DOCUMENT RESUME

ED 396 134 CE 071 860

AUTHOR Losh, Charles
TITLE National Skills Standards Development Program: Organization and Operation of Technical Committees To Develop National Skill Standards for Competency in the Electronics Industry. The Third Party Summative Evaluation of the Electronic Industries Foundation Project. Phase I & II. Final Report.
INSTITUTION Electronic Industries Foundation, Washington, DC.
SPONS AGENCY Office of Vocational and Adult Education (ED), Washington, DC.
PUB DATE 8 Dec 95
NOTE 56p.; For related documents, see ED 389 946, CE 071 858-859, and CE 071 909-910.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Competence; Educational Certificates; *Electronics Industry; *Electronic Technicians; Job Skills; Postsecondary Education; Program Development; Program Effectiveness; Program Evaluation; Standards; *Student Certification; Student Evaluation; Technical Education
IDENTIFIERS *National Standards

ABSTRACT

The Electronics Industries Foundation was awarded a project to develop national entry-level standards and a certification system. Ten specialties were included: automotive electronics, avionics, biomedical electronics, business machines, consumer products electronics, general electronics, industrial electronics, instrumentation, microcomputer, and telecommunication electronics. During phase I, tasks/skills were verified and later ratified, and measurable electronic technician skill standards were published and distributed. The objective of phase II was to develop a plan for implementation of a certification program for entry-level electronics technicians based on the skill standards. The formative external evaluation process for phase II provided feedback on proposed activities and incremental products. The summative external evaluation process was designed to determine overall project effectiveness. Phase II accomplishments included the following: establishment of measurement criteria for more than 300 skill sets; review of existing models and practices for accreditation and certification of nine national programs; survey of industry interest in and concerns about certification/accreditation processes; and recommendation of a certification test process. (Appendixes to the 11-page report include a summary report of the certification systems structure questionnaire; report on industry information preference when hiring entry-level electronics technicians; and technical committee membership.) (YLB)

FINAL REPORT
of
THE THIRD PARTY SUMMATIVE EVALUATION
of the
ELECTRONIC INDUSTRIES FOUNDATION PROJECT

PHASE I & II

NATIONAL SKILLS STANDARDS DEVELOPMENT PROGRAM: ORGANIZATION AND OPERATION OF TECHNICAL COMMITTEES TO DEVELOP NATIONAL SKILL STANDARDS FOR COMPETENCY IN THE ELECTRONICS INDUSTRY

U.S. DEPARTMENT OF EDUCATION
BUSINESS AND EDUCATION STANDARDS PROGRAM
CFDA #84.244-A

Submitted by

Instructional Systems Ltd.
Charles Losh, Ph.D.

December 8, 1995

THE THIRD PARTY EVALUATION
of the
ELECTRONIC INDUSTRIES FOUNDATION
NATIONAL SKILL STANDARDS DEVELOPMENT PROJECT

Final Report of PHASES I & II

Introduction

This is the final report of the Electronics Industries Foundation National Skill Standards Development Project (NSSDP) initiated in 1992. This report includes a summary of the Phase I activities and a summative evaluation of Phase II of the project, initiated April 1, 1994.

The NSSDP was one of 22 standards projects sponsored by the United States Departments of Education (USDE) and Labor (USDOL). The projects, which began October 1, 1992, were designed to develop and disseminate proposed national standards for competencies in industries and trades.

In the USDE category, a project was awarded to the Electronic Industries Foundation (EIF) to develop National Entry Level Standards and a Certification System to include the areas of:

1. Consumer Electronics Technician
2. Communications Technician
3. Computer/data processing Technician
4. Industrial/commercial technician
5. Engineering Technician
6. Automotive Electronics Technician

As the project progressed, it became clear that these categories needed to be expanded/revised, and more specialties added. The Phase I project ultimately included the following specialties in its entry level standards development:

1. Automotive Electronic Technician
2. Avionics Technician
3. Biomedical Electronics Technician

4. Business Machines Technician
5. Consumer Products Electronic Technician
6. General Electronics Technician
7. Industrial Electronics Technician
8. Instrumentation Technician
9. Microcomputer Technician
10. Telecommunication Technician

The project purpose stated in the original EIF proposal was:

> To organize and operate technical committees that will develop task-based skill standards for the core competencies needed across the electronics industry and for the specialty occupations within the industry .... The standards will be developed through a business, education, and labor partnership that examines the full extent of occupational needs and determines the full range of academic, theoretical, occupational and employability skills needed to enter, succeed, and advance in a job. Special attention will focus on skills that are needed to conform to a changing workplace and that can be tested against international benchmarks.

The project purpose was not modified, and the products of Phase I reflected this purpose. Phase II continued to operate under this broad project purpose statement. The project objectives were:

1. To create a coalition of employers, labor organizations, and vocational and educational groups who will participate in the development of the skills standards and certification process.
2. To develop standards that include job-specific academic and reasoning skills along with a certification process that will be maintained and updated.
3. To propose procedures for testing the validity of skill standards to insure non-discrimination on the basis of race, gender, national origin, age, or disability.
4. To develop a method for determining whether the certified personnel perform better than non-certified.
5. To develop methods for using skill standards as the basis for vocational education curriculum and certification.
6. To propose procedures for probable future skill standards at the national and world class levels in the next 5-10 years.

The original objectives and a determination of the impact of the skill standards was predicated on a three year process, with the second 18 months (Phase II) beginning April 1, 1994. Objectives one, two (partially addressed), and three were dealt with during Phase I.

The tasks/skills verified by the respondents to the National Skill Standards Validation Questionnaire; Electronic Industries Foundation were subsequently ratified by the EIA Board of Governors, made up of representatives of the industry association.

Objectives four, five, and six of the original proposal were not addressed in Phase I. They, along with part of objective two ("... a certification process that will be maintained and updated."), were to be addressed during Phase II of the project.

Measurable electronic technician skill standards, the primary product of Phase I, were published in Raising the Standard, Electronics Technicians Skills for Today and Tomorrow and subsequently distributed to audiences involved in preparing or employing electronic technicians. The manual has also been distributed via announcements in the CE Network News, the Telecommunications Industry Association Pulse, the American Vocational Association and Career Colleges Association Journals, and on the Internet. Copies were sent to all state directors of vocational technical education for state program utilization. In total, more than 3,100 copies of the "Raising the Standard" manual have been distributed to various audiences. Numerous workshops and seminars have been conducted by project and state staff to move the Electronics Standards to national use in the training and education environment.

Phase II activities of what became known as the "National Skills Standards Development Project" (NSSDP Phase II) focused on a single objective that consolidated objectives four, five, six, and part of objective two, all from the original (Phase I) proposal. The objective of Phase II, Certification, was

to develop a feasible and detailed plan for implementation of an industry-wide certification program for entry-level electronics technicians based on the skill standards developed in the first phase of this project.

The Independent External Evaluation of the NSSDP Phase II

The formative external evaluation process for Phase II was designed to provide feedback to the project director on proposed activities and incremental products. Included in the formative element was the review of selected documents and discussions with the Project Director. These activities provided adequate opportunities for the evaluator to determine the progress of the project activities in the development of a technician and program certification process. Materials, such as copies of quarterly reports submitted to USDE, copies of DRAFT technician and program certification materials, and communication to Technical Committee members, were forwarded to the evaluator for review.

The Project Evaluator provided feedback to the Project Director relative to development processes and interim products, and enhanced the ability of the project to remain "on track".

The summative external evaluation process was designed to determine the overall effectiveness of the project in achieving its primary objectives. The data collected during Phase II of the project was compared with the project objective to measure the degree to which the project processes impacted the proposed outcome of Phase II -- "... a feasible and detailed plan for implementation of an industry-wide certification program for entry-level electronics technicians ...".

The degree to which this objective was met, and a summation of the formative interaction with the project director is identified in this final evaluation report.

EIF proposed that the development procedure for the plan be similar to the industry-led process used during Phase I. Therefore, the Project Management Team, Executive Advisory Board, and the Technical Committee formed during Phase I continued to function during Phase II of the project. An additional member from the Educational Testing Service (ETS) joined the Project Management Team, providing expertise needed for the technician

assessment process. In the Phase II activities, the Technical Committee had a major role in the review and development of a prototype technician certification process.

The Phase II project plan had six major activities identified in the EIF continuation proposal:

1. Confirming the measurements of success in mastering the standards identified in Phase I.

STATUS:

This activity was sub-contracted to the Vocational-Technical Education Consortium of States (V-TECS), for the development of "first-cut" measurement criteria for Entry-level Electronics Technician technical skills identified in Raising the Standard. These criteria were then reviewed and modified by teams consisting of working technicians, first line managers and electronics instructors.

The measurement criteria developed for the skills in each of these areas provide a basis for the development of specific skill assessment instruments. The criteria were developed in such a manner that both performance and written test items can be developed as might be most appropriate for skill verification. Multiple measurement criteria, fully describing the critical knowledge, skill, or ability required for competent performance has been identified. In addition, the expected results of competent performance describe observable behaviors for assessment reliability. Measurement criteria was established for more than 300 skill sets. These criteria are available in an electronic format and were provided on disk to recipients of Raising the Standard.

2. Reviewing existing models and practices for accreditation of training facilities, and the practices followed for certifying the competency of individuals through various assessment processes. This activity will also look at re-certification and continuing accreditation issues.

STATUS:

Nine national programs that presently certify individuals and/or accredit training programs were studied to provide a basis

for further work relative to the type of process recommended by this project. The nine programs included the Printing Industries of America, Federal Aviation Administration, National Institute for Automotive Service Excellence, National Automotive Technicians Education Foundation, Electronics Technicians Association International, American Institute of Certified Planners, Associated General Contractors of America, American Society for Nondestructive Testing, American Welding Society, and the International Society of Certified Electronics Technicians. Eight of the nine programs certify individual technical skills, while four of the nine accredit training programs for the occupation.

This study provided invaluable information for this project. It also has great utility for other skill standards projects, and most importantly, for the recently established National Skill Standards Board. Among the observations from the study were:

a) the need for clear industry support of any certification/ accreditation program (if not financial, at least through recognition of the value of individual certification in the employment, and some cases remuneration processes),

b) the most successful programs use test developers external to the organizing agency,

c) a commitment from external resources for several years of up to $200,000 annually before the program can be expected to be self sufficient.

The major finding from the "existing model and practices" study was that "Unlike (technician) certification programs, none of the (training program) accreditation programs were completely self sufficient, all of them requiring considerable ongoing industry financial support."

Industry demand for an employee certification process was mixed. The project director indicated that when survey respondents (electronic technician employers) were asked if

> ... they would require certification, employers answered no; when asked if they would prefer it, they answered yes; when asked if they would pay more for certified employees, they answered no.

This finding is critical to the future of efforts to develop national certification systems and industry transportable skill certificates. Therefore, it should be shared with the National Skill Standards Board.

3. Gathering information on two major topics: "Do certified personnel perform better than uncertified personnel?", and identifying concerns of groups effected by an entry-level technician certification process.

STATUS:

The question of certified vs. non-certified performance was not addressed in the project. Given that an objective of this project was to design such a process, it is understandable that this objective was not addressed. Although the International Society of Certified Electronics Technicians has a technician certification program with limited scope, there was not an adequate research base to pursue this topic. This was noted in communication with the USOE Project Officer in the quarterly report of October 28, 1994.

Two surveys were conducted as part of the development of a valid data base on industry interest in and concerns about various types of certification/ accreditation processes. One survey included 259 questionnaires to 147 companies, with 34 companies receiving two questionnaires and 39 receiving three questionnaires. Companies and contact people were not chosen randomly, rather they were selected based on demonstrated interest in the skills standards project. The survey asked the participants to respond to the following topics:

- What do companies require of the electronics technicians they hire?
- What information about technicians do employers consider important and how good do they consider the information that is available?
- What should the industry do to implement the skills standards?
- How important are accreditation or certification?
- How would accreditation or certification be used?

• If the industry instituted a certification program, what would be the desirable uses and features?

The results of this survey are found in the NSSDP report titled "Summary of Phase II - Certification Systems Structure Questionnaire" (Appendix A).

To provide further specific data on the certification and accreditation issues, a questionnaire (included in the Appendix of the NSSDP report titled "Industry Information Preference When Hiring Entry-Level Electronics Technicians", Appendix B) was sent to a selected sample of employers of electronics technicians. This instrument included four potential processes, and asked the business-industry representatives to:

> Rate the importance of each program (option) for its potential to help you evaluate a job applicant's skill qualifications for a work-ready, entry-level electronics technician's position. Use the following scale: (1) Not Important; (2) Somewhat Important: (3) Important; (4) Very Important.
>
> Option A) an EIA-Accredited Electronics Technician Training Program process;
>
> Option B) an Entry-Level Technician Certification Examination process;
>
> Option C) an Education Portfolio process which includes information on a job applicant's educational achievement;
>
> Option D) a Work Experience Portfolio detaining school-to-work program, internship, apprenticeship, or other on-the-job training and experience.

Fifty-eight companies responded to the "Certification Systems Structure Questionnaire" (Appendix B) with the results indicating a preference for an individual certification process (Option B). The results of this survey are reported in the "Industry Information Preferences When Hiring Entry-Level Electronics Technicians" questionnaire (reported in Appendix B).

4. Present the certification and accreditation options to the Technical Committee for review and a choice of one or more certification options. For the chosen options, draft assessment and certification materials and processes will be developed, and finally, the options will be pilot tested.

STATUS:

Throughout Phases I and II of the project, materials were forwarded to the Technical Committee for their review and feedback to project staff. This group played a vital role in all of the decisions relative to both interim and final products.

The assessment criteria materials identified in Activity 1 resulted from numerous discussions between the NSSDP staff and Technical Committee members relative to format and content of the criteria statements for the standards. As an outcome of these discussions, the resultant criteria have significant utility for both employers of electronics technicians and potential or trainee electronics technicians.

The findings of the surveys identified earlier in this report were subsequently reported to the Technical and Executive Committees (Appendix C) for their review and decisions relative to the process(es) to be supported by the industry. The results were presented to the Technical Committee at their September 26, 1995, meeting:

> ...58 companies responded to nearly 400 questionnaires sent. Because a statistically significant 47 percent of the respondents clearly preferred certification testing of individuals, Option B, he (Irv Kaplan, NSSDP Director) asked committee members (the Technical Committee) for approval to recommend this option to the Executive Advisory Board. They concurred. ... There was little preference among survey respondents for accreditation of training programs.

5. Selecting the most viable technician and program certification process as a result of the pilot studies conducted during Phase II.

STATUS:

At their meeting on September 26, 1995, the Technical Committee reviewed the results of the State-of-the-Art Study of extant technician and program certification programs and the employer survey, and then recommended to the Executive Advisory Board that:

> ... certification testing was the single approach to be recommended by the NSSDP.

The Executive Advisory Board concurred with this recommendation during their meeting held on September 27, 1995.

As of the date of this report, development of the NSSDP report describing the certification test process is in progress. The components of an "industry-driven" technician certification/ program accreditation are in the process of being identified. The NSSDP report will include a recommended organizational structure, the staffing requirements and resources needed by the organization(s) overseeing the program; suggested methods for securing test questions, test results, and personnel information; recommendations relative to testing issues such as numbers and locations of test sites, the anticipated uses of the system, and finally, a suggested fee system for both program accreditation and technician certification.

6. Disseminating the results of Phase II and briefings for parties interested in becoming certifying agencies.

STATUS:

Numerous project products have been distributed to both industry and education/training entities. Technical reports and related materials were distributed to and reviewed by project committees, business and industry representatives, and state and local educators. During Phase II of the project, technical assistance was provided to several states contributing to the development or upgrading of electronic technician curriculum and training materials.

The major products distributed from the project include Raising the Standard, Electronics Technicians Skills for Today and Tomorrow (the primary Phase I product), and Characteristics of Competency, Measurement Criteria for Entry-Level Electronics Technicians, to be used for validating student/employee performance level. The measurement criteria will be distributed on disk to entities and individuals that have been involved with the project, or have demonstrated an interest in receiving project products. In the Phase II proposal, the concept of a "Kit" with a portfolio/checklist for recording student

performance during their instruction was considered. However, in communications with the NSSDP Project Director, he indicated that "Because the portfolio concepts were rated poorly (by respondents to the questionnaire found in Appendix B), the kit concept has gone away."

Upon completion, the final project report detailing project activities, products, and recommendations for future work will be distributed to the United States Department of Education and other pertinent parties. The timelines, activities and specific project processes are included in the final report and will not be included in this report.

Conclusion

The Electronic Industries Foundation project, National Skills Standards Development Program: Organization and Operation of Technical Committees to Develop National Skill Standards for Competency in the Electronics Industry, has substantially met the objectives described in the Phase I and Continuation proposals. The research conducted and products developed are of great potential value to the electronics industry, education and training programs, and ultimately, the international competitiveness of the United States.

Appendix A

National Skill Standards Development Project

Summary of Phase II - Certification
Systems Structure Questionnaire

Electronic Industries Foundation
919 18th Street, NW, Suite 900
Washington, DC 20006
(202) 955-5810 FAX: (202) 955-5837

Summary of Phase II - Certification
Systems Structure Questionnaire

To support the NSSDP's Phase II design of a certification/accreditation system, the project held focus groups with electronics technicians, supervisors of technicians, and educators to obtain their opinions on questions relating to industry certification of entry-level electronics technicians, accreditation of training programs or some combination of the two. The NSSDP defines accreditation not as approval by an official body but as endorsement of a training program by the industry. A report of the results of these focus groups has been prepared and is available.

Focus groups provide qualitative information, indications of how larger populations of similar composition are likely to respond. Because of the limited recruitment of respondents, the number of respondents, and the influence of one respondent on another, focus group findings cannot be considered valid in a statistical sense. For these reasons, the NSSDP developed and disseminated a questionnaire to gather quantitative data from industry and provide more reliable feedback than focus groups could assure on how industry believes a certification/accreditation program should be structured to best meet its needs. The results are reported in question and answer format in the following sections.

The questionnaire results, along with findings from the earlier focus groups, will be used to develop scenarios for optional approaches to the design of a certification/accreditation program. These scenarios will become the basis for a follow-up industry questionnaire; its findings will form the basis for design of the certification/accreditation system.

Who responded to the questionnaire?

The NSSDP sent 259 questionnaires to 147 companies, with 34 companies receiving two questionnaires and 39 receiving three questionnaires.. Companies and contact people were not chosen randomly, rather they were selected based on demonstrated interest in the skill standards project.

The project received 68 responses (26 percent of 259) representing 53 companies in 26 states. The respondents should be viewed as atypical, representing the most interested of especially interested companies. Virtually all respondents (99 percent) reported their electronics technicians serviced or repaired electronic products or both. Most (72 percent) reported their technicians tested product quality. Just over one-third (36 percent) reported they manufactured electronic products. More than one-third of respondents (37 percent) were from companies with 100 or fewer employees; nearly the same number (35 percent) were from companies with 101 to 300 employees. The remainder (28 percent) were from companies with more than 300 employees. Most respondents (62 percent) were from companies employing 20 or fewer technicians; few (12 percent) had over 100 technicians.

What do companies require of the electronics technicians they hire?

Almost all respondents (93 percent) reported postsecondary training as a requirement. Most respondents (72 percent) reported requiring a 2-year degree. One in four required completion of a training program known to the employer. One in four required certified technician status based on a certification exam. Over half (59 percent) reported requiring 1 to 2 years' prior experience as a technician. Of those requiring work experience, the majority used the information to give them "extremely important" information on work habits, dependability, knowledge of electronics, ability to apply knowledge, and the use of test equipment and tools. As shown in Table 1, two conditions would persuade the majority to waive experience as a requirement: if the technician had completed a training program that included on-the-job training and evaluation (75 percent) or if the technician had passed a rigorous skills certification exam (57 percent).

TABLE 1

Conditions Under Which A Work Experience Requirement for Hiring Would be Waived

Conditions	Percent Indicated	
	YES	NOT SURE
If training program were accredited by industry	39	39
If individual passed rigorous certification exam	57	26
If trainee work habits were rated in training program	14	41
If OJT and evaluation were included in training program	75	11
A combination of the above conditions	76	15

What information about technicians do employers consider important and how good do they consider the information that is available?

In four of seven areas, a majority of respondents gave the information the highest ranking, "very important," as follows: troubleshooting, 69 percent; electronics skills, 62 percent; use of tools and test equipment, 59 percent; and characteristics and work habits, 52 percent.

It is significant that the percentage of respondents giving the quality of this "very important" information the highest ranking ("good") ranges from 10 percent to no higher than 20 percent. The discrepancy between importance and quality for these four most important items is 40 percent or greater. In other words, as indicated by questionnaire results, the information the industry judges to be most important is also information the industry believes to be of poor quality. These four categories also showed the greatest divergence between importance and quality, perhaps precisely because they are considered the most important.

Figure 1 also reveals that few respondents (14 percent) thought math skills were "very important." However, 47 percent of respondents ranked math skills as "important" for a combined positive ranking of 61 percent (not shown). Similarly, only 30 percent of respondents ranked reading skills as "very important," but including those who deem them "important" provides a combined positive response of 94 percent (not shown).

What should the industry do to implement the skill standards?

When asked to rate four possible courses of action on a scale of 4.0 (highly desirable) to 1.0 (not particularly desirable), respondents clearly preferred using the skill standards to guide educators in planning training programs (3.23). Next came using the standards to accredit training programs (3.03), followed by using the standards to create a national certification examination program (3.00). The lowest rating was given to wide distribution of the standards with no additional action (2.13). However, as Table 3 shows, 42 percent of all respondents and 56 percent of those in manufacturing ranked this option as desirable or highly desirable.

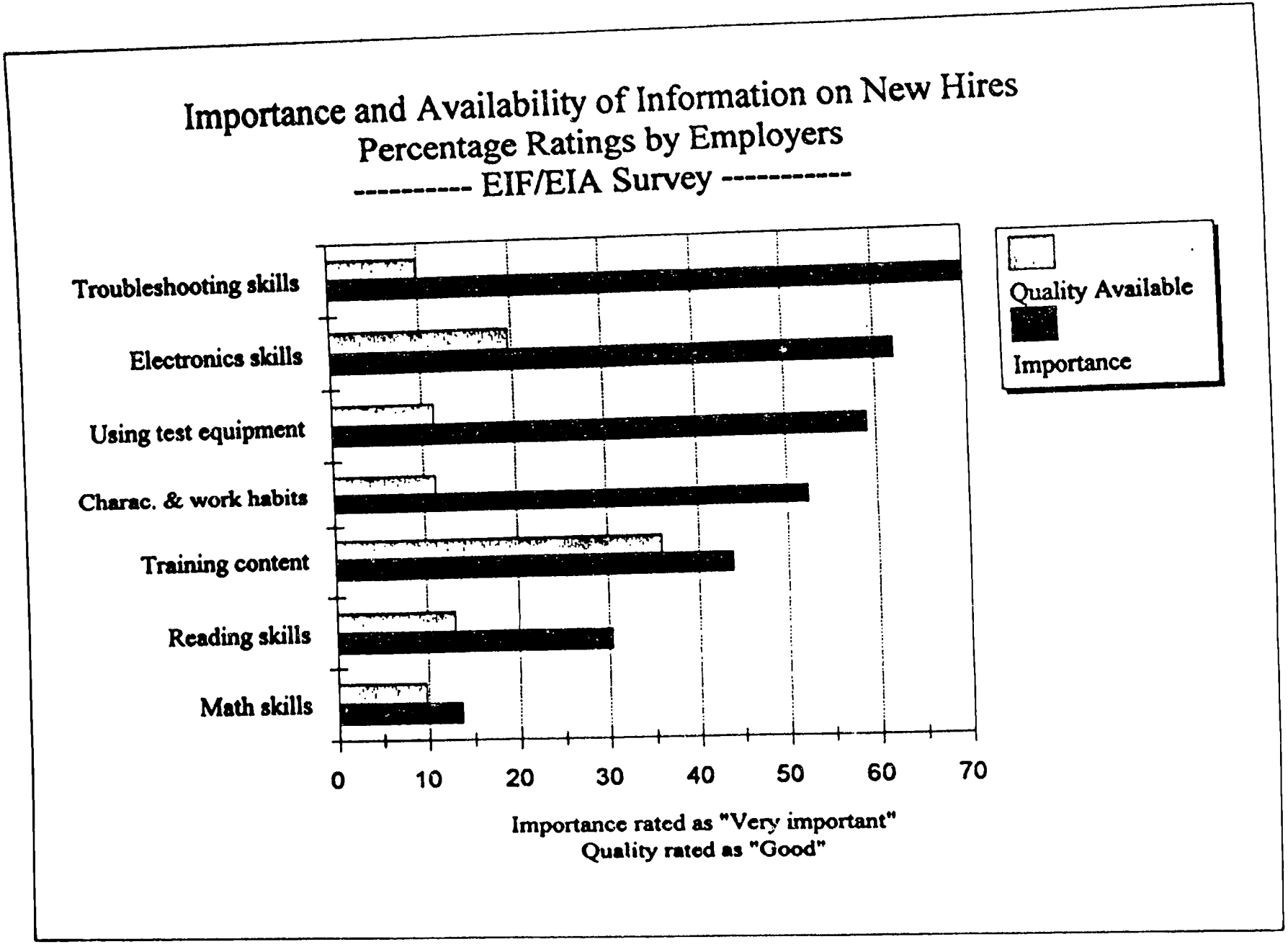

Importance and Availability of Information on New Hires
Percentage Ratings by Employers
---------- EIF/EIA Survey ----------
Troubleshooting skills
Electronics skills
Using test equipment
Charac. & work habits
Training content
Reading skills
Math skills
Quality Available
Importance
0
10
20
30
40
50
60
70
Importance rated as "Very important"
Quality rated as "Good"

TABLE 3

Possible Courses of Action to Implement Skill Standards						
	All Employers		Manufacture/Employers		Service/Employers	
	Highly Desirable	Desirable	Highly Desirable	Desirable	Highly Desirable	Desirable
Take no action	10%	32%	6%	50%	10%	21%
Use to shape training	40%	43%	28%	39%	47%	37%
Use to accredit programs	25%	56%	22%	39%	21%	66%
Use to create cert. exam	34%	41%	28%	33%	38%	38%

How important are accreditation or certification?

Respondents also rated the importance to their own company and to the industry of accrediting training programs and creating a national certification exam as shown in Table 4. A majority of respondents considered both options important. All cross-sections of respondents, but especially those in manufacturing companies, assigned greater importance to accreditation than to certification. In every employer group, respondents thought both options were more important for the industry than for their individual companies.

TABLE 4

Percent Rating Actions as "Very Important" or "Important"				
	Create National Accreditation Program		Create National Certification Exam	
	For My Company	For the Industry	For My Company	For the Industry
All Employers	73%	82%	52%	72%
Manufacture/Employ.	79%	90%	47%	74%
Service/Employers	68%	74%	53%	67%

How would accreditation or certification be used?

Respondents were unwilling to make either completion of an accredited program or passage of a certification exam a requirement in their recruitment and hiring, although most said they would give preference to applicants meeting either condition.

Asked how they anticipated using information about program accreditation based on skill standards, employers consistently favored accreditation as a useful piece of information they would use to some degree in their recruitment and hiring practices.

- Most employers (70 percent) would recruit from accredited schools or training programs they would not have contacted otherwise.
- Most employers (68 percent) would give preference to applicants who had completed an accredited program.
- However, few employers (21 percent) would make completion of an accredited program a requirement for employment; some (38 percent) were unsure as to whether or not they would require it.

If the industry instituted a certification program, what would be the desirable uses and features?

As shown in Table 5, few (17 percent) would consider passage of a certification exam as equivalent to 2 to 3 years of work experience. Respondents were not sure about awarding a bonus or offering other financial incentives for certified new hires. Most employers would not require certification for all new hires; only one in four expressed interest in this approach. (One in four also claim to be doing this now.)

TABLE 5

Anticipated Uses in Recruitment and Hiring of National Certification		
would you -	YES	NOT SURE
Give preference to certified technicians	70%	14%
Require certification for all new hires	26%	30%
Consider certification as equivalent to 2-3 years work experience	17%	44%
Award bonus to new hires with certification	14%	42%

A majority of respondents (65 percent) considered certifying individuals on their successful completion of an accredited training program as "desirable" or "highly desirable." A greater majority (85 percent) similarly rated certification of technicians who passed a national exam that might include a practical component. A slight majority (55 percent) rated as "desirable" or "very desirable" certification of only those who met both conditions. Most respondents (79 percent) saw a hands-on component as "very important" or "important" in any national certification exam. They said this component should cover soldering, troubleshooting, analyzing circuit diagrams, and using test equipment but not circuit design.

Appendix B

NATIONAL SKILL STANDARDS DEVELOPMENT PROJECT

Industry Information Preference when Hiring Entry-Level Electronics Technicians

Electronic Industries Foundation
919 18th Street, N.W., Suite 900
Washington, D.C. 20006
Telephone: 202/955-5810
FAX: 202/955-5837

NATIONAL SKILL STANDARDS DEVELOPMENT PROJECT

Industry Information Preference when Hiring Entry-Level Electronics Technicians

Introduction

Since the fall of 1992, the Electronic Industries Association (EIA) and its foundation, the Electronic Industries Foundation (EIF), have been working under funding from the U.S. Department of Education and in concert with over 100 participating companies, government agencies, institutions, unions, and associations, to develop and implement national skill standards for work-ready, entry-level electronics technicians. The work has been conducted in two phases:

- Phase I involved drafting the skill standards and validating them against workplace performance. After 18 months' work, the skill standards were ratified for adoption by the EIA Board of Governors in March 1994 and disseminated to EIA-member companies, educational institutions, and other interested parties. Since then state departments of vocational education across the country have been using them for curriculum planning.

- Phase II, now under way, includes designing an industry-based program for evaluation of work-ready, entry-level electronics technicians based on the skill standards developed in Phase I.

In the spring of 1994, EIA, EIF, and participating companies and organizations began the task of determining industry requirements for certification testing of individual electronics technicians, accreditation of electronics training programs, standardized portfolios that summarize an individuals's training and experience, or some combination of these. The project conducted focus group discussions with educators, working technicians, supervisors of technicians, corporate executives, and state directors of vocational technical education to obtain their views and opinions. It gathered information on existing accreditation and certification programs in fields related to the electronics industry.

A technical committee made up of industry, labor, and education representatives studied information and analyzed data to identify those "best practices" that appeared to be most desirable, logical, and cost effective for the electronics industry. From this process, four "scenarios" for evaluation of job candidates emerged as feasible and useful program options. Each provided some objective criteria or standard by which the prospective employer could measure an applicant's skills and/or readiness for work. The four scenarios are listed below and described in detail in the questionnaire package presented in the Appendix.

Option A:	EIA-Accredited Electronics Technician Training Program
Option B:	Entry-level Technician Certification Examination
Option C:	Education Portfolio
Option D:	Work Experience Portfolio

The questionnaire asked respondents to answer three questions:

Question 1:	Rate the importance of each program [scenario] for its potential to help you evaluate a job applicant's skill qualifications for a work-ready, entry-level electronics technician position. Use the following scale: (1) Not Important; (2) Somewhat Important; (3) Important; (4) Very Important.
Question 2:	In order of preference, rank each of the program options from four (4) to one (1), with four (4) being the most preferred and one (1) being the least preferred.
Question 3:	If you prefer a combination of options instead of a single option, please list the combined options below using the letter designations.

A separate section asked for demographic information about the respondent's company's business interest, number of employees, and number of technicians employed.

Process and Response

Approximately 400 questionnaires were sent to human resource specialists and members of the project's Technical Committee and Executive Advisory Board (EAB). To obtain knowledgeable responses, the cover letter asked that the questionnaire be completed by someone directly responsible for hiring entry-level electronics technicians. Recipients were sent a reminder postcard approximately 3 weeks later. A total of 58 responses were received. These were tallied and statistically analyzed. Details and results of this analysis follow.

Questionnaire Results

Demographics

There were a total of 58 responses to the questionnaire. Table 1 summarizes the distribution of responses by number of employees, number of technicians employed, and business. Because several responses showed multiple business interests, the total is greater than the number of responses. Not all respondents answered the questions about company size.

Data

Figures 1, 2, and 3 summarize responses to question 1: Rate the importance of each program for its potential to help you evaluate a job applicant's skill qualifications for a work-ready, entry-level electronics technician position. Use the following scale: (1) Not Important; (2) Somewhat Important; (3) Important; (4) Very Important.

Figure 1 shows the arithmetic mean of the responses for each option. Option B was ranked highest with an arithmetic mean of 3.4. Option A was next highest at 2.9, Option D next at 2.7, and Option C lowest at 2.4.

TABLE 1
CERTIFICATION OPTIONS QUESTIONNAIRE
DEMOGRAPHICS OF RESPONSES

Number of Employees		Number of Technicians	
1-50	5	1-10	8
51-200	3	11-25	8
201-1000	11	26-100	10
> 1000	30	> 100	22

BUSINESS

Education - 10
Consumer Products - 18
Telecommunications - 6
Manufacturing/Industrial - 13
Defense/Aerospace/R&D - 12
Electronic Components - 5
Computers-Commercial/Medical - 4

FIGURE 1: ARITHMETIC MEAN FOR OPTIONS

QUESTION 1

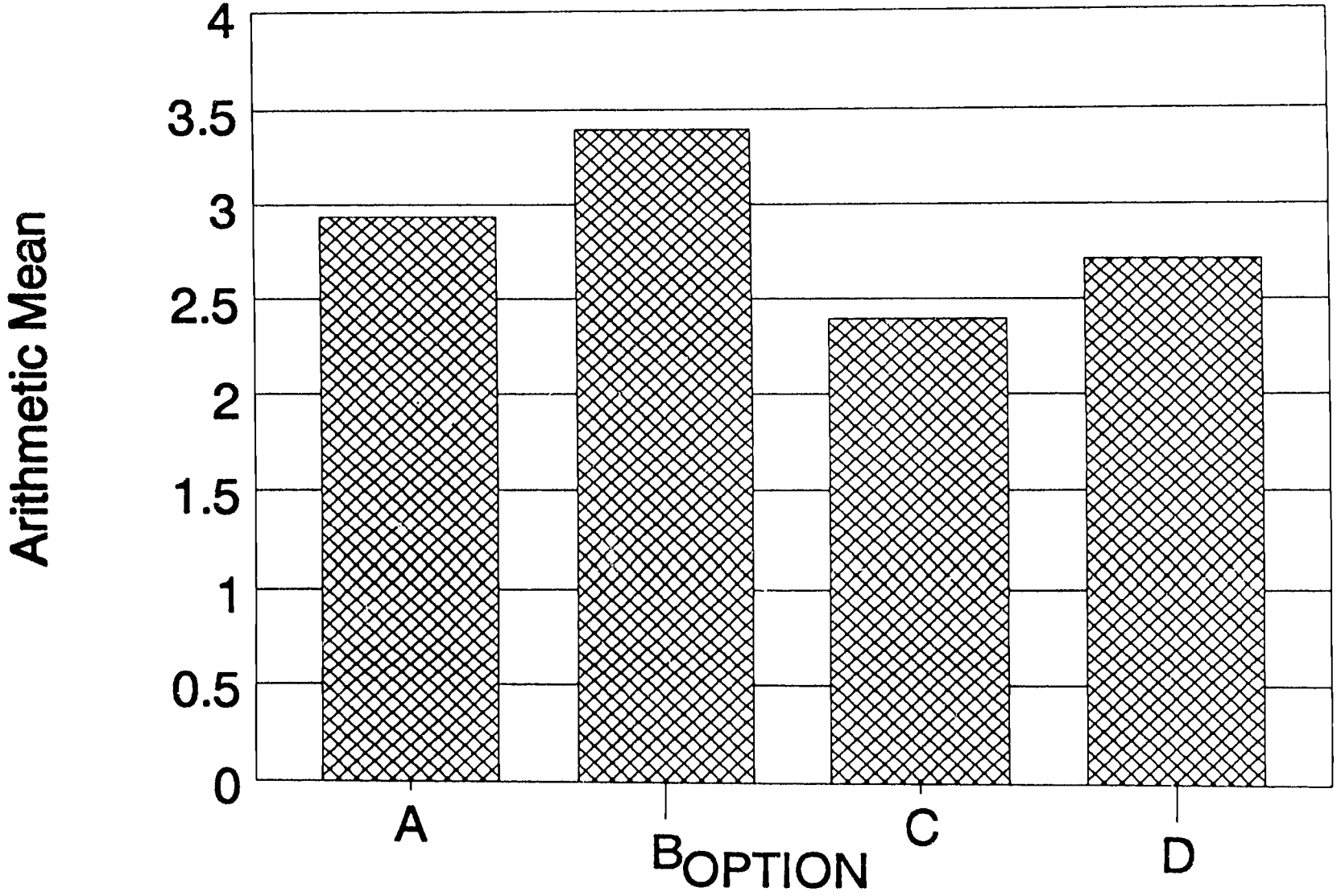


FIGURE 2: % RATINGS – VERY IMPORTANT QUESTION 1

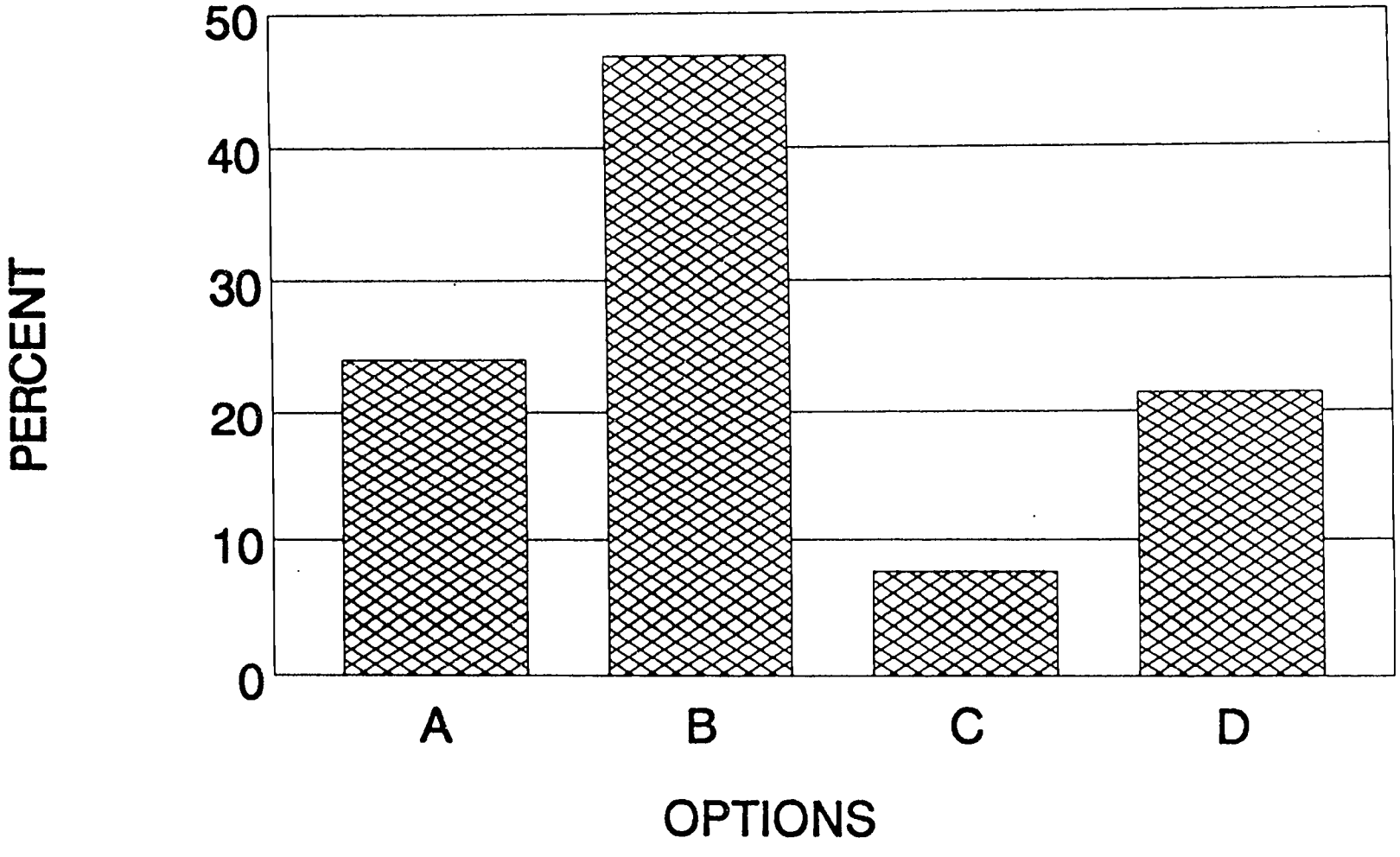


FIGURE 3: QUESTION 1
% RATINGS – IMPORTANT+VERY IMPORTANT

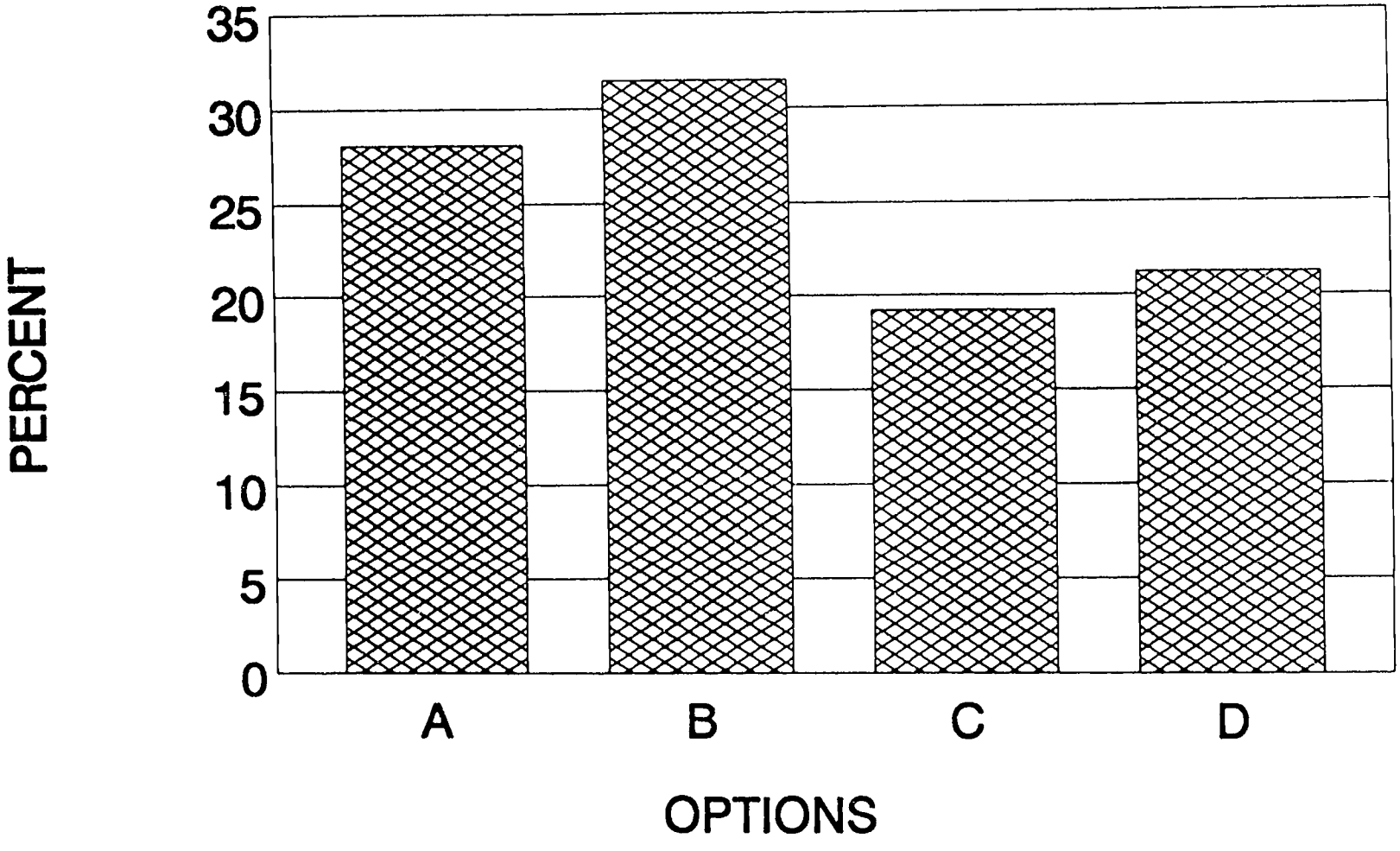


Figure 2 shows a breakout of only the "Most Important — 4" ratings given. Looking at percentages, we find that about 47 percent of respondents rated Option B as most important; Option A received 24 percent of the top rating; Option D received 22 percent; and Option C received only 8 percent.

Figure 3 combines the "Important - 3" and "Very Important - 4" ratings given. About 32 percent of respondents are seen to favor Option B; 28 percent favored Option A; 21 percent favored Option D; and 19 percent favored Option C.

Although the relative degree of preference for one option over another changes when the results to question 1 are analyzed in these three different ways, the absolute preference for Option B — followed by A, D and C — remains constant.

Figures 4, 5, and 6 present the results of question 2: In order of preference, rank each of the program options from four (4) to one (1), with four (4) being the most preferred and one (1) being the least preferred. One response to question 2 was inappropriate and could not be included in the analysis.

Figure 4 shows the arithmetic mean of the responses for each of the options. Option B was ranked highest, receiving an arithmetic mean of 3.0; Option A was next at 2.6; Option D was next at 2.3; and Option C was ranked lowest at 2.1.

Figure 5 shows only the respondents' ratings of options as "Most Important - 4." About 47 percent of respondents preferred Option B; 23 percent preferred Option D; 19 percent preferred Option A; and 11 percent preferred Option C.

Figure 6 presents the combined responses "Important - 3" and "Very Important - 4." In combination, about 33 percent chose Option B; 29 percent chose Option A; 21 percent chose Option D; and 18 percent chose Option C.

Once again, the ratings were consistent in terms of an absolute preference for Option B.

FIGURE 4: ARITHMETIC MEAN FOR OPTIONS

QUESTION 2

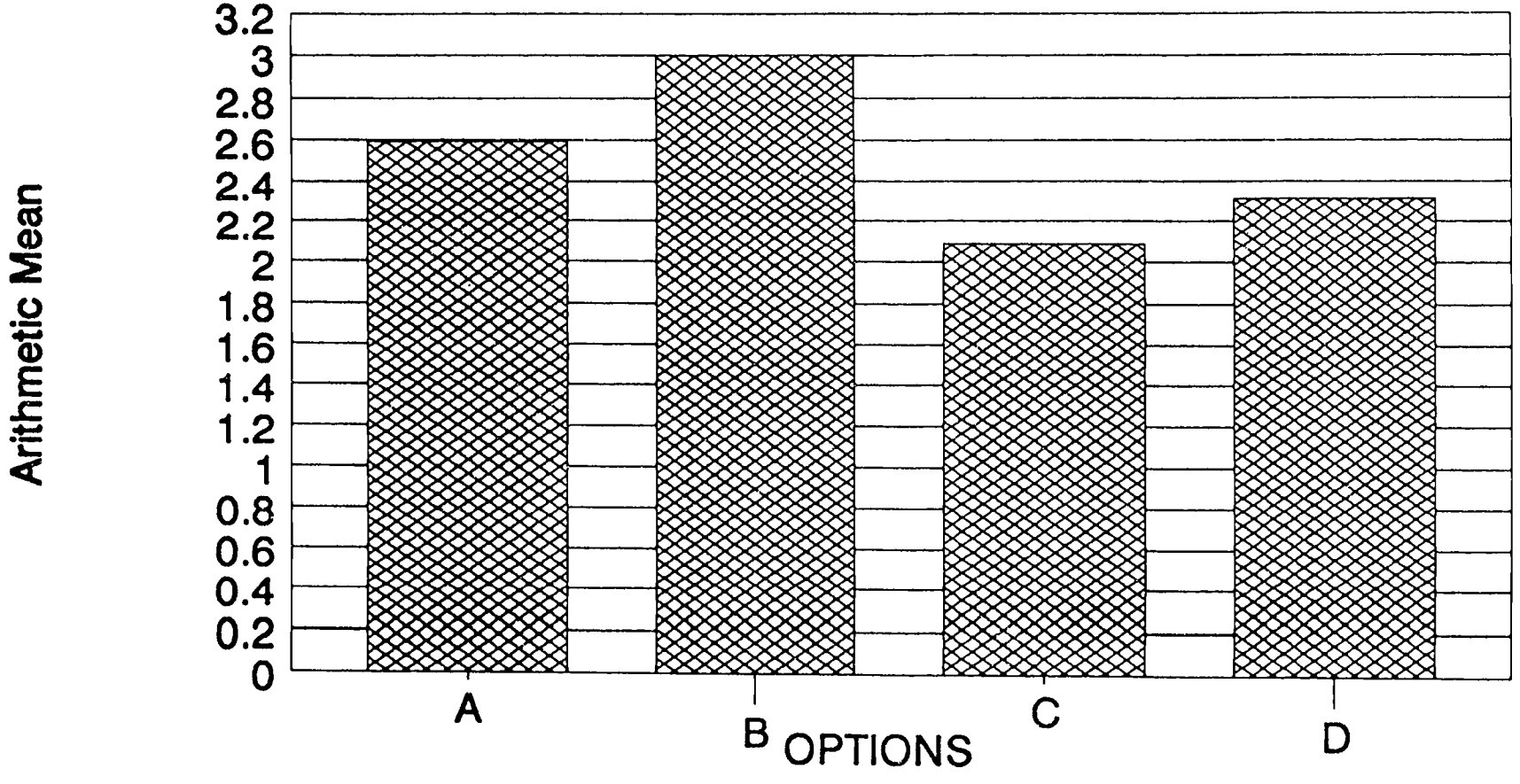


FIGURE 5: % OF RANKING – VERY IMPORTANT
QUESTION 2

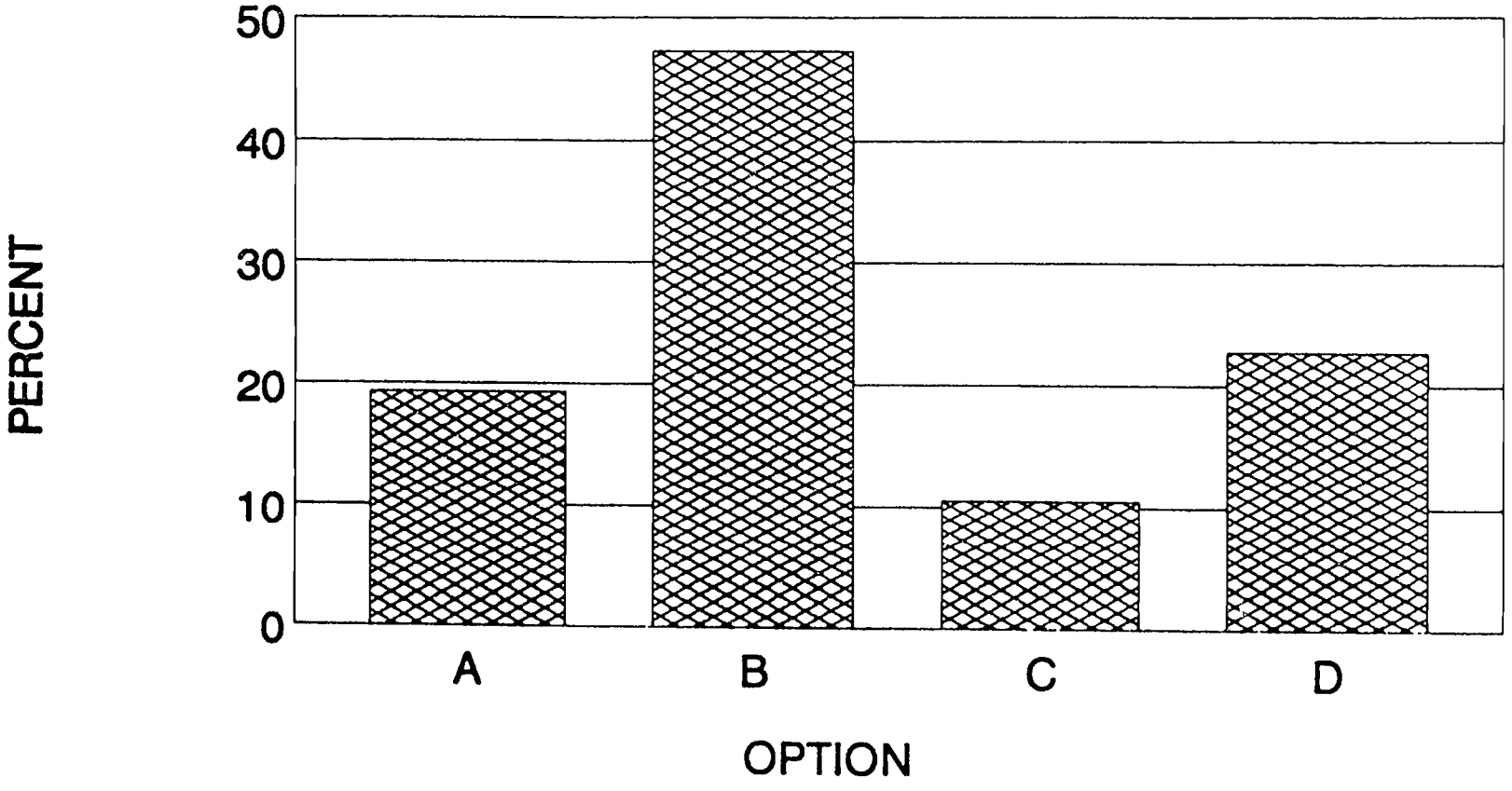
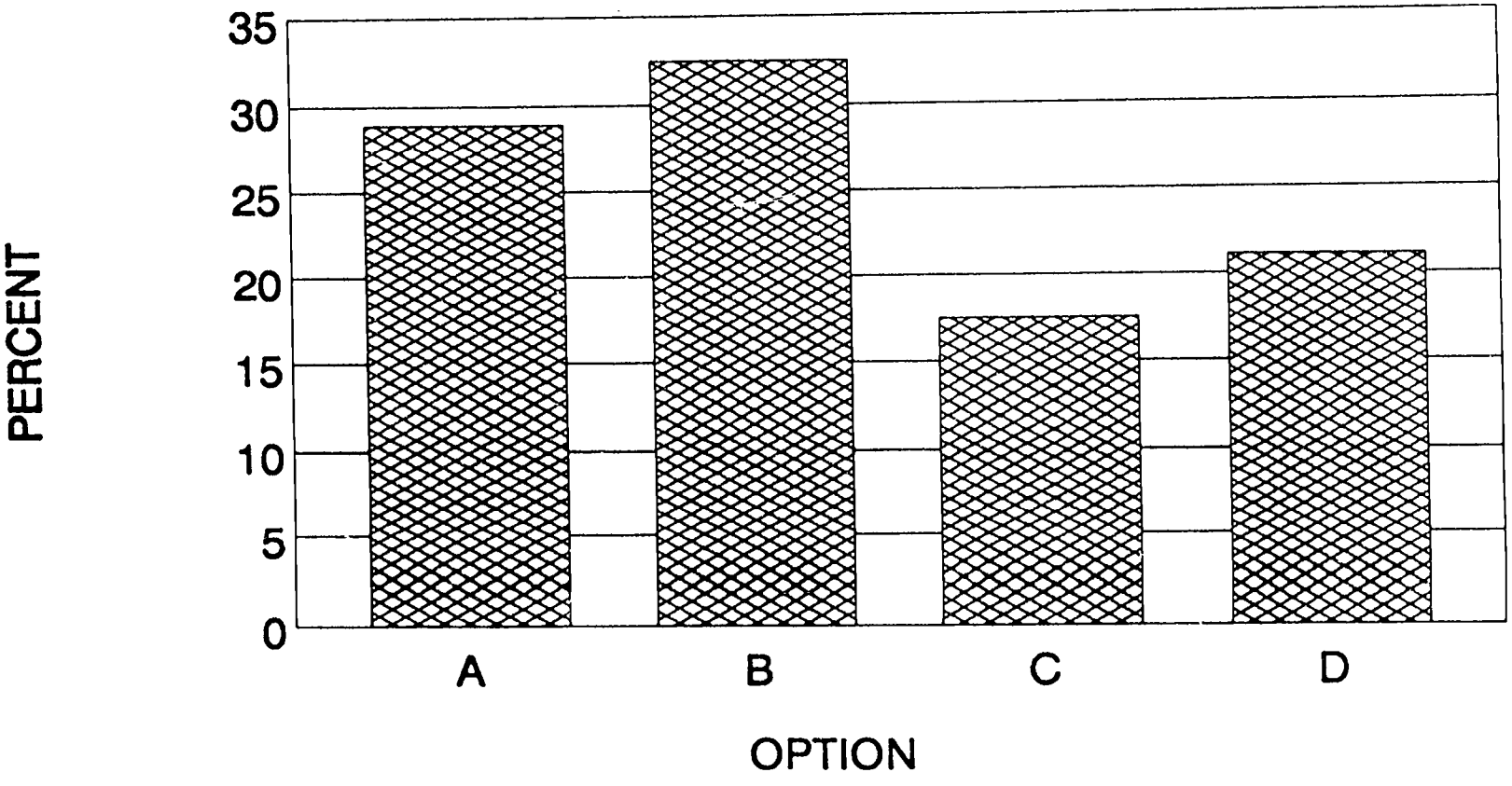


FIGURE 6: % OF RANKING – VERY IMPORTANT+IMPORTANT
QUESTION 2



Question 3 was included to provide an opportunity for response to those who preferred a combination of options, rather than one "scenario." Table 2 presents the results. Of the 61 responses, 30 answered question 3. Because some listed more than one option, there are more responses than respondents. No clear preference emerged for any combination of options.

TABLE 2

Question 3: **If you prefer a combination of options instead of a single option, please list the combined options below.**

COMBINATION	NUMBER SELECTING
A+B	11
A+C	1
A+D	1
B+C	2
B+D	5
C+D	5
A+B+C	1
A+B+D	3
A+C+D	1
B+C+D	0
TOTAL	30

Analysis of Results

Figures 1 through 6 show a preference for Option B, Entry-level Technician Certification Examination. To determine whether this preference is significant, three questions were considered:

A. Considering the complete set of data for question 2, have all of the responses been taken from the same population?

B. Considering the results from question 1, are Option A and Option B (the two highest-rated options) from the same population?

C. Considering the results of question 2, are Option A and Option B (the two highest-rated options), from the same population?

To be considered significant, these questions should have less than a 5 percent chance of eliciting a positive response (or of being "true") for any comparison. Two tests were performed to determine the significance of the responses. Friedman's Two-Way Analysis of Variance by Rank, a special test for ranked data, was used to answer question A. The Chi Square Test was used to analyze questions B and C. Table 3 shows the questions have less than a 1 percent probability of being true, significantly better than the 5 percent target.

The results of these tests show the preference for Option B is valid; it is the preferred source of information to help select job applicants.

TABLE 3

TESTING FOR SIGNIFICANCE

Question A: **Considering the complete set of data, have all of the samples been taken from the same population?**

Question B: **Considering the results from the questionnaire question 1, are Option A and Option B from the same population?**

Question C: **Considering the results from questionnaire question 2, are Option A and Option B from the same population?**

TEST	SCORE	PROBABILITY
Friedman's Two-Way Analysis of Variance by Ranks - Question A	15.84	< .01
Chi Square Test - Question B	13.26	< .01
Chi Square Test - Question C	11.8	< .01

APPENDIX

NATIONAL SKILL STANDARDS DEVELOPMENT PROJECT (NSSDP)

ACCREDITATION/CERTIFICATION CONSIDERATIONS

Request for Industry Response

Background

Since the fall of 1992, the Electronic Industries Association (EIA) and its foundation, the Electronic Industries Foundation (EIF), have been working under funding from the U.S. Department of Education and in concert with over 100 participating companies, government agencies, institutions, unions, and associations, to develop and implement national skill standards for the work-ready, entry-level electronics technician. The work has been conducted in two phases:

- Phase I involved drafting the skill standards and validating them against workplace performance. After 18 months' work, the skill standards were ratified for adoption by the EIA Board of Governors in March 1994 and disseminated to EIA member companies, educational institutions, and other interested parties. Since then state departments of vocational education across the country already have been using them for curriculum planning.

- Phase II, now under way, involves developing an industry-based certification/accreditation program for work-ready, entry-level electronic technicians based on the skill standards developed in Phase I.

Late last spring, EIA, EIF, and participating companies and organizations began the task of determining industry requirements for certification testing of individual electronics technicians, accreditation of electronics training programs, portfolios that summarize an individual's training and experience, or some combination of these. The project conducted focus group discussions with educators, working technicians, supervisors of technicians, corporate executives, and state directors of vocational technical education to obtain their views and opinions. It gathered information on existing accreditation and certification programs in fields related to the electronics industry. It disseminated a questionnaire to obtain industry input on program needs and content.

A technical committee made up of industry and education representatives studied information and analyzed data to identify those "best practices" that appeared to be most desirable, logical, and cost effective for the electronics industry. The four certification and/or accreditation scenarios that emerged from this process as feasible and useful program options are presented for consideration. Each provides some objective criteria or standard by which the prospective employer can measure the applicant's skills and/or readiness for work.

NSSDP ACCREDITATION/CERTIFICATION CONSIDERATIONS

Option A: EIA-Accredited Electronics Technician Training Program

This proposed program option would provide notification to the prospective employer that a job applicant, having graduated from an EIA-accredited program, could be expected to possess the skills and knowledge required of an entry-level technician.

Programs desiring to be accredited by EIA would need to complete the following four-step process:

1. Completion of application for accreditation;
2. Completion of self evaluation of the training program using an EIA-developed guide;
3. Demonstrated improvement in the training program; and
4. On-site evaluation by an EIA accreditation team.

The goal of an accreditation process would be to assure that training programs were equipped to produce the numbers of qualified work-ready, entry-level electronics technicians that the industry needs. Accreditation would create an incentive for programs to improve and the evaluation process would assure that the training program had the appropriate facilities, administrative structure, and curriculum to conduct such training and that training materials adequately addressed the five categories of skill standards contained in the manual *Raising the Standard*: desirable behavior and work habits, technical skills, test equipment and tools, basic and practical skills, and additional skills. The training program also would be evaluated on the following factors:

- Student selection and admissions process;
- Employment or continuing education success rate of program graduates;
- Existing procedures for student feedback;
- Procedures available for use by the evaluation team to gather feedback on the program from graduates and employers of graduates;
- Adequacy of training facilities and resources;
- Faculty competency: instructors' knowledge of the field and training experience;
- Availability and type of in-service training for staff instructors;
- Existence and adequacy of written program policies;
- Existence and use of an industry advisory body to guide the program;
- On-the-job or other "real world" training opportunities for students;
- Record-keeping procedures to document student plans, records, and performance; and
- Cooperative agreements with other training programs.

Programs successfully meeting the evaluation criteria would be accredited by EIA for a 5-year period. However, training program administrators would be required to notify EIA of changes in curriculum, staff instructors, or available resources or of relocation of facilities so that affected elements of the program could be re-evaluated. In such cases, re-evaluation would occur in fewer than 5 years. Failure to report such changes could result in the loss of accreditation.

Option B: Entry-Level Technician Certification Examination

This proposed program option would provide notification to the prospective employer that a job applicant had passed an industry-developed certification examination for entry-level electronics technician based on the requirements of the EIA-ratified skill standards.

The goal of a certification program would provide an objective means of evaluating whether a program graduate or job applicant possessed the technical, basic, and practical knowledge required of an entry-level electronics technician and his or her ability to troubleshoot circuits and to use test equipment. Individuals wishing to become certified under this program would take a two-part examination normally within 6 months prior to applying for their initial employment. Students would be tested for mastery of two general areas and their corresponding subsets. Each area and each of the technical skill subsets would be scored on a pass/fail basis. A simulation program such as "Electronic Work Bench" would be used to determine the examinee's ability to troubleshoot, use test equipment, and repair faulty circuits.

1. Technical Skills

- AC and DC circuits;
- Discrete solid-state devices and analog circuits;
- Digital circuits;
- Microprocessors;
- Microcomputers;
- Troubleshooting and using test equipment

It is anticipated the technical skills test would take approximately 4 hours to complete.

2. Technical Fundamentals

- Literacy in technical reasoning, writing, and computer use (using a computer-based test);
- Literacy in reading technical materials and using technical resources; and
- Technical math fundamentals I - basic.
- Optional: Technical math fundamentals II - advanced.

It is anticipated the technical fundamentals test would take approximately 2 hours to complete.

Although advanced professional certification programs may be developed as part of this project later on, it is assumed that they would be available only for experienced and specialized electronics technicians.

Option C: Education Portfolio

This proposed program option would provide a prospective employer a portfolio containing detailed information on a job applicant's educational achievements.

The goal of creating a standardized education portfolio would be to give prospective employers adequate and comparable background information on all job applicants' abilities to perform as entry-level electronics technicians. Developed in collaboration with industry-based and education-based training programs, the portfolio would contain the following:

1. A resume outlining educational achievements, any work experience, and short- and long-term career goals.

2. Documentation of awards or special commendations received for outstanding performance or achievement in a training program.

3. A checklist, initialed by appropriate instructors, verifying the applicant's demonstrated competency in meeting each of the technical requirements outlined in the skill standards manual: desirable behavior and work habits, mastery of technical skills, mastery of use of test equipment and tools, mastery of basic and practical skills, and mastery of additional skills.

4. References, including letters from instructors, employers, or others (excluding family members) with knowledge of the applicant's capabilities and personal attributes.

5. Examples of written work such as lab sheets, a lab notebook, or exams.

6. Other items an employer might find useful in making hiring decisions.

Option D: Work Experience Portfolio

This proposed program option would provide a prospective employer a portfolio containing detailed information on the applicant's experience in a school-to-work program, internship, apprenticeship, or other on-the-job training opportunity.

The goal of creating a work experience portfolio would be to give prospective employers adequate background information on a job applicant's practical experience as a work-ready electronics technician. Developed by the applicant from materials compiled during employment or apprenticeship, internship, or on-the-job training, the portfolio would contain the following:

1. A resume outlining work experience and its value and short- and long-term goals.

2. Documentation of awards or letters of commendation received as a result of on-the-job performance.

3. References, including letters from supervisors or others providing on-the-job performance evaluation.

4. Copies of written work evaluations documenting work habits and interpersonal skills, technical competency, troubleshooting skills, and soldering and other manual skills.

5. Examples of written work the applicant developed or contributed to such as lab notebooks, memos, or reports.

6. Other items that an employer might find useful in making hiring decisions.

EIA/EIF NATIONAL SKILL STANDARDS DEVELOPMENT PROJECT

ACCREDITATION/CERTIFICATION CONSIDERATIONS: RATING FORM

To the respondent: Please review each of the four accreditation/certification program options accompanying this rating form and complete and return this form. Thank you.

1. Evaluating Skill Qualifications of Job Applicants

Rate the importance of each program for its potential to help you evaluate a job applicant's skill qualifications for a work-ready, entry-level electronics technician's position. Use the following scale: (1) Not Important; (2) Somewhat Important; (3) Important; (4) Very Important.

_____ Option A: EIA-Accredited Electronics Technician Training Program

_____ Option B: Entry-Level Technician's Certification Examination

_____ Option C: Education Portfolio

_____ Option D: Work Experience Portfolio

2. Program Preference

In order of preference, rank each of the program options from four to one, with four being the most preferred and one being the least preferred.

_____ Option A: EIA-Accredited Electronics Technician Training Program

_____ Option B: Entry-Level Technician's Certification Examination

_____ Option C: Education Portfolio

_____ Option D: Work Experience Portfolio

3. Single or multiple options.

If you prefer a combination of options instead of a single option, please list the combined options below using the letter designations.

Combination of Options (by letter)_____

Name_____ **Title**_____

Company_____

Business interest (e.g., consumer products, industrial, telecommunications):

_____

Number of company employees _____ **Number of electronic technicians employed**_____

PLEASE RETURN BY AUGUST 11

Mail or Fax to Irv Kaplan, EIF, 919 18th St., NW, Suite 900, Washington, D.C. 20006
Fax: 202/955-5837

Appendix C

TECHNICAL COMMITTEE MEMBERSHIP

Mr. Mike Bir
Hewlett Packard
11311 Chinden Boulevard
Boise, ID 83714
208/396-2355
FAX 208/396-6859

Mr. William E. Boss
Senior Project Consultant
8403 Swan's Way
Indianapolis, IN 46260
317/251-2511
FAX 317/251-5314

Mr. Mike Brooks
Director, Technical Service
Philips Consumer Electronics
P.O. Box 555
Old Andrew Johnson Hwy
Jefferson City, TN 37760
615/475-0426
FAX 615/475-0475

Mr. Steve Chisom
Director of Remanufacturing
Cobra Electronics Corporation
6500 West Cortland St.
Chicago, IL 60635
312/889-8870
FAX 312/622-4913

Dr. Don Eshelby
Director of Program Services
Idaho Division of Vocational Education
650 W. State Street
Boise, Idaho 83720-0095
208/334-3216
FAX 208/334-2365

Mr. Paul Evans
Supervisor, Electronic Technical Support
Lockheed Idaho Technologies Co.
P.O. Box 1625, MS 2095
1955 Fremont Avenue
Idaho Falls, ID 83415-2095
208/525-0567
FAX 208/525-0576

Mr. Perc A. Everitt
Manager of Compensation
Martin Marietta Corporation
6801 Rockledge Drive
Bethesda, MD 20817
301/897-6231
FAX 301/897-6083

Ms. Elizabeth Frey
Training Administrator
ENI
100 Highpower Road
Rochester, NY 14623
716/427-8300 716/292-7413
FAX 716/427-7839

Mr. Merrill Frost
Automotive Coordinator
IAM&AW
9000 Machinist Place
Upper Marlboro, MD 20772
301/967-4556
FAX 301/967-4591

Mr. Tim Frye
Indirect Manager, Training and Development
Motorola, Inc.
1301 East Algonquin Road
Room 4348
Schaumburg, IL 60196
708/616-5037
FAX 708/538-3432

Mr. Tom H. Graff
Manager, Product Support & Technical Training
Thomson Consumer Electronics
Mail Stop INH100
P.O. Box 1976 (zip code 46206-1976)
10330 N. Meridian Street
Indianapolis, IN 46290-1024
317/587-3968
FAX 317/587-6773

Mr. Mel Gilson
Part Sales Administration
Zenith Electronics Corporation
1900 N. Austin Ave.
Chicago, IL 60639
312/745-2000
FAX 312/745-5171

Mr. Don Hatton
Vice President, Product Services
Consumer Electronics Group
Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201
703/907-7633
FAX 703/841-0030

Mr. Emmanuel E. Henry
Technical Support Manager
Technical Services Division
Matsushita Services Company
50 Meadowland Pkwy., Panazip: 2B-6
Secaucus, NJ 07094
201/392-6021
FAX 1-800/348-7315

Dr. Chuck Hopkins
Assistant State Director for Supportive Services
Oklahoma Department of Vocational and Technical Education
1500 West 7th Ave.
Stillwater, OK 74074
405/743-5432
FAX 405/743-5541

Mr. Paul E. Hurst
Director, Customer Service Division
Goldstar Electronics Intl. Inc.
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
201/816-2033
FAX 201/816-2177

Mr. Dennis Machesky
Senior Regional Instructor for the Chicago Region
Sony Electronics Inc.
7540 Caldwell Avenue
Niles, IL 60648
708/647-3006
FAX 708/647-3030

Dr. William H. Mast
P.O. Box 2025
Boone, NC 28607-2025
704/262-6352
FAX 704/262-6312

Overnight Mail:
Appalachian State University
Department of Technology
Boone, NC 28607

Mr. Terrance Miller
Vice President
Kenwood Service Corporation
2201 E. Dominquez Street
P.O. Box 22745
Long Beach, CA 90810-5745
310/761-8296
FAX 310/609-2127

Mr. Ed Nevins
General Manager
JVC Service and Engineering Co.
107 Little Falls Rd.
Fairfield, NJ 07004
201/808-6507
FAX 201/808-1370

Mr. Bill Perkins
Curriculum Coordinator
ITT Educational Services
5975 Castle Creek Parkway
North Drive
P.O. Box 50466
Indianapolis, IN 46250
317/594-4363
FAX 317/594-4284

Elmer Poe, Ph.D.
209 Lawson Road
Washington, NC 27889
Office: 919/328-6705, 919/328-4861
Home: 919/975-2291
FAX 919/328-4250

Mr. Robert Sawyer
Manager, Field Product Support
Zenith Electronics Corporation
1900 N. Austin Ave.
Chicago, IL 60639
312/745-2000
FAX 312/745-5258

Mr. Walt Seymour
Staff Director, Product Services
Consumer Electronics Group
Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201
703/907-7659
FAX 703/841-0030

Ms. Doris Sharkey
Curriculum Management Specialist
Curriculum Management System
Maryland State Department of Education
Division of Career Technology & Adult Learning
200 West Baltimore Street
Baltimore, MD 21201
410/767-0172
FAX 410/333-2099

Ms. Pam Skarda
Workforce Development Specialist
Career Colleges Association
750 First Street, N.E.
Suite 900
Washington, DC 20001
202/336-6768
FAX 202/336-6828

Mr. Joe Sloop
Route 2
Box 168
Ararat, VA 24053
Home 703/251-5753
Work 910/386-8121
FAX 910/386-8951

Ms. Marian Stamos
V.P., Major Appliances
Association of Home Appliance
Manufacturers (AHAM)
20 North Wacker Drive
Chicago, Il 60606
312/984-5800 X344
FAX 312/984-5823

Mr. Robert Throop
National Director of Education
ITT Educational Services
5975 Castle Creek Parkway
North Drive
P.O. Box 50466
Indianapolis, IN 46250
317/594-4363
FAX 317/594-4284

Dr. Peter Tom
Senior Instructional Designer
Sharp Electronics Corporation
Box DD, Sharp Plaza
Mahwah, NJ 07430
201/529-9644
FAX 201/512-2016

Ms. Gloria Whitman
National Association of State
Vocational Technical Education
Foundations
444 North Capitol St., Suite 830
Washington, D.C. 20001
202/737-0303
FAX 202/737-1106