupations generally require the individual to work in an environment protected from the weather. However, the machinist is exposed to extensive noise and vibration. Some of the occupations are considered to be hazardous, particularly for the entry-level worker.

Occupations related to the duties and tasks in this analysis are specified below.

- Instrument-maker Apprentice (DOT # 600.280-018)
- Machinist (All-around Machinist) (DOT # 600.280-022)
- Machinist Apprentice (DOT # 600.280-026)
- Maintenance Machinist (DOT # 600.280-042)
- Production-machine Tender (DOT # 609.685-018)
- Tool-and-die-maker Apprentice (DOT # 601.280-050)
- Tool Grinder Operator (DOT # 603.280-018)

DUTIES

INTERPRETING DRAWINGS	VISUALIZE PARTS 3.10	IDENTIFY STOCKS 2.35	CONVERT METRIC MEASUREMENTS TO ENGLISH MEASUREMENTS 2.20	READ AND FOLLOW FOOTNOTES 3.05	INTERPRET SYMBOLS 3.10	CONVERT FRACTIONS TO DECIMALS 3.00	UTILIZE GIVEN DIMENSIONS 3.45	CALCULATE MISSING DIMENSIONS 3.10	FOLLOW WRITTEN VERBAL INSTRUCTIONS
OPERATING LATHES	UTILIZE APPROPRIATE SAFETY PRACTICES 3.40	CLEAN AND LUBRICATE LATHES 2.85	MEASURE WORKPIECES ACCURATELY 3.75	PERFORM LAYOUT WORKS 2.80	SET UP AND USE CUTTERS 3.50	SELECT AND USE CARBIDE TOOLS 3.10	PUT TOOLS ON CENTER 3.25	SET STOPS 2.80	ESTABLISH FEEDS AND SPEEDS
	FACE WORKPIECES 2.95	CENTER DRILLS AND DRILL WORKPIECES 2.90	TURN WORKPIECES BETWEEN CENTERS 2.75	BORE HOLES 3.05	USE REAMERS 2.90	USE TAPS 2.95	USE THREAD CHASERS 2.55	CUT SINGLE POINT THREADS 2.80	CUT INTERNAL THREADS
OPERATING MILLING MACHINES	UTILIZE APPROPRIATE SAFETY PRACTICES 3.65	CLEAN AND LUBRICATE MILLING MACHINE 3.05	TRAM THE HEAD 3.00	MEASURE WORKPIECES ACCURATELY 3.75	PERFORM LAYOUT WORKS 2.85	HOLD WORKPIECES 3.35	INDICATE VISES 3.00	SELECT AND SET UP PROPER CUTTERS 3.10	SELECT AND USE CARBIDE TOOLS
	USE INDEXING HEADS 2.75	USE CENTER FINDERS 2.75	USE ANGLE PLATES 2.75	USE REAMERS 2.70	USE V-BLOCKS 2.65	MILL WORKPIECES MOUNTED BETWEEN CENTERS 2.35	USE COLLETS 3.00	USE HANDRELS 2.40	USE ANGLE HEADS
OPERATING DRILL PRESSES	UTILIZE APPROPRIATE SAFETY PRACTICES 3.55	CLEAN AND LUBRICATE DRILL PRESSES 3.05	PERFORM LAYOUT WORKS 2.85	MEASURE WORKPIECES ACCURATELY 3.70	ESTABLISH FEEDS AND SPEEDS 2.85	HOLD WORKPIECES 3.15	APPLY COOLANTS 2.70	SELECT PROPER CUTTER 3.05	SELECT AND USE CARBIDE TOOLS
	USE V-BLOCKS 2.40	USE COLLETS 2.55	USE HANDRELS 2.05	USE HONES 1.90	USE QUICK CHANGE ATTACHMENTS 2.20				
OPERATING BENCH AND SURFACE GRINDERS	UTILIZE APPROPRIATE SAFETY PRACTICES 3.50	CLEAN AND LUBRICATE GRINDERS 2.85	MEASURE WORKPIECES ACCURATELY 3.40	PERFORM LAYOUT WORKS 2.55	USE CORRECT GRINDING WHEELS 2.90	CHANGE GRINDING WHEELS 3.10	DRESS GRINDING WHEELS	HOLD WORKPIECES 3.25	APPLY COOLANTS
USING HAND TOOLS	UTILIZE APPROPRIATE SAFETY PRACTICES 3.60	CARE FOR AND MAINTAIN HAND TOOLS 3.25	USE FILES 2.55	USE HAMMERS AND PUNCHES 2.65	USE TAPS AND DIES 2.95	USE TRANSFER SCREWS 2.25	USE HAND-HELD HONES 1.70	USE HAND DRILLS 2.10	USE HAND REAMERS
USING PRECISION TOOLS	UTILIZE APPROPRIATE SAFETY PRACTICES 3.55	CARE FOR AND MAINTAIN PRECISION TOOLS 3.65	USE MICROMETERS 3.70	USE VERNIER CALIPERS 3.55	USE INDICATORS AND ATTACHMENTS 3.55	USE SURFACE PLATES 3.15	USE CADILLACS 2.05	USE HEIGHT AND SURFACE GAUGES 2.90	USE TELESCOPE HOLE GAUGE
	USE SINE BARS 2.35	USE GAUGE BLOCKS 2.85	USE LAPPING BLOCKS 2.40						
OPERATING POWER SAWS	UTILIZE APPROPRIATE SAFETY PRACTICES 3.50	CLEAN AND LUBRICATE POWER SAWS 3.00	MEASURE WORKPIECES ACCURATELY 3.20	SELECT PROPER BLADES 2.65	ESTABLISH FEEDS AND SPEEDS 2.75	PERFORM LAYOUT WORKS 2.65	HOLD WORKPIECES 3.15	SELECT APPROPRIATE GUIDES 2.60	SET GUIDES
USING SHOP MATH	ADD AND SUBTRACT WHOLE NUMBERS, FRACTIONS AND DECIMALS 3.80	MULTIPLY AND DIVIDE WHOLE NUMBERS, FRACTIONS AND DECIMALS 3.75	CONVERT FRACTIONS TO DECIMALS 3.55	CONVERT DECIMALS TO FRACTIONS 3.20	APPLY PLANE GEOMETRY PRINCIPLES 3.05	USE TRIGONOMETRY TABLES AND FORMULAS 3.00	CALCULATE FEEDS AND SPEEDS 3.15	CONVERT DECIMAL ANGLES TO DEGREES, MINUTES AND SECONDS 2.80	USE METRIC CONVERSION FACTORS

INIST

-LEVEL

SKS

APPLY COMPANY STANDARDS 3.15	MAKE SKETCHES 2.25	WORK FROM SKETCHES 2.80	USE MACHINISTS' HANDBOOKS 2.65					
ADJUST LATHES FOR BACKLASH 2.50	REMOVE BURRS 2.30	USE INDICATORS 3.00	USE FOUR-JAW CHUCKS 2.90	USE SOFT JAWS 2.45	USE COLLETS 2.70	MOUNT WORK ON FACEPLATES 2.30	USE HANDRELS 2.15	APPLY COOLANTS 2.30
PART OFF WORKPIECES 2.45	KNURL WORKPIECES 2.35	USE COMPOUNDS 3.05	USE TAILSTOCKS 2.95	USE STEADY RESTS 2.45	USE TAPER ATTACHMENTS 2.65	USE FOLLOW RESTS 2.05	USE ROLLER TURNERS 1.65	
ESTABLISH FEEDS AND SPEEDS 3.15	ADJUST MILLING MACHINES FOR BACKLASH 2.65	APPLY COOLANTS 2.70	REMOVE BURRS 2.35	PERFORM CONVENTIONAL MILLING OPERATION 3.05	PERFORM CLIMB MILLING OPERATION 2.70	SQUARE PARTS 3.10	USE EDGE FINDERS 2.70	CENTER DRILLS AND DRILL HOLES 2.70
USE CUTTER ARBORS AND BEARINGS 2.65	USE SOFT JAWS 2.30	USE ROTARY TABLES 3.00	CUT ANGLES 3.00	USE BORING HEADS 2.75	USE TAPPING HEADS 2.35			
USE DRILL JIGS 2.70	REMOVE BURRS 2.50	USE TAPPING HEADS 2.80	USE ROTARY TABLES 2.05	USE INDEXING HEADS 1.95	USE CENTER FINDERS 2.00	USE ANGLE PLATES 2.15	USE REAMERS 2.85	CENTER DRILLS AND DRILL HOLES 2.80
ESTABLISH PROPER TOOL GEOMETRY 2.40	GRIND BORING TOOLS 2.35	GRIND DRILLS 2.75	UTILIZE ANGLE PLATES 2.55	GRIND FORM TOOLS 2.15	DRESS SURFACE GRINDER WHEELS (RADI) 2.15	USE GRINDER ATTACHMENTS 2.30		
USE PROTRACTORS 2.80	USE HACKSAWS 2.40	USE SQUARES 2.75	USE RULES (SCALES) 3.00	USE FEELER GAUGES 2.60	USE HAND GRINDERS AND SANDERS 2.30	USE ARBOR PRESSES 2.10		
USE DIAL BORE GAUGES 2.75	USE RADIUS GAUGES 2.80	USE PLUG AND RING GAUGES 3.00	USE DIVIDERS 2.50	USE THREAD WIRES 2.50	USE OPTICAL COMPARATORS 2.90	USE PROFILOMETERS 2.40	USE MHO LIGHTS AND OPTICAL FLATS 1.95	USE BENCH CENTERS 2.30
SET STOPS 2.35	APPLY COOLANTS 2.65	REMOVE BURRS 2.15	CHANGE AND FOLD BLADES 2.35	WELD BLADES 2.20				
USE CALCULATORS 2.85								

RATING SCALE

0--Irrelevant or not important

1--Little importance

2--Average importance

3--Very important

4--Critical importance


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USE OF THE OCCUPATIONAL ANALYSIS¹

Effective vocational education programs require a valid basis for determining the learner performance objectives. Such objectives for a vocational education program should be based on occupational information derived from an analysis of the work performed by individuals in the occupation. An analysis provides a basis for determining the specific learner objectives for an instructional program.

Before specific learner or performance objectives are developed, the occupational tasks to be considered for instructional purposes should be organized and sequenced to make instructional planning and development more efficient. The following strategies for selecting the tasks to be dealt with during instruction should be considered.

- Select those tasks that are considered important for performance by entry-level workers.
- Select those tasks that are perceived as requiring considerable instruction and practice to learn.
- Select those tasks that are important to job success but are difficult to learn on the job.

The tasks selected should reflect the requirements of the employment area to be served by the program. If the selection of these tasks involves major departures from the tasks identified in the statewide analysis chart presented earlier, one should ensure that such departures are justified on the basis of the available information.

After selecting the tasks that will be considered for instruction, the following general strategies can be applied to organize the selected tasks into a general order for instruction.

¹William L. Ashley, Tom L. Hines, and Faith L. Justice, Residential Construction: Task Inventories/Strategies for Curriculum (Columbus, Ohio: Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University, n.d.), pp. 57-61, 109-110.

- Organize the tasks for the various major sections of the program or course.
- Sequence the tasks based on the normal job sequence.
- Sequence the tasks from the simple tasks to the more complex tasks.
- Sequence the tasks so each new skill, concept or value to be learned builds on previous ones.
- Organize the tasks into groups that can be taught around the major common concepts or skills to be learned.

Once the tasks have been selected and sequenced into a general order for instruction, the terminal performance objective(s) for each task or group of tasks can be written. Since all tasks selected will not require learning the same kind or amount of skills and knowledge, the terminal objectives should specify the performance, conditions and standards that are particular for each task. The various content and subject matter areas to be studied are identified on the basis of the occupational information gathered from an analysis of the tasks to be taught. "What is relevant and meaningful for instruction that will enable the learner to reach the entry-level performance required for each task?" This question must be asked to identify the content or skills which need to be learned and which will be included in the instructional sequence.

Following the preparation of the performance objectives, evaluation instruments, instructional blocks and lessons should be developed. Next, the blocks and lessons should be sequenced into a teaching order that meets state and/or local needs and limitations.

In addition to being used as the basis for the determination of instructional objectives, evaluation items, and content as suggested above, the occupational analysis may be of value in the following situations.

● SELECTING TEACHING HARDWARE

A listing of tasks provides a basis for identifying tools and equipment necessary for educational purposes and for planning needed physical facilities. Such a list can be used as a guide for determining what learning and practice activities will be conducted. Criteria to be used in

selecting the necessary textbooks, occupational references, and learning materials for the related instructional topics can be derived using a task list.

● EVALUATING TEACHING MATERIALS

An occupational analysis can serve as a guide for determining how well the content of available instructional materials correlates with planned instructional content. Also it will provide a basis for selecting and coordinating related reading and study materials with laboratory exercises. Planning for teacher-made materials can be coordinated with the choice of other available materials before the instruction begins, providing more economical use of monies and time.

● SHARING MATERIALS

Instructional materials and learning resources can be shared between vocational education programs by identifying similar or identical tasks which are performed in different occupations. An example of such opportunity is found in service occupations where common business tasks are also performed. Comparing task information from a business program might identify common areas of instruction within the service occupation program. Such sharing can economize on the cost of instructional materials as well as teacher planning and development time.

● IDENTIFYING FUNDAMENTAL SKILLS

A listing of tasks can aid in identifying fundamental skills such as reading and math skills which the student must develop. An analysis can also serve as a guide for developing teacher-made tests to be used before and after instruction.

● IDENTIFYING TASK GROUPS

A comparison of the listings of tasks for two or more related occupations will enable one to identify common tasks among those occupations and thereby provide a basis for grouping tasks for instructional purposes. Such common tasks can serve as a core for programs which provide entry opportunities into many positions in the same occupational area. The identification of task

groups will also allow for team teaching with instructors concentrating their efforts on specific areas of expertise.

● MAINTAINING CURRENT CONTENT

An occupational analysis provides a basis for identifying specific areas of performance that are rapidly changing in an occupation. By monitoring the occupation through separate surveys, teachers and supervisors can identify the types of refresher experiences they will need to maintain up-to-date curriculum; to aid teachers in keeping abreast of technological changes; to identify obsolete skills or content to be eliminated from the program; to review tool and equipment needs; and to adjust teaching emphasis as job demands change.

● COMMUNICATING WITH OTHERS

An analysis can be used as a communication device. It might be distributed to learners, parents, administrators, or counselors as a listing of the duties and tasks that an employee would possibly be expected to perform. Too, it might be used as a basis for relating learner progress and/or lack thereof to all interested parties.

