A STUDY OF THE SKILLS AND KNOWLEDGE REQUIRED OF PLASTICS EMPLOYEES IN THE DALLAS METROPOLITAN AREA

THESIS

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

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The primary purpose of this study was to identify the skills and knowledge required of employees in the plastics industry in the Dallas Metropolitan area. An instrument was utilized to obtain data in order to identify various skills and knowledge.

This study was limited to fifteen instruments returned by fifteen participating firms in the Dallas Metropolitan area.

A comparison was made of the industrial arts plastics course offerings in the Dallas Metropolitan area schools with the requirements of the plastic industry in order to ascertain the degree of importance the course offerings were to the plastics industry.

The data gathered through the use of the instruments revealed the following findings.

1. Fifteen firms in the Dallas Metropolitan area had a total of 603 employees.

2. Age did not appear to be a crucial factor in the employment requirements.

3. The educational requirements for personnel seeking
employment in the plastics industry varied with the particular type job skills.

4. The knowledge of plastics fundamentals, equipment, and machinery required by each participating firm varied with the type of production of each firm.

5. The importance of specific subject matter areas to the plastics industry varied with the job assignment difference and the nature of work performed.

6. Prospective employees had to have a working knowledge of general shop practices including blueprint reading, basic plastics work, techniques of precision measurement, and the use of basic tools.

7. The projected per cent of increase in employment was expected to double within the next three years.

8. No real admission tests were administered to prospective employees.

9. There was a shortage of employees in the plastics industry in the Dallas Metropolitan area, and, therefore, employment opportunities existed.

10. Persons having taken plastics courses in high school appeared to be preferred for employment.

11. Some type of in-service training programs were utilized by all of the participating firms.

The following conclusions are based on the findings of the study.
1. The shortage of employees in the plastics industry may be due to the community's unawareness of the job opportunities that exist presently and in the future.

2. High school graduates being preferred for employment by most plastics firms may have been due to the broad range of job skills they are capable of being trained to perform.

3. The increase in demands for technicians, engineers, and skilled workers may foster the need for admission tests in various areas of the plastics industry.

4. The industrial arts courses in the area of plastics, like many other courses in general education, cannot meet in every detail the exact requirements set by the various areas of the industrial market.

5. In-service programs, and the extent of these programs, depend on the skills and knowledge already obtained by prospective employees.

The following recommendations are made in view of the findings and conclusions of the study.

1. Revision in industrial arts plastics curriculum should be made at least every three years to keep abreast of the rapid changes in the plastics industry.

2. Opportunities for employment in the plastics industry should be stressed in the schools and community.

3. Students should be encouraged to take industrial arts plastics courses in the high schools.
4. In programs designed to explore plastics, some degree of emphasis should be placed upon working from blueprints.

5. Similar studies should be conducted in other occupational areas.

6. Future studies should be conducted periodically in order to maintain up-to-date information for use in revising plastics curriculums.
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CHAPTER I

INTRODUCTION

Plastics, in modern industry terminology, are synthetic materials that are capable of being formed into usable products by heating, molding, and similar processes. The term is derived from the Greek word Plastikos, meaning "to form." By some interpretations of the word, rubber and other natural products are sometimes said to be plastics. However, the modern definition, in relationship to industry, excludes rubber and other natural products such as wood, leather, and metals (8).

The use of plastics products began slowly in the last half of the nineteenth century. They are presently used for a wide variety of purposes, such as the manufacturing of automobile parts, toys, cabinets, housewares, wall and floor covering, containers, cases, military armor, and furniture.

The role of plastics in today's industry is a tremendous one. Many of the traditional constructional materials, which have served and will continue to serve many useful purposes, suffer from certain disadvantages. Iron and steel will rust and corrode when exposed to industrial fumes and gasses present in the atmosphere, or when in
contact with liquids containing acids or alkalies. Wood may be damaged by fungus or rot and in certain exposed positions requires periodic painting for protection. In plastics, there is a class of material with collective properties not possessed by any other material found in nature. Products made of plastics do not rust or decay. They are free from attacks by insects and are not affected by moisture, oils, acids and alkalies (5).

Since plastics are becoming more and more deeply involved in all types of manufacturing, job requirement, along with personnel requirements, are changing. The greatest attention-getter in today's plastics industry is the shortage of qualified personnel needed to bridge the gap between supply and demand. While the use of plastics is increasing at a remarkable rate, the availability of trained personnel needed to work is decreasing at an alarming rate, and a formal source of supply is practically non-existent (10, p. 7).

Statement of the Problem

This study was designed to identify the skills and knowledge required of workers employed in the plastics industry in the Dallas Metropolitan area. In order to arrive at a probable solution to the problem, it was necessary to answer the following questions:
1. Is previous experience required of a prospective employee?
2. What are the maximum, minimum and preferred ages of prospective employees?
3. What are the educational requirements of prospective employees?
4. Is certification or licensing required for employment?
5. What knowledge of machinery is required of prospective employees?
6. How important is specific subject matter to the plastics industry?
7. What general shop practices are required of prospective employees?
8. What are the present and future opportunities in the plastics industry in the Dallas Metropolitan area?
9. What are the anticipated needs in employment in the job classifications within the next three years?
10. Are admission tests required of prospective employees?
11. How much emphasis is placed on personal interviews?
12. What is the content of the plastics curriculum in the Dallas Metropolitan area high schools?
13. How do the course offerings compare to the requirements of the participating firms?

It is believed that the result of this study will provide pertinent and current information that may be helpful in developing criteria for evaluating and revising industrial arts courses in the area of plastics.

Method of Procedure

In seeking answers to the questions stated in the statement of the problem, the following procedures were followed:

A list of all plastics firms in the Dallas Metropolitan area was prepared from the following sources:

1. Society of Plastic Engineers Report (10)
2. Greater Dallas Telephone Directory (7)
3. Dallas Metropolitan Area Directory of Manufacturers (4)

An instrument was designed to seek answers to the questions asked in stating the problem. The instrument, along with a letter of explanation, was mailed to forty plastics firms in the Dallas Metropolitan area. Some of the letters were returned due to various reasons such as "gone out of business," "lack of interest," and "not in the production aspects of the plastics industry." Fifteen of the forty firms completed and returned the instruments.
The compiled data are presented in tabular form to further explain their meaning.

Source of Data

The data used in this study were obtained from the instruments that were returned by the fifteen participating firms in the Dallas Metropolitan area. Also, previous research was utilized to lend strength to the study. Information was obtained from literature and books.

Limitations of the Study

This study was limited to the fifteen instruments returned by the participating firms in the Dallas Metropolitan area and their responses to the information requested.

The comparison of the industrial arts plastics curriculum to the requirements of the plastics industry was limited to the Dallas Metropolitan area firms and high schools.

A further limitation was made to the job classifications of plastics employees as categorized in the Dictionary of Occupational Titles (13). They are as follows:

777.844 Plastics molder
754.381 Plastics lay-up man
754.381 Plastics bench mechanic
763.884 Plastics top assembler
554.702 Plastics spreading-machine operator
556.782 Thermoforming machine operator
601.280 Die-cast and plastics-mold maker
556.884 Injection molding machine tender
754.884 Caster
520.782 Extruder operator
556.780 Die setter
556.887 Mold parter
556.783 Rotational molding machine operator
754.381 Fabricator
754.381 Inspector
712.884 Packer
554.886 Finisher
736.381 Processor
559.587 Quality control

Definition of Terms

The following terms are defined to keep ambiguity to a minimum in this study:

Curriculum, as used in this study, refers to the total offerings in the area of plastics provided by the high school in the Metropolitan area.

Industrial Arts refers to that phrase of general education which provides opportunities for students, both
boys and girls, to explore the materials, tools, and processes of industry (11).

Plastics are synthetic materials that are capable of being formed into usable products by heating, milling, molding and similar processes (5).

Skills and Knowledge refers to the competence in the application of the principles and concepts of plastics work and the use of certain tools, equipment, and machinery.

The Dallas Metropolitan Area refers to the city of Dallas and the surrounding area of the city (4).

Plastics molder is one who constructs plastics segments of mannequins and display forms, using molds, liquid plastics and glass-fiber cloth (13).

Plastics lay-up man is one who casts plastics reproductions of molds, patterns and prototypes (13).

Plastics bench mechanic is one who fabricates and repairs parts made of plastics (13).

Plastics top assembler is one who stacks sheets of glue-coated plywood, fiberglass, fiberboard and plastics sheets in specified sequence for pressing into laminated tops for furniture (13).

Plastics spreading-machine operator is an employee who operates machinery which spreads synthetic resin and glass fiber over continuous sheets of plastics film to prepare material for subsequent molding (13).
Die-cast and plastics-mold maker lays out, machines, fits, assembles, and finishes parts to make and repair dies for die casting of metal molds for injection and compression molding of plastics products (13).

Injection molding machine tender sets up and operates injection-molding machines to cast products for thermoplastics materials (13).

Extruder operator sets up and operates machines to handle thermoplastics materials to form tubes, rods, and films according to specifications (13).

Die setter is one who sets up and adjusts compression, injection, or transfer machines to mold plastics materials to specified shapes (13).

Quality-control tester is one who tests plastics materials to grade them for conformance to quality standards (13).

Processor supervises and coordinates activities of workers engaged in preparing chemical solutions that can be used to produce certain plastics materials (13).

Fabricator constructs articles according to blueprint specifications (13).

Presser is the title given to an employee who presses plastics materials over or into molds to form objects (13).

Inspector tests and checks plastics sheets, rods, tubes, powders or fabricated articles for uniformity of
color, surface defects, hardiness and dimensional accuracy (13).

Related Studies

Research revealed that several studies have been completed and are related to this study. A brief description of these studies and their results follows:

Weid's (15) study concerned itself with the job opportunities and requirements for female employees in the electronics industry in the Dallas Metropolitan area. The data presented were collected from information supplied by the industries and agencies in the Dallas Metropolitan area. The data indicated that employment opportunities for female employees in electronics were increasing more rapidly than the number of workers being trained for positions. Weid recommended that young women be encouraged to take electricity-electronics courses in high school. He further recommended that high schools should foster an awareness of the opportunities in electronics industry for women and that other occupational fields for women be investigated.

Turner (12) conducted a study of the duties and requirements of personnel who work with electronic devices in the manufacturing industries in St. Louis and St. Charles counties in Missouri, and in Madison and St. Clair counties in
Illinois. This study indicated that employment opportunities would double within the next three years.

In a study made by Warner (14), it was found that a situation existed where there was an imbalance between employment and training opportunities. The suggested procedure was to survey the opportunities for employment and in some areas reduce the training programs, as there would be an over amount of workers with no employment available to them. It was further suggested that industry and training should coordinate their efforts toward a balance in job skills and availability of employment.

Bodine's (2) study referred to the employment requirements for prospective technicians in selected industries in Pittsburg, Kansas. The study indicated that the prospective technician needed to have a high school education involving knowledge of tools, materials and processes of industry related to the particular job function.

Craghead (3) conducted a study of the knowledge and skills required of draftsmen in the manufacturing and non-manufacturing firms in the Dallas-Fort Worth area. This study indicated that most of the draftsmen at some time or another participated in the actual design of products. A further indication of this study was that the employment demands for training draftsmen were steadily increasing.
Slaughter (9) conducted a study of the knowledge and skills required of welders in the Dallas-Fort Worth area. His study indicated that opportunities did exist for a wide range age group of welders. He further indicated that young men, having taken welding courses in high school, had a better understanding of the welding industry and were satisfied with their work, and that welding courses offered in the public schools would be of benefit to young men as an introduction to a vocation upon graduation from high school.

Abney's (1) study was concerned with the availability of employees in the area of radio and television repair and electronics in the Dallas Metropolitan area. The purpose of his study was to determine what the requirements were for persons seeking employment in the commercial phase of salable skills in the consumer area of electronics technicians.

Mosby (7) conducted a study of the knowledge and skills required of machinists in the Dallas-Fort Worth area. The following recommendations were made in view of his findings. 1. Students should be encouraged to take metal-working courses in high schools. 2. In programs designed to explore metal working involving machines, emphasis should be placed on the understanding of skills involving the use of various machines. 3. Future studies, with specific regards
to the Dallas-Fort Worth area, be conducted periodically in order to maintain current and up-to-date information for use in reviewing and revising programs designed to explore the machinist's trade. 4. Emphasis should be placed upon learning to read working drawings and blueprints in programs designed to explore machine metal working.

Gier (5) conducted a study of the comparison of a junior college plastics curriculum in Dallas County and the requirements of the reinforced plastics industry in the Dallas-Fort Worth area. The following conclusions were drawn from the study. 1. It was apparent that the existing programs of the participating institution were adequately providing for the present needs of the local reinforced plastics industry. 2. An over supply of trained personnel was indicated by the informants in his study. 3. To make any material contribution, a local plastics program should offer training in reinforced plastics directly related to the individual needs of the manufacturers contacted in his study.

Organization of the Study

Chapter I of this study includes an introduction, statement of the problem, method of procedure, source of data, limitations of the study, definition of terms, related studies and organization of the study.
Presented in Chapter II are the qualifications and duties of plastics employees as indicated by fifteen participating firms.

Chapter III is devoted to the job opportunities for individuals seeking present and future employment in the plastics industry.

Chapter IV compares the industrial arts plastics curriculum with the requirements for employment in the plastics industry.

A summary, findings, conclusions and recommendations are presented in Chapter V.
CHAPTER BIBLIOGRAPHY


CHAPTER II

GENERAL QUALIFICATIONS REQUIRED

OF 603 EMPLOYEES IN FIFTEEN

PARTICIPATING FIRMS

The general qualifications required of plastics employees are presented in this chapter. The information presented was provided by the plastics firms in the Dallas Metropolitan area. Data were collected through the use of an instrument (see Appendix A) designed to obtain information from the participating firms concerning job qualifications with reference to previous work experience, age requirement, educational requirement, knowledge of equipment and machinery, importance of specific subject matter, general shop practices, job opportunities, types of tests for admission, and in-service training programs. The instrument was sent to forty firms engaged in the plastics industry. Fifteen, or 37.5 per cent, of these forty firms returned the instruments.

It is recognized that the data presented in this study are somewhat limited due to the number of firms participating. These firms ranged in size from the smallest which employed two persons to the largest which employed 198.
Qualifications of Prospective Employees

The qualifications, with reference to work experience, deemed necessary by the participating firms for prospective employees are presented in Table I. These data represent the number of firms, employees, and per cent of firms and employees.

As shown in Table I, one, or 6 per cent, of the firms indicated that it required previous on-the-job experience as a prerequisite for employment. This 6 per cent of the firms employed .8 per cent of the employees.

TABLE I

QUALIFICATIONS REQUIRED OF PROSPECTIVE EMPLOYEES
WITH REFERENCE TO PREVIOUS WORK EXPERIENCE

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Firms</th>
<th></th>
<th>Employees</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Firms requiring prospective employees to have prior work experience</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>.8</td>
</tr>
<tr>
<td>Firms desiring prospective employees to have prior work experience</td>
<td>7</td>
<td>47</td>
<td>355</td>
<td>56.0</td>
</tr>
<tr>
<td>Firms preferring prospective employees to have prior work experience</td>
<td>4</td>
<td>27</td>
<td>53</td>
<td>9.0</td>
</tr>
<tr>
<td>Firms not requiring previous work experience</td>
<td>3</td>
<td>20</td>
<td>210</td>
<td>34.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td>100</td>
<td>603</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Seven, or 47 per cent, of the firms which employed 56 per cent of the employees indicated that previous on-the-job experience was not desired. Four, or 7 per cent, of the firms which employed 9 per cent of the employees preferred that prospective employees have on-the-job experience, while 20 per cent of the firms indicated that it did not matter whether prospective employees had previous work experience.

Age Requirements

As indicated by the response of the fifteen participating firms in the Dallas Metropolitan area, age did not appear to be a crucial factor in the employment process. This was indicated by the wide range of age requirements according to minimum, maximum, and preferred ages. Table II indicates the age limit requirements as set by the fifteen participating firms.

Twelve, or 80 per cent, of the firms indicated that eighteen was the minimum age requirement for prospective employees. Ages of twenty through thirty were preferred by 87.3 per cent of the firms. Sixty per cent of the firms indicated that ages of forty through seventy were the maximum ages for employment.

Educational Requirements

The educational requirements for persons seeking employment in the plastics industry varied with the
TABLE II
AGE REQUIREMENTS OF 15 PLASTICS FIRMS IN THE DALLAS METROPOLITAN AREA

<table>
<thead>
<tr>
<th>Age</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Preferred</th>
<th>Per Cent of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td>Preferred</td>
<td>Minimum</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td></td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>12</td>
<td></td>
<td>80.0</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>3</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>3</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
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<td>24</td>
<td></td>
<td></td>
<td>1</td>
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</tr>
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<td>30</td>
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<td>1</td>
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<td>45</td>
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<td>2</td>
<td>1</td>
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<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

particular type job skills. Table III indicates the educational level prospective employees should have obtained in order to consider employment in the Dallas Metropolitan area as indicated by the participating firms.

The data presented in Table III are an indication that a definite level of education was not required
TABLE III

EDUCATIONAL REQUIREMENTS FOR PROSPECTIVE EMPLOYEES DESIRED BY THE PARTICIPATING FIRMS

<table>
<thead>
<tr>
<th>Educational Requirements</th>
<th>Number</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior high</td>
<td>2</td>
<td>13.4</td>
</tr>
<tr>
<td>High school (9-12)</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>High school graduates</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Vocational training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some college or university training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College or university graduates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No preference</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td>100.0</td>
</tr>
</tbody>
</table>

for persons seeking employment in the plastics industry. However, the importance of certain educational levels varied with certain firms. The firms with 100 or more employees stated that the basic requirements for prospective employees were that they be able to read and write and have knowledge of basic mathematics. Many of the participating firms indicated that high school graduates, having taken plastics courses in high school, were the most preferred. One firm stated that high school training in the area of
plastics was preferred, but the main item of importance was a desire to learn the necessary skills and procedures through on-the-job training.

The consensus of all the participating firms was that high school graduates were preferred. They were preferred because they can be trained to perform a broad range of job skills in less training time.

Certification Requirements

Eighty per cent of the firms participating in this study indicated no certification, or licensing, was required of prospective employees. The remaining 20 per cent required certification for employment in the highly skilled areas of the plastics industry. The types of certification required by these firms were in-plant certification programs in specialized areas and vocationally trained persons certified by vocational programs.

Required Knowledge of Plastics Fundamentals, Equipment, and Machinery

Many areas of industry have undergone new and revolutionary changes. The area of plastics is no exception. It has become necessary for personnel concerned with the plastics industry to become fully aware of the new skills and related information needed to keep abreast with the up-to-date operations and mastery of conventional equipment and machinery.
Table IV presents a list of machinery and equipment used by the participating firms. The number and per cent of firms desiring prospective employees to have knowledge of the machinery and equipment are also presented.

**TABLE IV**

**EQUIPMENT AND MACHINERY USED IN THE PLASTICS INDUSTRY AS INDICATED BY THE PARTICIPATING FIRMS**

<table>
<thead>
<tr>
<th>Equipment and Machinery</th>
<th>Firms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Extruder</td>
<td>4</td>
<td>26.6</td>
</tr>
<tr>
<td>Injection molding machine</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Thermoforming machine</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Plastics spreader</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Compression molder</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Drill press</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Band saw</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Jig saw</td>
<td>4</td>
<td>26.6</td>
</tr>
<tr>
<td>Circular saw</td>
<td>4</td>
<td>26.6</td>
</tr>
<tr>
<td>Jigs and fixtures</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Spray gun</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Grinder</td>
<td>4</td>
<td>26.6</td>
</tr>
<tr>
<td>Lathe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slitting machine</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Hydraulic press</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Overhead crane or hoist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jointer</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Test equipment</td>
<td>2</td>
<td>13.3</td>
</tr>
</tbody>
</table>
Due to the many areas of the plastics industry, no
certain machinery, or equipment, could be assigned to all
of the areas. The type of equipment and machinery used in
any one area depends entirely on what is produced by a
particular firm, and the knowledge of their operations could
be learned, in many instances, through on-the-job training.

Data in Table V reflects the importance of specified
related subject matter to the area of plastics as indicated
by the participating firms.

TABLE V
THE IMPORTANCE OF SPECIFIC SUBJECT MATTER AREAS
TO THE PLASTICS INDUSTRY AS INDICATED
BY THE PARTICIPATING FIRMS

<table>
<thead>
<tr>
<th>Areas of Study</th>
<th>Degree of Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Cent of Firms</td>
</tr>
<tr>
<td>Measuring instruments</td>
<td>5 33.3</td>
</tr>
<tr>
<td>Structural drafting and blueprint reading</td>
<td>5 33.3</td>
</tr>
<tr>
<td>Adding and subtracting fractions</td>
<td>3 20.0</td>
</tr>
<tr>
<td>Multiplication and division of whole numbers</td>
<td>5 33.3</td>
</tr>
</tbody>
</table>
As indicated by the data in Table V, the importance of different areas of subject matter varied with the different firms. These variations, according to the response of the participating firms, were due mainly to difference in job assignments and the nature of the work carried on by the individual firms.
In Table VI a list of general shop practices that were taught in the Dallas Metropolitan area schools plastics courses are presented. The number and per cent of firms requiring prospective employees to have knowledge of these practices are also shown in this table. Basic work in plastics was required by five, or 33.3 per cent, of the firms. Blueprint reading was required by one of the firms. Techniques of precision measurement were required by four, or 26.8 per cent, of the firms. The use of basic hand tools was required by 33.3 per cent of the firms. None of the firms indicated a requirement or need for basic drafting practices.

TABLE VI

GENERAL SHOP PRACTICES REQUIRED OF PROSPECTIVE EMPLOYEES IN THE DALLAS METROPOLITAN AREA AS INDICATED BY THE PARTICIPATING FIRMS

<table>
<thead>
<tr>
<th>General Shop Practices</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Basic drafting practices</td>
<td>. .</td>
</tr>
<tr>
<td>Blueprint reading</td>
<td>1</td>
</tr>
<tr>
<td>Basic plastics work</td>
<td>5</td>
</tr>
<tr>
<td>Techniques of precision measurement</td>
<td>4</td>
</tr>
<tr>
<td>Use of basic hand tools</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
</tr>
</tbody>
</table>
CHAPTER III

JOB OPPORTUNITIES FOR PERSONS SEEKING
EMPLOYMENT IN THE PLASTICS INDUSTRY

While the usage of plastics products is increasing at a remarkable rate, the availability of trained plastics engineers, technicians and skilled workers is decreasing at an alarming rate. A formal source of supply is practically non-existent. Industry statistics show that in-plant positions during 1960 have exceeded 20,000 openings. While this is impressive, it actually offers only a glimpse into the future of industry where new developments and expanding markets are commonplace. The shortage of qualified personnel today foretells an almost unlimited potential of future employment and opportunities (1).

Current and Future Employment Opportunities

This chapter is concerned with the current and future opportunities for employment in the plastics industry in the Dallas Metropolitan area. The information presented was taken from the specific job classifications as indicated by the participating firms. It is presented in Table VII, which shows the number of employees in each
<table>
<thead>
<tr>
<th>Job Classification</th>
<th>Present Employees</th>
<th>Three-year Projected Increase</th>
<th>Per Cent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bench mechanic</td>
<td>4</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>Extruder operator</td>
<td>53</td>
<td>227</td>
<td>330</td>
</tr>
<tr>
<td>Plastics molder</td>
<td>40</td>
<td>290</td>
<td>625</td>
</tr>
<tr>
<td>Lay-up man</td>
<td>45</td>
<td>360</td>
<td>700</td>
</tr>
<tr>
<td>Injection molding machine tender</td>
<td>63</td>
<td>98</td>
<td>55</td>
</tr>
<tr>
<td>Compression and transfer molder</td>
<td>2</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>Fabricator</td>
<td>5</td>
<td>13</td>
<td>250</td>
</tr>
<tr>
<td>Machinist</td>
<td>49</td>
<td>196</td>
<td>300</td>
</tr>
<tr>
<td>Top assembler</td>
<td>103</td>
<td>155</td>
<td>50</td>
</tr>
<tr>
<td>Thermoforming machine operator</td>
<td>99</td>
<td>722</td>
<td>629</td>
</tr>
<tr>
<td>Acrylic fabricator</td>
<td>20</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>Inspector</td>
<td>37</td>
<td>201</td>
<td>471</td>
</tr>
<tr>
<td>Die-cast and plastics-mold maker</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packers and finishers</td>
<td>29</td>
<td>87</td>
<td>200</td>
</tr>
<tr>
<td>Raw material processor</td>
<td>40</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Presser</td>
<td>4</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Quality control</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
specific job classifications and the projected per cent of increase within the next three years.

As indicated by the data presented in Table VII, an anticipated growth pattern in 47.0 per cent of the listed job classifications will more than double the existing facilities within the next three years.

No projected increase were indicated in the die-cast and plastics-mold maker and quality control job classifications. However, this does not necessarily mean that there is not a demand for future employment in these areas of the plastics industry. The die-cast and plastics-mold maker functions vitally to the success and growth of injection and compression-transfer operations. This particular job classification is directly attributed to skilled tool makers, machinists, and their source of replenishment (1).

The role automation is expected to play in many areas of the plastics industry in the future may very well be a cause for no increase in the listed areas. The rapid projected increase indicated in the other listed job classifications can be attributed to technological breakthroughs and new innovations in the plastics field.

Admission Tests

As reported by the participating firms, no real admission tests are administered to prospective employees.
However, all of the participating firms holds personal interviews. Physical examinations are required by two, or 13.3 per cent, of the firms.

The consensus of the firms was that due to the rapid growth of the plastics industry and the increase in demand for more highly skilled technicians and engineers, it is expected that some type of evaluation will be administered in the future.

In-Service Training Programs

Table VIII presents data concerning the number of firms that have in-service training programs. It was found that 73.3 per cent of the participating firms conducted on-the-job training programs. Another 13.3 per cent used classroom instruction as in-service training.

<table>
<thead>
<tr>
<th>Programs</th>
<th>Firms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>On-the-job training</td>
<td>11</td>
<td>73.3</td>
</tr>
<tr>
<td>Classroom instruction</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Tuition assisted programs</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Apprenticeship programs</td>
<td>2</td>
<td>13.3</td>
</tr>
</tbody>
</table>
Three of the firms, having an average of eighty or more employees, provided their employees with tuition assisted evening programs. Apprentice programs were utilized by 13.3 per cent of the total firms. No additional types of programs were specified by the participating firms.
CHAPTER IV

INDUSTRIAL ARTS PLASTICS CURRICULUM COMPARED TO THE REQUIREMENTS OF EMPLOYEES IN THE PLASTICS INDUSTRY

The information presented in this chapter makes a comparison of the courses offered in the Dallas Metropolitan area public schools with the requirements of employees in the plastics industry.

Curriculum Offering in the Dallas Metropolitan Area High Schools' Plastics Courses

Industrial arts is a general education subject area which is designed to prepare youth for effective living in an industrial society. Courses are based on technology and learning experiences which include work with common tools, materials, and industrial processes. Students are taught safe work habits, develop skills and pride in craftsmanship, develop new insights regarding American industry and learn to select and use products of industry. They also solve a variety of problems which require application of mathematics and communication skills as well as natural and social sciences concepts. Experiences gained in industrial arts provide a foundation for additional technological training (2, p. 140).
Plastics courses in industrial arts enable students to become involved in a young industry. They are designed to offer a basic foundation for the study of plastics.

The Texas Education Agency has described the plastics courses offered in the public schools as follows:

Industrial skills are developed by exploring each subdivision of the main process groups. Specific skills are developed by machine operation, by project construction and by development of tools for plastics work. Particular attention is given to the study of materials of the plastics industry. Particularly the classification structure and ingredients of plastics.

Safety instruction includes general laboratory safety, the proper handling of chemicals and the correct operations of machines.

General economics in handling and using plastics material is stressed so that students will develop an understanding of and appreciation for the efficient use of the plastics materials (3).

The course offerings in the area of plastics in the Dallas Metropolitan area schools are divided into two parts, Plastics 1 and 2. Plastics 1 is taught during the first semester of the school year. Plastics 2 is taught during the second semester. Both parts of the course are of a laboratory nature and are designed to provide students with practical experience with the materials of the plastics industry, safety regulations, the basic processes used in the plastics industry and the techniques of cutting,
finishing and fabricating. This course is not taught from a technical approach. It is offered to students in the tenth, eleventh, and twelfth grades, one hour per day, five days per week for thirty-six weeks.

The specific offerings of the plastics course, as stated by the Dallas Metropolitan area schools' curriculum, are as follows:

1. Identify, use and care of the common tools and machines related to industry.
2. Safety regulations of the plastics industry.
3. Classification of plastics.
5. Ingredients of plastics.
7. Members of the plastics family.
8. Basic groups or processes in the plastics industry (1).

Course Offerings Compared to the Requirements for Employment by the Participating Firms

The plastics curriculum offerings of the Dallas Metropolitan area schools as related to the requirements of industry are shown in Table IX. This comparison was made from data received from the participating firms indicating the degree of importance of each course offering according to the plastics industry requirements for employment.
<table>
<thead>
<tr>
<th>Course Offerings</th>
<th>VE*</th>
<th>Per Cent</th>
<th>D*</th>
<th>Per Cent</th>
<th>NE*</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification, use, and care of common tools</td>
<td>6</td>
<td>40.0</td>
<td>5</td>
<td>33.3</td>
<td>1</td>
<td>6.6</td>
</tr>
<tr>
<td>Identification and use of machines common to the plastics industry</td>
<td>2</td>
<td>13.3</td>
<td>10</td>
<td>66.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety regulations</td>
<td>5</td>
<td>33.3</td>
<td>7</td>
<td>46.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastics classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>60.0</td>
</tr>
<tr>
<td>Ingredients of plastics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Available forms of plastics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>46.6</td>
</tr>
<tr>
<td>Properties of plastics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>40.0</td>
</tr>
<tr>
<td>Members of the plastics family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>40.0</td>
</tr>
<tr>
<td>Proper use and care of machines</td>
<td>5</td>
<td>33.3</td>
<td>5</td>
<td>33.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic groups or processes</td>
<td>1</td>
<td>6.6</td>
<td>7</td>
<td>46.6</td>
<td>4</td>
<td>26.6</td>
</tr>
</tbody>
</table>

*"VE"--very essential, "D"--desirable, "NE"--non-essential.

Six, or 40 per cent, of the firms indicated that the identification, use, and care of common tools were very essential. Ten, or 66.6 per cent, of the firms indicated that the proper identification and use of common machines were desired of persons seeking employment. Rules of safety
were considered desirable by 46.6 per cent of the firms. Plastics classifications were desired by 60 per cent of the participating firms. Knowledge of the ingredients of plastics was not considered essential, but was desired by 20 per cent of the firms.

A working knowledge of available forms of plastics was considered desirable by 47 per cent of the firms. An almost equal number of firms indicated that this was not essential. Knowledge of chemical and physical properties of plastics was considered desirable by 40 per cent of the firms. Seven, or 46 per cent, of the firms indicated it was not essential to have knowledge of these properties of plastics. Basic groups, or processes, in the plastics industry were indicated as being essential by 6.6 per cent of the firms. Further indications by the participating firms were that these groups or processes could be learned through on-the-job training.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary purpose of this study was to identify the skills and knowledge required of employees in the plastics industry in the Dallas Metropolitan area. An instrument was utilized to obtain data in order to identify various skills and knowledge.

The instrument was sent to forty plastics firms in the Dallas Metropolitan area. Fifteen firms completed and returned the instruments, thereby stating their opinions of the skills and knowledge required of employees.

This study was limited to data collected by the instruments returned by the participating firms and their responses to the information requested. Further limitations were made to the Dallas Metropolitan area and the job classifications of plastics employees as categorized by the Dictionary of Occupational Titles (1).

A comparison of the industrial arts plastics course offerings in the Dallas Metropolitan area schools with the requirements by the plastics industry was made. This
comparison was made in order to ascertain the degree of importance the course offerings were to the plastics industry.

Findings

The data gathered through the use of the instrument revealed the skills and knowledge required of employees engaged in the plastics industry of the Dallas Metropolitan area. It is recognized that the data are somewhat limited due to the number of participating firms, and the following findings are based on the data gathered and interpreted.

1. Fifteen plastics firms in the Dallas Metropolitan area had a total of 603 employees. The number of employees ranged from two to 198.

2. Age did not seem to be a crucial factor in the employment requirements. The age requirements ranged from a minimum of eighteen to a maximum of sixty-five years.

3. The educational requirements for personnel seeking employment in the plastics industry varied with the particular type job skills.

4. The knowledge of plastics fundamentals, equipment, and machinery required by each participating firm varied with the type of production of each firm.

5. The importance of specific subject matter areas to the plastics industry, as indicated by the participating
firms, varied with the job assignment difference and the nature of work performed.

6. A working knowledge of the general shop practices that were required of potential employees are as follows: blueprint reading, basic plastics work, techniques of precision measurement and the use of basic tools.

7. The projected per cent of increase in employment is expected to double within the next three years.

8. No real admission tests were administered to prospective employees, but the consensus of the participating firms was that some type of admission test will be administered in the future.

9. There was a shortage of employees in the plastics industry in the Dallas Metropolitan area and employment opportunities did exist.

10. Persons having taken plastics courses in high school appeared to be preferred the most for employment.

11. Some type of in-service training program was utilized by all of the participating firms.

Conclusions

The following conclusions are based on the findings of the study.

1. The shortage of employees in the plastics industry may be due to the community's unawareness of the job opportunities that exist presently and in the future.
2. High school graduates' being preferred for employment by most plastics firms may have been due to the broad range of job skills they are capable of being trained to perform.

3. The increase in demand for technician, engineers, and skilled workers may foster the need for admission tests in the various areas of the plastics industry.

4. The industrial arts courses, like many other courses in general education, cannot meet in every detail the exact requirements set by the various areas of the industrial market.

5. In-service training programs, and the extent of these programs, depends on the skills and knowledge already obtained by prospective employees.

Recommendations

The following recommendations are made in view of the findings and conclusions of this study.

1. Revision in industrial arts plastics curriculum should be made at least every three years to keep abreast with the rapid changes in the plastics industry.

2. The opportunities for employment in the plastics industry should be stressed in the schools and community.

3. Students should be encouraged to take industrial arts courses in the area of plastics.
4. In programs designed to explore plastics, some degree of emphasis should be placed upon working from blueprints.

5. Similar studies should be conducted in other occupational areas.

6. Future studies in the area of plastics in the Dallas Metropolitan area should be conducted periodically in order to maintain current and up-to-date information for use in revising and reviewing programs designed to explore the area of plastics.

7. The data presented in this study should be used for revising course content in industrial arts plastics course offered in the public schools in the Dallas-metropolitan area.
APPENDIX A

INTRODUCTORY LETTER

Attention: Director of Personnel

Dear Sir:

At present, I am engaged in a master's degree program in Industrial Arts at North Texas State University. For my research problem, I am conducting a study to identify the skills and knowledge required of prospective and present employees in the plastics field in the Dallas Metropolitan area.

In order to complete the study, there is certain information needed from the various plastics companies throughout the Dallas Metropolitan area. I am soliciting your help in providing information on the enclosed instrument. Be assured that the information received will be presented in tabulated form, and you and your company will remain anonymous.

A stamped and self-addressed envelope is enclosed for your convenience. Your cooperation in this endeavor shall be greatly appreciated.

Sincerely,

Clarence Mack
APPENDIX B

INFORMATION INSTRUMENT

A STUDY OF THE SKILLS AND KNOWLEDGE REQUIRED OF PLASTICS EMPLOYEES IN THE DALLAS METROPOLITAN AREA

Directions: Please supply the information requested by checking the appropriate place or by filling in the blank and space provided.

Name of firm ____________________________________________

Principle products or type of products handled by your firm ____________________________________________

1. Please fill-in or check the following space as to:

   A. Number of employees in each job classification?

   B. What per cent of increase in employment, if any, is expected in each job classification within the next three years?

*Note: Please list other classifications not mentioned.

<table>
<thead>
<tr>
<th>Job Classifications</th>
<th>A. Number of employees</th>
<th>B. Per Cent increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part time</td>
<td>Full time</td>
</tr>
<tr>
<td>Plastics molder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lay-up man</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bench mechanic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top assembler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job Classifications</td>
<td>A. Number of employees</td>
<td>B. Per Cent increase</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>Part time</td>
<td>Full time</td>
</tr>
<tr>
<td>Spreading machine operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermoforming machine operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Die-cast-die-and-plastics mold maker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injection mold machine operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extruder operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Die setter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mold parter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotational molding machine operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabricator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finisher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality control tester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. What are the age requirements for persons employed by your firm?

<table>
<thead>
<tr>
<th>Part time</th>
<th>Full time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>Minimum</td>
</tr>
<tr>
<td>Maximum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Preferred</td>
<td>Preferred</td>
</tr>
</tbody>
</table>

3. Is certification required of a prospective employee in your firm?  Yes ______ No ______

4. What type of admission tests, if any, are administered to prospective employees?
   A. ( ) None
   B. ( ) Skill or performance test
INFORMATION INSTRUMENT--Continued

C. ( ) Practical test
D. ( ) Standardized test
E. ( ) Oral test
F. ( ) Physical examination

Please specify others not listed

G. ( ) __________________________
H. ( ) __________________________

5. What per cent of emphasis is placed on personal interviews in the selection of new employees?

( ) 0-25% ( ) 51-75%
( ) 26-50% ( ) 76-100%

6. Are in-service training programs conducted in your firm? Yes ( ) No ( ). If answer is yes, check the following as to the type of programs conducted.

A. ( ) On-the-job training program
B. ( ) Classroom instruction
C. ( ) Tuition assisted evening classes
D. ( ) Apprenticeship programs
E. Others (Please specify) __________________________

7. Is previous on-the-job experience a requirement for employment with your firm?

Yes ( ) No ( ) If answer is no, is previous experience:

A. Desired ( )
B. Preferred ( )
C. Does not matter ( )
8. Which of the following educational attainments does your firm require of a person entering the plastics trade?

A. ( ) Elementary
B. ( ) Junior high
C. High school
   Grade level:
   ( ) 10th
   ( ) 11th
   ( ) 12th
D. ( ) High school graduate
E. ( ) Vocational training
F. ( ) College or university
   ( ) one year
   ( ) two years
   ( ) three years
   ( ) four years
   ( ) graduate
G. Others (please specify)

9. Check the appropriate box to show the importance of the following subject matter to the employees you employ.
### INFORMATION INSTRUMENT—Continued

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Important</th>
<th>Necessary</th>
<th>Unnecessary</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Measuring instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Structural drafting and blueprint reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Adding and subtracting fractions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Multiplication and division of whole numbers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Multiplication and division of fractions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Basic trigonometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Plane geometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Chemistry and physical science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Basic plastics, materials and processes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Strength and stress of materials</td>
<td></td>
<td></td>
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<tr>
<td>K. Solid geometry</td>
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<tr>
<td>L. Shop and industry safety</td>
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<td>Others:</td>
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</tbody>
</table>


10. A knowledge of which of the following machines is required of a potential employee?

A. ( ) Extruder
B. ( ) Thermoforming machine
C. ( ) Injection molding machine
D. ( ) Plastics spreader
E. ( ) Compression molder
F. ( ) Drill press
G. ( ) Band saw
H. ( ) Buffer machine
I. ( ) Jig saw
J. ( ) Circular saw
K. ( ) Jigs and fixtures
L. ( ) Spray gun
M. ( ) Grinder
N. ( ) Wood lathe
O. ( ) Bending machine
P. ( ) Slitting machine
Q. ( ) Hydraulic press
R. ( ) Overhead crane or heavy duty hoist
S. ( ) Jointer

Others

T. ( ) ___________________________
U. ( ) ___________________________
V. ( ) ___________________________
INFORMATION INSTRUMENT--Continued

W. ( )

X. ( )

11. A knowledge of what type general shop practices is required by your firm of a prospective employee?
   A. ( ) Blueprint reading
   B. ( ) Basic drafting practices
   C. ( ) Basic plastics work
   D. ( ) Techniques of precision measurement
   E. ( ) Use of basic hand tools

   Others

   F. ( )

12. In your opinion, how essential are the following course offerings taken from the Dallas Metropolitan area's schools curricula in aiding prospective employees? Please indicate by checking the space provided.

<table>
<thead>
<tr>
<th>Course offerings</th>
<th>Essential</th>
<th>Desirable</th>
<th>Non-Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Identification, use and care of common tools related to the plastics industry</td>
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<tr>
<td>B. Identification and use of machines common to the plastics industry</td>
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<tr>
<td>C. Safety regulations of the plastics industry</td>
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</tbody>
</table>
### Course Offerings

<table>
<thead>
<tr>
<th>Course Offerings</th>
<th>Essential</th>
<th>Desirable</th>
<th>Non-Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Plastics classification</td>
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<td>E. Ingredients of plastics</td>
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<td>F. Available forms of plastics</td>
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<td>G. Properties of plastics</td>
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<tr>
<td>H. Plastics family members</td>
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<tr>
<td>I. Proper use and care of machines used in the plastics industry</td>
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<tr>
<td>J. Basic groups of processes in the plastics industry</td>
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</tbody>
</table>

**Note:** If you would like a copy of the results of this study, please list your name and address.
BIBLIOGRAPHY

Books


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Encyclopedia Articles

Public Documents


Texas Education Agency, Principles and Standards for Accrediting Elementary and Secondary Schools and Description of Approved Courses, Grades 7-12, Bulletin 615, Revised, Austin, Texas, 1971.


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