

# **Semiconductor Workforce Consortium CORE SKILLS ANALYSIS Summary Report**

Manufacturing Technician / Specialist  
OATC, Wilsonville, Oregon  
July 21, 1999

## **Executive Summary:**

This Gap Analysis was completed for the occupation of manufacturing technician in the semiconductor industry. The purpose was to validate, expand and enhance the identified core competencies common to similar positions in other high-performance manufacturing organizations. Duties for this position include supporting product design, production systems and manufacturing processes; monitoring and maintaining production equipment, personnel and resources; performing production and administrative duties; and supporting and maintaining safety and quality standards of the company.

The participants reviewed an initial draft of nine core manufacturing functions, 32 related tasks, technical knowledge requirements, and employability skills, drawn from research incorporating at least six core standards and competencies in related industries. This matrix was edited, expanded, revised, and reordered to ten core functions and 54 tasks, including some that were specific to the semiconductor industry. In addition, three of the eight ACT Work Keys skill areas were reviewed, and participants identified the levels required for both entry and effective performance of the job. Those skills were Locating Information, Applied Mathematics, and Applied Technology. The tasks were also reviewed for Relative Time Spent and Relative Importance, and were ranked in criticality to the industry by the participants.

On Wednesday, July 21, 1999, five former and current manufacturing technicians from the local semiconductor industry gathered in a meeting room at the OATC in Wilsonville for the eight hour process. The companies represented included: Intel Corporation, Integrated Device Technology (IDT), Mitsubishi Silicon America, Wacker Siltronic Corporation, and Hyundai Semiconductor America. The Gap Analysis was conducted by Laura Tonkin from The Mackey Group, Seattle, WA, and Eileen Casey White from Chemeketa Community College's Training & Economic Development Center.

## **Summary Information and Next Steps:**

Attached are the Gap Analysis results, summarized by job function and expanded in a matrix format. Also included is a summary report of the ACT Work Keys component, with skill levels and descriptions determined by the participants and the 54 tasks ranked from most to least critical. Because of the diverse nature of processing and practices represented by the companies participating in this gap analysis, the ranking may not directly apply to any one company. Rather, it is designed to give a broader understanding of the nature of the work and

the general expectations of the industry for the occupation of manufacturing technician.

Several new opportunities and some enhancement of existing partnerships have emerged as a result of this gap analysis:

- These results have already been forwarded to the Semiconductor Workforce Consortium subcommittee working on alignment of community college curriculum and industry skills and standards.
- Several companies have requested the matrix for internal use in further discussions of job descriptions, reorganization, and responsibilities.
- At least two participating companies have requested further information on the ACT Work Keys component for both internal use and with partnering colleges.
- This matrix of core competencies will be used in validation with other high-performance, high-tech industries in Oregon, in order to ensure more effective worker preparation and cross-training.

## **Tasks Ranked by Criticality**

1. Performs wet/dry etch.
2. Inspects and measures wafers.
3. Inspects in-process and completed semiconductor products.
4. Ensures Clean Operations protocol is maintained.
5. Monitors wafer and semiconductor fabrication equipment.
6. Operates and controls equipment through continuous monitoring.
7. Performs training and certification of new employees.
8. Maintains quality records.
9. Performs deposition of films on wafers.
10. Ensures manufacturing system meets health and safety requirements.
11. Inspects, adjusts, cleans, or aligns equipment.
12. Assists in chemical handling/housekeeping.
13. Monitors production flow.
14. Performs communication at time of shift change.
15. Ensures environmental management requirements.
16. Ensures manufacturing meets quality system requirements (e.g., QS9000, ISO9000 and other customer requirements).
17. Tests end-product.
18. Assists in routine low volume processing of product.
19. Evaluates and records performance of production tools set.
20. Interprets and clarifies customer expectations prepared by others.
21. Monitors and processes output parameters.
22. Participates in product experiments to find source of process problems to optimize process limits.
23. Uses company problem-solving systems to continuously improve manufacturing operations.
24. Analyzes and troubleshoots process related problems.

25. Performs emergency shutdown procedures.
26. Troubleshoots and diagnoses equipment.
27. Maintains and adjusts production plans to meet internal customer requirements.
28. Tests integrated circuits.
29. Uses standard improvement tools to define problem, identify possible causes and evaluate causes and potential solutions.
30. Assists in the development of work instructions and modification of standards for internal operations.
31. Cleans and replaces supply items on equipment as needed.
32. Compares and contrasts standards to determine appropriate dispositions.
33. Grows, grinds, and flattens crystal.
34. Performs photo-lithography.
35. Provides feedback information on prototype processes and products.
36. Slices, laps, lazermarks and polishes wafers.
37. Assists in audits by internal/external customers and ISO (International Standardization Organization).
38. Assists in team development and performance reviews.
39. Collects and reports on experimental data.
40. Performs preventative maintenance.
41. Records process data such as flow rates and parts changes.
42. Assists in the development of prototype processes and products.
43. Conducts periodic internal compliance reviews as required.
44. Maintains accurate records and logs of modifications, calibrations, and adjustments.
45. Monitors maintenance activities.
46. Participates in design of experiments to find source of process problems to optimize process limits.
47. Reviews and documents specifications and makes recommendations on requirements using quality-planning tools.

48. Assists in calibration of equipment.
49. Makes modifications to equipment to optimize performance.
50. Prepares purchase requests, work requests, and reports.
51. Documents product specifications (e.g., formulas, engineering drawings), including product materials.
52. Maintains accurate records and logs of parts inventory and monitors maintenance of parts stock.
53. Manages and improves preventative maintenance plans.
54. Performs light wiring using logic and schematic diagrams.

## Work Keys Profile

Occupational Title: **Manufacturing Technician/Specialist**

Profile Date: **07/21/99**

Total Number of Companies Represented: **5**

Total Number of Subject Matter Experts (SMEs): **5**

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Skill	Entry Level	Performance Level	Range
Applied Mathematics	5	6	3-7
Locating Information	5	5	3-6
Applied Technology	4	4-5	3-6

Briefly, profiling an occupation involved the following four steps:

1. Developing a list of the most critical tasks to the occupation;
2. Identifying the tasks associated with each Work Keys skill;
3. Identifying on-the-job behaviors associated with each skill as it is used on the job; and
4. Determining the Work Keys skills levels of the occupation.

As the initial step, subject matter experts (SMEs), consisting of employees identified by your organization as having firsthand knowledge of the requirements of the occupation, reviewed the task and functions for relevance and comprehensiveness. The SMEs rated each task on both IMPORTANCE (i.e., the significance of the task to overall job performance) and RELATIVE TIME SPENT (i.e., the amount of time spent performing this task compared with that spent on other tasks). The CRITICALITY of each task to the occupation (the multiplication of IMPORTANCE and RELATIVE TIME SPENT) was then calculated. The SMEs reviewed the list of tasks and their CRITICALITY ratings and revised the list so that only the most critical tasks remained.

Using this list of the most critical tasks, the SMEs discussed how the Work Keys skills (i.e., Applied Mathematics, Locating Information and Applied Technology) were required for performance of each task, and then identified the tasks associated with each skill (task could be associated with more than one skill). Guided by these new lists, the SMEs identified on-the-job behaviors and activities that required a particular skill, such as reading manuals, calculating the sum of a list of numbers, etc. Finally, the SMEs reviewed the descriptions of the Work Keys skills to determine the levels needed to perform the tasks of the occupation.

The resulting occupational profile as determined by the SMEs is presented in the table at the top of this page. The most critical tasks and a description of the Work Keys skills levels for this occupation are presented on the following pages.

## Skill Level Descriptions

### **Applied Mathematics      Level: 5**

Employees are required to

- look up a formula and change from one unit to another unit of measurement within a system of measurement (e.g., from ounces to pounds) or between systems of measurements (e.g., from centimeters to inches).
- calculate using mixed units (e.g., 3.50 hours and 4 hours 30 minutes).
- do several steps of logic and calculations, including division of negative numbers.
- decide what information, calculations, or unit conversions are needed to find a solution.
- determine the best deal.

For example, employees may be required to calculate perimeters and areas of basic shapes (e.g., rectangles and circles), to calculate percent discounts or markups, to compare costs to determine which is the best deal, or to complete a balance sheet or order form that requires several math operations (e.g., total an order, and then calculate tax and shipping costs).

### **Applied Mathematics      Level: 6**

Employees are required to

- set up problems and do several steps of calculations or conversions.
- calculate using negative numbers, fractions, ratios, percentages, or mixed numbers (e.g.,  $12 \frac{1}{8}$ ).
- transpose a formula before calculating (e.g.,  $8X = 20 \Rightarrow X = 20/8$ ).
- look up and use two formulas to change from one unit to another unit within the same system of measurement (e.g., 1 cup = 8 fl oz, 1 quart = 4 cups).
- find mistakes in calculations, such as those required in lower levels.
- determine the best deal and perform a further calculation with the result.

For example, employees may be required to calculate multiple rates, to find areas of rectangles and volumes of rectangular solids, or to solve problems that compare production rates and pricing schemes.

### **Locating Information      Level 5**

Employees must read complicated workplace graphics, such as detailed forms, tables, graphs, diagrams, instrument gauges, and maps.

Employees are required to

- summarize and/or compare information and trends in a single graphic.
- summarize and/or compare information and trends among more than one workplace graphic, such as a bar chart and a table showing related information.

## **Applied Technology      Level: 4**

Employees must be able to solve problems involving a moderately complex system or the interaction of two or more simple systems. While all the information employees need to solve the problems is available, some extraneous information is also included. In addition, solutions may involve changing two variable at the same time.

In solving these problems, employees must

- understand the operation of moderately complex tools, machines, and systems, such as small appliances, pulley-driven equipment, or piping systems that carry more than one fluid.
- apply the more abstract and less intuitive elementary principles underlying the operation of physical systems to the solutions of work-related problems, such as heat transfer or electric current.
- determine the meaning of some technical terms defined within the context of a problem.
- identify information relevant to solving a problem (two variables) and disregard extraneous information.
- eliminate several physical symptoms as the potential source of a problem or identify the best solution after eliminating other possibilities.

## **Applied Technology      Level: 5**

Employees are required to solve problems involving a complex system which consists of more components and performs more complex operations than that found at Level 4, or those involving one or more simple tools or systems which interact. These problems present more extraneous information and include more jargon than problems at Level 4. In additions, solutions may involve changing two or three variables at the same time.

In solving these problems, employees must

- understand the operation of complex machines and systems, such as gasoline engines, complex appliances, and building electrical systems.
- apply moderate and advanced principles of mechanics, electricity, thermodynamics, and fluid dynamics to the solutions of work-related problems, such as phase change (e.g., from gas to liquid) or pressure equilibrium in a system.
- apply prior knowledge of systems and testing procedures (e.g., operation of ohmmeter).
- identify information relevant to solving a problem (two to three variables) and disregard extraneous information.
- eliminate several physical symptoms as the potential source of a problem or identify the best solution after eliminating other competing possibilities.