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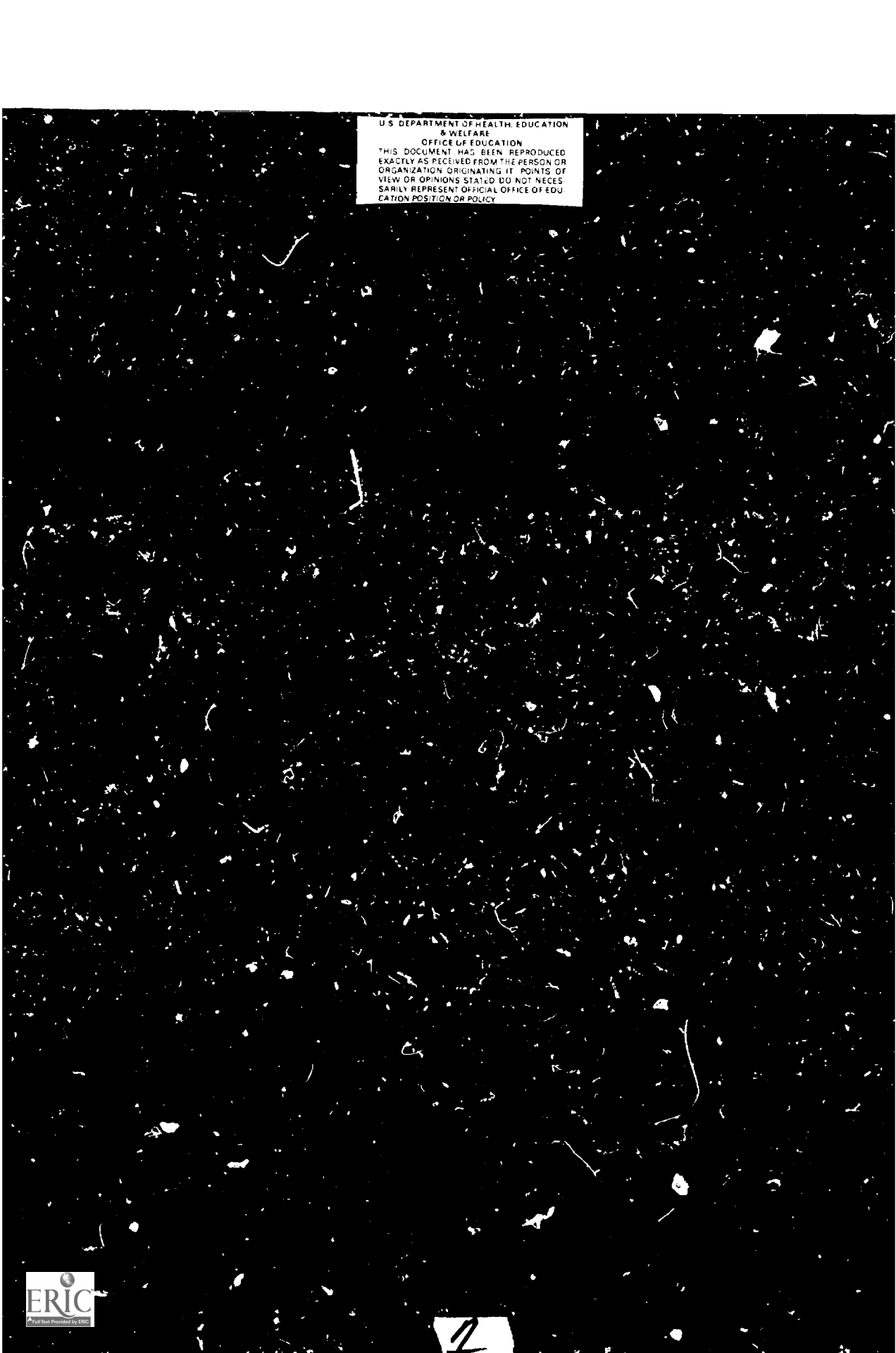
ABSTRACT

A study was conducted in the field of auto mechanics under a research grant from the Vocational Education Branch of the Iowa Department of Public Instruction to provide data necessary for future curriculum planning. Objectives included the analysis of the automotive repair field to determine jobs performed, the time spent in major areas, level of training expected, skills and competencies needed, and personal characteristics of mechanics. Thirty-four employees of franchised dealers and six representing the independent repair shops in the state of Iowa were surveyed by personal interviews. Personal data sheets were completed by the 242 automotive service personnel employed in the 40 shops. A 5-point rating scale was used to evaluate the data which is presented in tabular form. The findings indicate that 43 out of the 51 items listed under technical knowledge rated desirable or above, 63 percent of the service managers wanted to hire postsecondary trained mechanics, and of the major divisions, 27 percent of the work was devoted to engine work. It is recommended that this study be utilized in revising programs, and that early education and counseling be provided. (GEB)



JOB CHARACTERISTICS OF AUTOMOTIVE MECHANICS IN SELECTED IOWA DEALERSHIPS AND GARAGES

by

Jim L. Drost

PURPOSE OF THE STUDY

Senate File 550, enacted by the Sixty-First General Assembly of the State of Iowa, provided for the establishment of area vocational schools and community colleges, which were in turn reinforced by aid and assistance from the 1963 Vocational Education Act passed by the Federal Government. Consequently, with the state wide establishment of many new schools and programs, a critical need emerged concerning the development and planning of curriculums and meaningful course content that meets student and community needs. Due to the great diversity and variation of the programs being offered at the post-secondary level in Iowa in the automotive mechanics training programs and, after consultation with the area school automotive teachers, members of the Vocational Education Branch, Iowa State Department of Public Instruction, and Industrial Education faculty members at Iowa State University, it was ascertained that a study should be conducted in the field of automotive mechanics.

Quality educational programs depend on careful analysis and planning. This study was designed to provide data relevant to the automotive repair and service field, to provide facts and implications for future course content and curriculums in automotive mechanics training programs.

The objectives of this study were:

1. To analyze the automotive repair field to determine jobs performed by automotive mechanics.

2. To determine the proportion of time spent in major areas of the automotive repair field.

3. To determine the level of training expected of post-secondary program graduates.

4. To determine the skills and competencies expected in automotive mechanics.

5. To determine personal characteristics of mechanics surveyed.

Delimitations of the Study

This study was a survey that included dealerships suggested by the Iowa Auto Dealers Association, representing franchised dealers, and the Independent Garage Owners, representing the independent repair shops.

Various aspects of the automotive dealerships were surveyed to gather material which would be useful in the development of post-secondary educational programs in Iowa. Therefore, only dealerships located in Iowa were included. Businesses were included that offered general automotive service and repair. Auto body work was not included in the study. An attempt was made to select progressive businesses of all sizes distributed over the entire State of Iowa.

Definitions

The following definitions are basic to the understanding of the material presented in this study.

Automotive mechanic. A person with the necessary skill to diagnose, locate, and make needed repairs competently over a broad spectrum of auto service work, quickly and efficiently.

Service helper. An assistant mechanic, performs routine jobs and maintenance work.

Service manager. A person who oversees and manages the dealership service department. Must be good at administration, public relations, customer relations, building morale, and making men work as a team.

To service. Any action requiring checking, replacing, adjusting, or rebuilding to return the component or vehicle to useful service.

Funding

The research project was funded with a grant approved by the Iowa State Department of Public Instruction Vocational Education Branch, State Committee for Research, Demonstration, and Experiments. The proposal, presented to and approved by the committee on May 27, 1969, and ending Jul 31, 1970, included a list of proposed staff and estimated budget of expenditures, review of literature, objectives, method of procedure, and a time schedule of the proposed project.

METHOD OF PROCEDURE

The automobile dealerships and garages included in the study were selected by two state automotive associations in Iowa, the Iowa Auto Dealers Association (IADA), representing the franchised dealers, and the Independent Garage Owners Association (IGO), representing independent garages. Each association submitted a list of their most progressive members to cooperate in the study. The number submitted by each association was determined in proportion to the number of members in the state, as determined by Schumacher's study. The final population consisted of 6 IGO members and 34 IADA members. A letter of introduction and telephone calls were utilized to schedule the interviews. In the selection of the businesses, the associations were asked to select the most progressive businesses located in all sections of the state.

The instruments used in the collection of data consisted of a service manager interview schedule, an interview schedule for automotive mechanics and other service personnel, and a tally sheet listing the jobs performed by automotive mechanics and other service personnel. The instruments were developed by utilizing the information provided by various automotive curriculum outlines, automotive course guides, state plans, automotive textbooks, and consultation with industrial education faculty members, automotive mechanics, service managers, and area school automotive mechanics instructors. A letter was sent to all state departments of public instruction in the 50 states, to all major automobile manufacturers, and to any other source where the researcher thought information could be obtained. The instruments, upon completion, were pretested and revised before final printing and actual usage.

Data was collected using the personal interview technique, due to the type of information demanded by the study. The researcher felt the desired responses were much too long and were too great an imposition on the participants to expect valid results from a mailed questionnaire study design.

Information was collected from a total of forty businesses, with responses obtained from 40 service managers or owners and 242 automotive mechanics and other service personnel. In excess of 5000 service records were also drawn, for a total survey of 14,849 individual jobs performed by automotive mechanics and service personnel in the shops surveyed. The number of service records drawn at each business was determined by multiplying the number of automotive mechanics and service helpers employed by 24. This formula was determined from an estimate made before the study was initiated. Each of the two state automotive associations were asked to estimate the number of automotive mechanics and service helpers employed at each business. A postal card was sent to those businesses on which no information was available. From this information, it was determined that two service records per month for a 12-month span of time would yield sufficient data, hence 24 times the number of service personnel employed. A period of twelve months of time was used to insure that any trends in service work attributable to the season of the year would be adequately

accounted for. It was also felt by the researcher that automotive mechanics and service helpers would be the personnel contributing the items listed on the service records. Service records utilized in the collection of data were drawn from service files.

Further data was collected from individual interviews with personnel directly responsible for the servicing of automobiles. A qualified person, usually the service manager or owner, was interviewed for approximately one-half hour to gather information relative to the automotive servicing field. They were asked to use a five-point rating scale, ranging from one (very little importance) through five (essential) to rate the major items relative to the automotive field. Areas submitted to service managers for evaluation were the importance of personal characteristics and competencies, ability to use major equipment, importance of technical knowledge, and the importance of technical skills. Service managers were also asked to estimate the percentage of jobs each year that were completed in eleven major areas of automotive service and, further, how their specific shop serviced 17 specific automotive components. In addition, each automotive mechanic and service helper completed a personal data sheet to determine age, educational level, major responsibilities, specific training completed, and training desired in the future.

Upon the completion of all interviews, responses were totaled according to specific categories. Percentages or weighted arithmetic means were calculated for each where appropriate. Results were then reported in graphical or tabular form. The information was then presented to an advisory committee for interpretation and evaluation. The advisory committee was composed of representatives of education, automotive mechanics, and automotive management. A very careful attempt was made to select men who were knowledgeable and interested in the improvement of educational programs for automotive mechanics. The committee met formally on March 31, 1970, for a six-hour period of time to consider the data that had been collected. Prior to this, each committee member had received a copy of the information collected.

FINDINGS

The primary purpose of this study was to collect information concerning Iowa automotive mechanics and auto servicing industry relative to the development of quality educational programs to train automotive mechanics. To satisfy the proposed objectives of the study, information was presented in four sections: (1) personal characteristics of automotive mechanics surveyed, (2) information concerning the servicing of major automotive components, (3) information on knowledge, skills, and competencies desired in automotive mechanics, and (4) jobs performed by automotive mechanics.

Personal Characteristics of Automotive Mechanics Surveyed

General:

Data was obtained from 40 interviews conducted with service managers and owners of Iowa garages and dealerships, from personal data sheets completed by 242 service helpers and automotive mechanics employed in these shops, and from the compilation of results of drawing service records from service files. Cooperation with the project was generally excellent.

Each of the service department employees listed years of experience in the trade. Responses are summarized in Table 1. One hundred and thirty-seven men, or in excess of 50 percent, indicated less than 15 years of experience in the trade, with 78, or 32 percent, indicating six years of experience or less.

Table 1. Years of experience as an automotive mechanic or service man

Years of experience as a mechanic or service man	f	%
Less than 1	20	8
1-2	14	6
2-4	20	8
4-6	24	10
6-8	12	5
8-10	17	7
10-15	30	12.5
15-20	27	11
20-30	57	24
30-40	18	7.5
40+	3	1
Total	242	100.0

Respondents indicated the amount of education completed and additional training desired, if it were made available to them. Fifty-eight percent indicated a completion of at least four years of high school and only two percent had completed in excess of two years of college. Responses are summarized in Table 2.

Table 2. Educational level attained by automotive mechanics surveyed in Iowa

Highest grade completed	f	%
7	3	1
8	27	11
9	13	4
10	23	10
11	16	7
12	140	58
13	7	3
14	9	4
15	1	.5
16	1	.5
Over	2	1
Total	242	100.0

Table 3 reveals the formal training received by the 242 men surveyed. Three sources of training appeared to have been utilized most by the service personnel employed in the businesses before actual entry into the trade. These were the military, high school automotive programs, and trade school automotive programs.

Table 3. Months of training received specifically related to automotive mechanics as reported by 242 mechanics and service personnel

	Type of Training							
Months	High school	ACC AVC	Trade school	College University	Military	Correspondence	Company	Appre.
0-6	1	2	8	0	18	4	103	19
6-12	23	8	23	2	6	0	5	10
12-18	8	2	1	0	6	0	0	8
Over 18	1	0	0	1	17	1	2	10
Total	33	12	32	3	47	5	110	47

Service managers were asked, "If you did employ a graduate of a post-secondary automotive program, at what level would you expect him to enter your business?". Utilizing the data summarized in Table 4, 63.75 percent

indicated that they would prefer to employ the graduate as a general line mechanic, with an additional 25 percent utilizing him as a mechanics assistant.

Table 4. Desired entry level of post-secondary automotive program graduates

Entry level	f	%
General line mechanic	25.5	63.75
Mechanic's assistant	10.0	25.00
Specialist in one area	2.0	5.00
Lubrication man	1.5	3.75
Used car reconditioning man	1.0	2.50
Total	40.0	100.00

Information Concerning Major Service Areas and the Servicing of Major Automotive Components

Service managers estimated the total jobs completed each year in eleven major areas of automotive service, as recorded in Table 5. Values are listed as percentages. It should be evident to the reader that the service managers estimated total jobs completed each year and did not list total time spent. Few areas were estimated greater than 21 percent of the jobs completed. Most of the areas were in the range of one to ten percent, although general service work; alignment, suspension, balance; engine repair; carburetion; and electrical did rate several responses in the 11 to 20 percent column. No responses were listed as being greater than 60 percent in any one area. Only a few respondents indicated responses greater than 21 percent. Some of these large values were derived from two independent garages that specialized in tune-ups, brakes, and alignment work.

Table 5. Percentage of total jobs completed per year in major automotive areas as estimated by service managers

Major automotive areas	Percentages					Total
	0	1-10	11-20	21-40	41-60	
General service work	0.00	57.5	37.5	2.5	2.5	100.00
Carburetion	0.00	67.5	20.0	7.5	5.0	100.00
Electrical	0.00	67.5	17.5	10.0	5.0	100.00
Complete engine overhaul	5.00	92.5	2.5	00.0	0.0	100.00
Engine repair	5.00	67.5	25.0	2.5	0.0	100.00
Transmission	0.00	87.5	12.5	0.0	0.0	100.00
Drive shaft	12.5	87.5	00.0	00.0	0.0	100.00
Differential	12.5	87.5	00.0	00.0	0.0	100.00
Alignment, suspension, balance	00.0	67.5	27.5	2.5	2.5	100.00
Brakes	0.0	72.5	17.5	7.5	2.5	100.00
Accessories	2.5	92.5	5.0	0.0	0.0	100.00

Service managers evaluated how 17 major automotive components were serviced in their specific shops. Each service manager listed for each of 17 major automotive components the percentage of units (A) rebuilt in his own shop, (B) those sent out to speciality shops for rebuilding, (C) those purchased as new or rebuilt units, and (D) those replaced as used units from wrecking yards. Upon completion of all the interviews, data were grouped into the appropriate percentage ranges listed in the left hand column of the table.

In interpreting the data, the reader should bear in mind that a high frequency of responses in the lower percentage ranges indicates this specific method of servicing to be less frequent across the state, and, conversely, a high frequency in the higher percentage ranges indicates that this specific method of servicing to be more frequent.

The data in Table 6 reveal how engines were serviced in the 40 shops surveyed. A majority of the engines serviced were rebuilt in the dealer's own shop, with only a few being sent out to speciality shops for rebuilding. The data illustrate that 17.5 percent of the respondents indicated 61-100 percent of the engines needing rebuilding were replaced as new or rebuilt units. Very few dealers were utilizing used engines from auto wrecking yards.

Table 6. Percentage of engines serviced by four methods

Percentage of engines serviced	Methods							
	Rebuilt in own shop		Sent out to spec		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	11	27.5	36	90.0	22	55.0	36	90.0
21-40	3	7.5	1	2.5	7	17.5	1	2.5
41-60	6	15.0	2	5.0	4	10.0	1	2.5
61-80	12	30.0	1	2.5	3	7.5	2	5.0
81-100	8	20.0	0	0.0	4	10.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Information recorded in Table 7 relates the methods of servicing engine heads. Forty-five percent, or almost one-half, reported 20 percent or less of the heads serviced were handled in their own shops. A small proportion of the total number were being sent out to speciality shops, few were being purchased as new or rebuilt units, and even a smaller number were being replaced with used units from the auto wrecking yard.

The data in Table 8 gives information relative to the servicing of auto engine blocks. Over one-half indicated that 20 percent or less of the blocks were serviced in their own shops, but a larger percentage were being replaced as new or rebuilt units. Few blocks were being replaced

Table 7. Percentage of engine heads serviced by four methods

Percentage of engine heads serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	18	45.0	31	77.5	19	47.5	37	92.5
21-40	1	2.5	2	7.5	10	25.0	0	0.0
41-60	4	10.0	2	5.0	3	7.5	1	2.5
61-80	9	22.5	2	5.0	5	12.5	1	2.5
81-100	8	20.0	2	5.0	3	7.5	1	2.5
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 8. Percentage of engine blocks serviced by four methods

Percentage of engine blocks serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	24	60.0	30	75.0	17	42.5	35	87.5
21-40	3	7.5	3	7.5	6	15.0	0	0.0
41-60	4	10.0	2	5.0	2	5.0	3	7.5
61-80	3	7.5	3	7.5	11	27.5	0	0.0
81-100	6	15.0	2	5.0	4	10.0	2	5.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

with used units. This might indicate a trend toward short block installation.

Table 9 summarizes the data relative to the servicing of carburetors. Forty-seven and five-tenths percent reported in excess of 80 percent of the carburetors as being rebuilt in their own shops, and other 35 percent indicated 61 to 80 percent fell in this category. It was unanimous that very few were sent out to speciality shops for rebuilding, few were replaced as new or rebuilt units, and even less were replaced with used units from a wrecking yard.

Information is listed in Table 10 concerning fuel pump servicing. Few fuel pumps were being rebuilt, very few were sent out to speciality shops for rebuilding, and a small number were replaced with used units from auto wrecking yards. A majority were replaced with a new or rebuilt unit; 34 respondents indicated that over 60 percent of the fuel pumps were serviced in this manner.

Table 9. Percentage of carburetors serviced by four methods

Percentage of carburetors serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	1	2.5	40	100.0	32	80.0	40	100.0
21-40	0	0.0	0	0.0	3	7.5	0	0.0
41-60	6	15.0	0	0.0	4	10.0	0	0.0
61-80	14	35.0	0	0.0	1	2.5	0	0.0
81-100	19	47.5	0	0.0	0	0.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 10. Percentage of fuel pumps serviced by four methods

Percentage of fuel pumps serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	31	77.5	40	100.0	3	7.5	39	97.5
21-40	4	10.0	0	0.0	1	2.5	0	0.0
41-60	3	7.5	0	0.0	2	5.0	0	0.0
61-80	2	5.0	0	0.0	11	27.5	0	0.0
81-100	0	0.0	0	0.0	23	57.5	1	2.5
Total	40	100.0	40	100.0	40	100.0	40	100.0

The next component surveyed was the distributor. From Table 11, it may be determined that very few distributors were being sent out to speciality shops for rebuilding or were being replaced with used units. Most other responses were rather evenly distributed over rebuilt in our own shop or replaced with new or rebuilt units.

Table 11. Percentage of distributors serviced by four methods

Percentage of distributors serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	8	20.0	40	100.0	22	55.0	40	100.0
21-40	2	5.0	0	0.0	6	15.0	0	0.0
41-60	8	20.0	0	0.0	4	10.0	0	0.0
61-80	6	15.0	0	0.0	4	10.0	0	0.0
81-100	16	40.0	0	0.0	4	10.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Utilizing data from Table 12 concerning starters, the reader can determine that few starters were sent out to speciality shops or were replaced with used units. Thirteen respondents indicated that approximately 50 percent were rebuilt in this own shops, with the other 27 respondents reporting values almost equally distributed over the entire range. Under the headings of replaced with new or rebuilt units, it might be noted that 32 service managers reported that 60 percent of the starters or less fit in this category.

Table 12. Percentage of starters serviced by four methods

Percentage of starters serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	8	20.0	38	95.0	15	37.5	38	95.0
21-40	4	10.0	0	0.0	6	15.0	2	5.0
41-60	13	32.5	0	0.0	11	27.5	0	0.0
61-80	8	20.0	1	2.5	6	15.0	0	0.0
81-100	7	12.5	1	2.5	2	5.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Data collected on generator servicing is recorded in Table 13. Sixty-seven and one-half percent indicated over 40 percent of the generators serviced were rebuilt in their own shops. Eight percent stated that 60 percent or less of the generators were replaced with new or rebuilt units. The categories of sent out to speciality shops and replaced with used units received very low values.

Table 13. Percentage of generators serviced by four methods

Percentage of generators serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	8	20.0	37	92.5	17	42.5	38	95.0
21-40	5	12.5	1	2.5	8	20.0	2	5.0
41-60	10	25.0	1	2.5	7	17.5	0	0.0
61-80	10	25.0	1	2.5	5	12.5	0	0.0
81-100	7	17.5	0	0.0	3	7.5	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Information relative to alternators is summarized in Table 14. The category of rebuilt in own shop contained values over the entire percentage range. Almost 50 percent stated 20 percent or less of the alternators were replaced with new or rebuilt units.

Table 14. Percentage of alternators serviced by four methods

Percentage of alternators serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	10	25.0	36	90.0	19	47.5	38	95.0
21-40	3	7.5	2	5.0	7	17.5	2	5.0
41-60	8	20.0	1	2.5	5	12.5	0	0.0
61-80	10	25.0	1	2.5	4	10.0	0	0.0
81-100	9	22.5	0	0.0	5	12.5	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Information relative to radiators is recorded in Table 15. In this case, 85 percent of the respondents indicated 20 percent or less of the radiators were rebuilt in their own shops. Seventy percent indicated 81 percent or more were sent out to speciality shops. Very few radiators were being replaced with new or rebuilt units or with used units from auto wrecking yards.

Table 15. Percentage of radiators serviced by four methods

Percentage of radiators serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	34	85.0	6	15.0	38	95.0	40	100.0
21-40	1	2.5	0	0.0	0	0.0	0	0.0
41-60	2	5.0	3	7.5	0	0.0	0	0.0
61-80	1	2.5	3	7.5	0	0.0	0	0.0
81-100	2	5.0	28	70.0	2	5.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Water pump servicing procedures are categorized in Table 16. Seventy-five percent of the respondents indicated that 20 percent or less of the water pumps serviced were rebuilt in their own shops. One hundred percent indicated less than 20 percent were being sent out to speciality shops or being replaced with used units. In this situation, most water pumps were replaced with new or rebuilt units. Thirty-three respondents indicated at least 61 percent of their water pump servicing problems fitted this category.

Clutch servicing procedures are revealed in Table 17. Few service managers indicated that they were sending clutches out to speciality shops for rebuilding or that they were replacing clutches with used ones from wrecking yards. Apparently, a majority were replacing clutches with new

Table 16. Percentage of water pumps serviced by four methods

Percentage of water pumps serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	30	75.0	40	100.0	0	0.0	40	100.0
21-40	4	10.0	0	0.0	2	5.0	0	0.0
41-60	5	12.5	0	0.0	5	12.5	0	0.0
61-80	1	2.5	0	0.0	11	27.5	0	0.0
81-100	0	0.0	0	0.0	22	55.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 17. Percentage of clutches serviced by four methods

Percentage of clutches serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	21	52.5	39	97.5	9	22.5	40	100.0
21-40	3	7.5	0	0.0	6	15.0	0	0.0
41-60	2	5.0	1	2.5	3	7.5	0	0.0
61-80	10	25.0	0	0.0	3	7.5	0	0.0
81-100	4	10.0	0	0.0	19	47.5	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

or rebuilt ones, although 14 did indicate that 61 percent or more of the clutches were rebuilt in their own shops. Clutch rebuilding was considered to be replacing parts with new or rebuilt parts and not actually riveting on lining.

Several conclusions about the servicing of standard shift transmissions can be made by utilizing the data presented in Table 18. It is quite evident that a majority of the transmissions were being repaired in their own shops. Responses in all other categories were very low. The situation is almost identical when one analyzes Table 19, which gives data on automatic transmissions. Very few automatic transmissions were being sent to speciality shops or being replaced with new or rebuilt or used units. Most were being repaired in local shops.

Differentials present much the same situation as transmissions did, although a few more were replaced with new, rebuilt, or used units. A small number were rebuilt by speciality shops. Again, a majority were rebuilt in the respondents' shops. Information is summarized in Table 20.

Table 18. Percentage of standard transmissions serviced by four methods

Percentage of standard transmissions serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	0	0.0	40	100.0	38	95.0	39	97.5
21-40	1	2.5	0	0.0	2	5.0	1	2.5
41-60	1	2.5	0	0.0	0	0.0	0	0.0
61-80	14	35.0	0	0.0	0	0.0	0	0.0
81-100	24	60.0	0	0.0	0	0.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 19. Percentage of automatic transmissions serviced by four methods

Percentage of automatic transmissions serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	1	2.5	39	97.5	35	87.5	38	95.0
21-40	2	5.0	0	0.0	5	12.5	2	5.0
41-60	4	10.0	0	0.0	0	0.0	0	0.0
61-80	11	27.5	0	0.0	0	0.0	0	0.0
81-100	22	55.0	1	2.5	0	0.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 20. Percentage of differentials serviced by four methods

Percentage of differentials serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	1	2.5	40	100.0	34	85.0	37	92.5
21-40	1	2.5	0	0.0	5	12.5	3	7.5
41-60	5	12.5	0	0.0	1	2.5	0	0.0
61-80	12	30.0	0	0.0	0	0.0	0	0.0
81-100	21	52.5	0	0.0	0	0.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Table 21 summarizes information about the servicing of power brake units. Power brake units repaired in their own shops vary a great deal from 27.5 percent, indicating 20 percent or less serviced, up to 22.5 percent, indicating over 80 percent are repaired in their own shops. A few sent units to speciality shops for rebuilding.

Table 21. Percentage of power brake units serviced by four methods

Percentage of power brake units serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	11	27.5	36	90.0	17	42.5	40	100.0
21-40	3	7.5	0	0.0	7	17.5	0	0.0
41-60	12	30.0	0	0.0	6	15.0	0	0.0
61-80	5	12.5	2	5.0	5	12.5	0	0.0
81-100	9	22.5	2	5.0	5	12.5	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

The last major component surveyed was the radio. Data from Table 22 indicates a majority of the radios serviced were sent to speciality shops. Only one respondent indicated over 80 percent of the radios serviced were rebuilt in his own shop. Few radios were replaced with new, rebuilt, or used units.

Table 22. Percentage of radios serviced by four methods

Percentage of radios serviced	Methods							
	Rebuilt in own shop		Sent out to spec.		Purchased new or rebuilt		Replaced as used units	
	N	%	N	%	N	%	N	%
00-20	39	97.5	4	10.0	37	92.5	40	100.0
21-40	0	0.0	0	0.0	0	0.0	0	0.0
41-60	0	0.0	1	2.5	1	2.5	0	0.0
61-80	0	0.0	4	10.0	0	0.0	0	0.0
81-100	1	2.5	31	77.5	2	5.0	0	0.0
Total	40	100.0	40	100.0	40	100.0	40	100.0

Information Concerning Personal Characteristics and Competencies, Knowledge, and Skills Desired in Automotive Mechanics

The 40 service managers participating in the study evaluated the importance of personal characteristics and competencies, the importance of the ability to use major equipment common to the automotive trade, the importance of possessing technical knowledge, and the importance of tech-

nical skills to the automotive mechanic. Each item was evaluated using a five-point rating scale, ranging from one (very little importance) through five (essential). Responses are summarized in Tables 23-26. Frequencies of responses are recorded in each column, and a weighted mean was computed for each individual item evaluated.

The importance of personal characteristics and competencies of automotive mechanics is revealed in Table 23. The lowest values reported were 2.700 and 2.800 for ability to prepare records and reports and ability to write neatly and legibly, respectively. Even these were near the rating of desirable. All others were 3.600 or above, indicating a value of highly desirable or higher. A desirable quality of work, safe work habits, and being punctual and dependable were rated as the most important traits. In addition to those listed in the table, service managers were asked to list other items that they considered important. Items included were a desire to work, no alcohol on the job, and the ability to translate technical skills to work.

Table 23 Importance of personal characteristics and competencies of automotive mechanics

Item	Rating					Mean
	1[a]	2[b]	3[c]	4[d]	5[e]	
Desirable quality of work	0	0	3	12	25	4.550
Safe work habits	0	0	4	11	25	4.525
Punctual and dependable	0	0	5	13	22	4.425
Adequate command of needed knowledge and skill	0	0	6	12	22	4.400
Hard, efficient worker	0	0	7	18	15	4.200
Cooperative and friendly	0	0	9	16	15	4.150
Ability to diagnose problems	0	0	10	17	13	4.075
Possesses a positive attitude	0	0	10	19	11	4.025
Favorable personal cleanliness and appearance	0	0	11	18	11	4.000
Accepts responsibility	0	0	13	17	10	3.925
Acceptable customer relations	0	0	14	16	10	3.900
Plans work logically	0	0	11	22	7	3.900
Ability to use manuals and charts	1	2	10	17	10	3.825
Self-confident	0	0	17	16	7	3.750
Adequate communication skills	0	1	21	9	9	3.650
Socially acceptable	0	3	18	11	8	3.600
Ability to write neatly and legibly	5	7	20	7	1	2.800
Ability to prepare records and reports	5	8	22	4	1	2.700

[a] Very little importance.
[b] Only background needed.
[c] Desirable.
[d] Highly desirable.
[e] Essential.

Table 24 summarizes the importance of an automotive mechanic's ability to use major automotive equipment. All equipment available in most modern automotive repair shops and intended specifically for this purpose received a rating above 3.000 (desirable), with a very significant part of the equipment receiving a rating in excess of 3.500. Fourteen pieces of equipment had a rating of four or above. Without exception, machine shop equipment (drill press, lathe and attachments, shaper or planer, and milling machine) received a rating at the low end of the scale.

Table 24. Importance of an automotive mechanic's ability to use major automotive equipment

Item	Rating					Mean
	1[a]	2[b]	3[c]	4[d]	5[e]	
Valve grinder	0	2	12	8	18	4.500
Timing light	0	0	8	5	27	4.475
Compression gauge	0	0	10	7	23	4.325
Jacks, lifts, hoists, stands	0	1	9	6	24	4.325
Battery-starter tester	0	0	12	7	21	4.225
Distributor stroboscope machine	0	1	18	8	13	4.200
Tachometer-dwell meter	0	2	9	10	19	4.150
Battery cell tester	0	1	11	9	19	4.150
Generator regulator tester	0	0	12	12	16	4.100
Battery hydrometer	0	1	13	7	19	4.100
Fuel pump tester	0	0	12	13	15	4.075
Vacuum gauge	0	0	13	11	16	4.075
Tachometer	0	0	14	9	17	4.075
Coil-condenser tester	0	1	12	13	14	4.000
Diode tester	0	1	14	11	14	3.950
Radiator cap tester	1	0	15	9	15	3.925
Combustion analyzer	0	3	11	14	12	3.875
Remote starter	1	0	14	14	11	3.850
Multimeter (volts, ohms, amps)	0	1	17	11	11	3.800
Ignition scope (console)	1	3	13	10	13	3.775
Cylinder leak tester	1	1	15	12	11	3.775
Valve seat refacer	2	1	13	12	12	3.775
Wheel balancer	0	2	15	15	8	3.725
Pressing equipment	0	3	15	12	10	3.725

[a] Very little importance.
[b] Only background needed.
[c] Desirable.
[d] Highly desirable.
[e] Essential.

Table 24. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Soldering tools	1	2	16	9	12	3.725
Armature growler	2	1	17	7	13	3.700
Dial indicators	1	4	13	10	12	3.700
Micrometers	0	7	13	6	14	3.675
Plastigage	1	5	15	5	14	3.650
PCV tester	3	0	18	7	12	3.625
Ridge reamer	2	8	8	7	15	3.625
Magnetic caster camber gauge	0	4	22	8	6	3.400
Projection caster camber unit	0	3	23	9	5	3.400
Honing equipment	2	11	11	5	11	3.300
Oxyacetylene cutting torch	2	12	15	6	5	3.000
Oxyacetylene welder	2	15	14	6	5	2.975
Brake drum lathe	7	11	11	4	7	2.825
Arc welder	4	14	14	6	2	2.700
Drill press	6	11	16	6	1	2.625
Set up dye	6	12	16	5	1	2.575
Magna flux	9	10	15	4	2	2.500
Shaper or planer	22	10	5	8	0	2.225
Chassis dynamometer	15	6	15	4	0	2.200
Lathe and attachments	19	11	8	1	1	1.850
Boring bar	15	19	5	0	1	1.825
Milling machine	24	9	6	1	0	1.600
How to handle hand tools					2	
Impact wrench					1	

Table 25 summarizes the responses to 51 items of technical knowledge related to the automotive field. It was the researcher's purpose to determine the importance of related technical knowledge to the training of qualified mechanics. An attempt was made to combine items and generalize categories into major blocks of information rather than a list of specific items. It should be noted that over 43 of the 51 items received a rating of desirable, highly desirable, or essential. History of the automobile, shop algebra and geometry, radio fundamentals, and matter and atomic energy received the lowest ratings. Items ranked at the top were gauges, safety, timing, principles of carburetion, and brakes and friction.

Service managers also rated the importance of an automotive mechanic being capable of performing technical skills related to the repair of automotive components and systems. These are listed in rank order from high to low in Table 26. It is quite evident that a majority of the items listed received a rating of desirable or higher. The items receiving the lowest values were bore a cylinder, service radios, repair radiators, and regrind crankshaft.

Table 25. Importance of an automotive mechanic's command of technical knowledge

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Gauges	0	2	11	10	17	4.500
Safety	0	0	5	12	23	4.450
Timing	0	1	11	7	21	4.200
Principles of carburetion	0	0	13	13	14	4.025
Brakes and friction	0	1	13	12	14	3.975
Electrical sending units	1	2	15	6	16	3.850
Theory of cooling and coolants	1	2	13	11	13	3.825
Read and trace electrical schematics	0	2	16	10	12	3.800
Torque	0	5	13	7	15	3.800
Principles of lubricants and lubrication	0	3	12	16	9	3.775
Bearings	0	3	15	10	12	3.775
Filters	0	4	13	13	10	3.725
Electrical circuitry	0	4	18	5	13	3.675
Balance	1	2	16	13	8	3.675
Mechanical linkage	0	5	17	7	11	3.600
Combustion fundamentals	0	4	17	11	8	3.575
Fundamentals of electricity	0	7	15	6	12	3.575
Engine theory	0	5	16	10	9	3.575
Vacuum and pressure	0	2	23	5	10	3.575
Principles of electrical generators	1	5	16	7	11	3.550
Reference books and manuals	0	6	15	10	9	3.550
Pumps	0	3	21	8	8	3.525
Principles of electric motors	0	9	13	9	9	3.450
Principles of springs and shocks	1	4	16	14	5	3.450
Pressure differentials	0	4	21	9	6	3.425
Electromagnets, magnetism, solenoids	0	7	17	9	7	3.400
Hydraulic fundamentals	0	7	18	10	5	3.325
Piston displacement	1	6	19	9	5	3.275
Types of gears	0	8	21	6	5	3.200
Theory of gases and fuels	2	7	19	5	7	3.200
Gear arrangements	0	12	13	11	4	3.175
Air conditioning	3	6	19	6	6	3.150
Ohm's law	2	13	11	6	8	3.125
Gearing and gear ratios	0	13	14	8	5	3.125

[a]Very little importance.
[b]Only background needed.
[c]Desirable.
[d]Highly desirable.
[e]Essential.

Table 25. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Current publications in the field	1	9	22	3	5	3.050
Principles of reading and interpreting measuring scales	4	8	17	7	4	2.975
Heat exchangers	3	7	23	5	2	2.900
Shop arithmetic	5	11	12	8	4	2.875
Volumetric efficiency	4	7	23	3	3	2.850
Solid state fundamentals	4	12	15	9	0	2.725
Tires and construction	3	15	15	5	2	2.700
Characteristics of metals	2	17	15	3	3	2.700
Flat rate manuals	1	9	22	3	5	3.050
Horsepower formulas and measurement	6	19	9	1	5	2.500
Laws of motion	6	20	6	4	4	2.500
Basic machines (screw, wedge, inclined plane)	6	19	9	2	4	2.475
History of the automobile	12	15	9	2	2	2.175
Shop algebra	9	19	10	2	0	2.125
Shop geometry	10	17	12	1	0	2.100
Radio fundamentals	15	16	7	1	1	1.925
Matter and atomic energy	17	13	9	1	0	1.850

Table 26. Importance of technical skills to an automotive mechanic

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Install points, plugs, condenser	0	1	3	12	24	4.475
Check, drain, refill fluid supplies	0	0	7	10	23	4.400
Adjust electrical timing	0	0	8	9	23	4.375
Adjust dwell	0	0	9	8	23	4.350
Test battery	0	1	5	13	21	4.350
Service carburetor	0	0	8	12	20	4.300
Service automatic choke	0	0	10	9	21	4.275
Service turn signals	0	2	9	14	15	4.250
Make voltage drop test	0	0	10	11	19	4.225
Service lights	0	0	8	16	16	4.200
Service wheel bearings	0	0	10	13	17	4.175
Make major brake adjustments	0	0	8	18	14	4.150

[a]Very little importance.
[b]Only background needed.
[c]Desirable.
[d]Highly desirable.
[e]Essential.

Table 26. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Service exhaust system	0	2	8	12	18	4.150
Service seals	0	0	11	13	16	4.125
Service anti-air pollution equipment	0	0	12	11	17	4.125
Check charging rate	0	2	9	12	17	4.100
Adjust voltage regulator	0	1	10	13	16	4.100
Rebuild wheel and/or master cylinders	0	0	11	16	13	4.050
Replace and/or adjust clutches	0	1	9	17	13	4.050
Service alternator	1	1	11	11	16	4.000
Service valves and valve train	0	1	16	5	18	4.000
Service cranking motors	0	1	14	10	15	3.975
Service drive shaft	1	1	12	10	16	3.975
Check cranking and/or charging voltage	0	1	13	12	14	3.975
Check starter amperage draw	0	2	12	11	15	3.97[illegible]
Service direct current generator	0	2	14	8	16	3.95[illegible]
Fit bearings	0	2	11	[illegible]	17	3.950
Service heaters	0	1	15	10	14	3.925
Service drive belts and chains	0	2	11	15	12	3.925
Check fuel pump volume, vacuum, and pressure	0	0	16	11	13	3.925
Service cooling system	0	4	8	16	12	3.900
Service windshield wipers	0	1	14	13	12	3.900
Check circuit resistance	0	0	17	11	12	3.875
Repair and adjust standard transmission and overdrive	0	2	12	15	11	3.875
Service lubrication system	0	5	8	15	12	3.850
Perform scope-console diagnosis	0	2	13	15	10	3.825
Service drum brakes	1	1	17	7	14	3.800
Service rear axle units	0	4	13	11	12	3.775
Service disc brakes	0	1	19	9	11	3.750
Service suspension system	0	2	16	12	10	3.750
Fit shoes to drums	2	1	11	17	9	3.750
Service pistons	1	1	18	8	12	3.725
Service dash instruments	0	1	17	14	8	3.725
Balance wheels	0	4	12	15	9	3.725
Adjust or repair manual steering	0	2	16	13	9	3.725
Adjust or repair power steering	1	2	15	13	9	3.675
Adjust automatic transmission	0	5	12	14	9	3.675
Service power brakes	1	[illegible]	16	6	13	3.650

Table 26. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Fit rings	0	2	22	5	11	3.625
Time valves	3	4	12	7	14	3.625
Service fuel pump	3	4	13	7	13	3.575
Align or replace connecting rods	1	4	19	3	13	3.575
Replace control arm bushings	1	5	15	8	11	3.575
Replace ball joints	0	8	14	6	12	3.550
Repair differential	0	8	14	7	11	3.525
Check crankshaft end play	0	9	15	4	12	3.475
Service front end (alignment)	0	8	17	5	10	3.425
Repair locking differential	1	6	17	7	9	3.425
Repair automatic transmission	0	10	11	12	7	3.400
Ridge ream a cylinder	2	12	9	4	13	3.350
Check and align crank and cam shafts	0	11	15	3	11	3.350
Service air conditioning system	2	2	22	9	5	3.325
Measure cylinder taper	2	12	8	10	8	3.250
Check and adjust alignment angles	0	11	14	8	7	3.275
Service power windows	4	10	15	7	4	2.925
Service power seats	4	13	13	6	4	2.825
Service tires	3	11	19	5	2	2.800
Service power tops	5	14	15	3	3	2.625
Turn brake drums and discs	8	10	13	7	2	2.625
Bore a cylinder	14	18	3	2	3	2.050
Service radios	15	13	11	0	1	1.975
Repair radiators	18	15	6	0	1	1.775
Regrind crankshaft	21	14	3	1	1	1.675

Frequency of Jobs Performed by Automotive Mechanics

The final section of the study was completed by utilizing information obtained by drawing shop service records and determining the number of jobs completed in each category. Data is summarized in Table 27 for each of the 13 major areas of automotive repair. Tables 28 through 40 give an individual breakdown of the items listed in each of the 13 major areas. Jobs are listed in rank order from high to low. The percentages of jobs completed in major areas compared to total jobs surveyed is given at the bottom of each Table 28 through 40 and are summarized in rank order in Table 27.

Table 27. Frequency of service in major areas

Major areas	f	%
Engine	4,049	27.27
General	1,577	10.62
Chassis	1,448	9.75
Electrical system (wiring)	1,313	8.84
Fuel system	1,190	8.01
Accessories	1,060	7.14
Brakes	910	6.13
Lighting	894	6.02
Transmission	870	5.86
Starting	491	3.31
Charging system	405	2.73
Rear end	380	2.56
Clutch	262	1.76
Total	14,849	100.00

Table 28. Frequency of service related to the engine

Jobs	f
Tune-up	712
Change oil	471
Check and/or add coolant	328
Install muffler	276
Replace header or tail pipes	206
Service or replace PCV	179
Service fan and belts	150
Replace valve cover gasket	140
Replace water pump	116
Test and/or replace thermostat	98
Regrind or replace valves or seats	90
Replace hoses and/or overflow	89
Repair oil leaks	88
Flush cooling system	82
Complete engine overhaul	72
Repair or replace radiator	71
Check compression	67
Replace head and/or manifold gaskets	53
Replace seals and/or miscellaneous gaskets	47
Replace or repair head	39
Service or replace valve lifters	39
Replace or free heat valve	37
Replace exhaust manifold	35
Test and/or replace radiator pressure cap	33

Table 28. (Continued)

Jobs	f
Replace timing chain and/or sprocket	30
Free sticky valves, check valve guides	22
Replace engine mounts	28
Check engine efficiency	28
Replace oil gauge or light	27
Wash engine	27
Replace engine	26
Replace frost plugs	24
Ring job	24
Replace rocker arms	22
Free sticky valves, check valve guides	22
Replace valve stem seals	22
Replace heat gauge or indicator transmitter	21
Replace or repair oil pump or lines	20
Adjust valves	18
Check and/or correct oil pressure	18
Check engine vacuum	15
Replace oil cap	15
Replace pistons	14
Replace camshaft and bearings	13
Replace main bearings	13
Replace or regrind crankshaft	13
Replace valve springs	13
Replace flywheel and/or starter ring gear	9
Fit wrist pins	8
Replace pushrods	7
Align and/or replace connecting rods	5
Exhaust system check	5
Clean oil passages	5
Replace vibration dampener	4
Service oil cooler and lines	4
Replace rod inserts	4
Test and/or align crankshaft or camshaft	4
Time valves	4
Cooling system check	3
Knurlize pistons	3
Replace oil pan	3
Replace rocker arm studs, check oil passages	3
Install valve shims	2
Replace by pass line	2
Bore engine	1
Install short block	1
Install sleeves	1
Total	4,049
Percent of total jobs	27.27

Table 29. Frequency of service related to general service work

Jobs	f
Complete lubrication	811
Wash car	206
Pack bearings	157
Find mechanical noises	118
Grease job	65
Install trailer hitches	53
Service new cars	51
Engine diagnosis	26
Service windows	23
Adjust doors	17
Replace or repair gas tank	15
Replace locks	11
Replace bolts and zerks	9
Install tank heater	5
Undercoat	5
Weather stripping repair	4
Instail seat belts	1
Total	1,577
Percent of total jobs	10.62

Table 30. Frequency of service related to the chassis

Jobs	f
Alignment	431
Balance wheels	335
Service springs, shocks, sway bars	158
Repair and/or change tires, wheels, hubs	128
Replace front wheel bearings and seals	89
Repair and adjust power steering components	83
Replace upper and lower ball joints	78
Lubricate suspension	65
Manual steering gear repair and adjust	50
Replace wheel studs	16
Replace stabilizer bar	10
Replace king pin	2
Replace steering wheel	2
Replace trunnions	1
Total	1,448
Percent of total jobs	9.75

Table 31. Frequency of service related to the electrical system (wiring)

Jobs	f
Replace points and condenser	310
Check, charge, or replace battery	251
Clean or replace gap plugs	234
Set dwell and timing	207
Repair ignition wiring	73
Replace distributor rotor	57
Replace distributor cap	42
Replace distributor	41
Check and/or replace coil	41
Check vacuum and mechanical advance	32
Service ammeter or indicator lights	18
Install or repair solid state ignition	7
Total	1,313
Percent of total jobs	8.84

Table 32. Frequency of service related to the fuel system

Jobs	f
Adjust carburetor	338
Rebuild carburetor	232
Service air cleaner	160
Clean and/or adjust automatic choke	152
Service fuel lines and filters	131
Service fuel pump	94
Carburetor exchange	33
Clean carburetor	20
Repair or replace fuel gauge	16
Repair and/or adjust fuel injection system	7
Service accelerator pedal	4
Service manual choke	3
Total	1,190
Percent of total jobs	8.01

Table 33. Frequency of service related to accessories

Jobs	f
Replace heater hoses and/or core	182
Accessory installation	140
Repair wipers and washers	137
Charging with freon (AC)	128
Replace or repair ventilation equipment	126
Service speedometer and odometer	87
Remove and replace radio, antenna	73
Test and adjust air conditioning parts	61
Service anti-air pollution devices	53
Horn repair	30
Adjust cruise control	17
Repair clock	15
Adjust speed warning	7
Repair cigarette lighter	3
Install vacuum tank	1
Total	1,060
Percent of total jobs	7.14

Table 34. Frequency of service related to brakes

Jobs	f
Check and/or replace shoes or lining	228
Adjust brakes and linkage	196
Check and/or add fluid	136
Turn drums	79
Recondition wheel cylinders	82
Bleed brakes	55
Recondition master cylinders	41
Rebuild power brake unit, vacuum unit	23
Replace drums	20
Replace other parts of the brake system	18
Fix brakes	14
Repair and/or replace disc brakes	12
Adjust air brakes	6
Total	910
Percent of total jobs	6.13

Table 35. Frequency of service related to lighting

Jobs	f
Fix lights or wiring	351
Replace bulbs	262
Replace light switches	115
Headlight adjustment	93
Check for shorts or grounds	48
Replace fuses	25
Total	894
Percent of total jobs	6.02

Table 36. Frequency of service related to the transmission

Jobs	f
Check and/or add fluid	156
Replace or rebuild universal joints	138
Repair automatic transmission	126
Adjust automatic transmission	101
Repair manual transmission	77
Replace seals and gaskets	72
Adjust transmission linkage	70
Replace transmission	42
Replace automatic transmission filter	24
Replace drive shaft	22
Check and/or adjust vacuum control pressure	18
Replace carrier bearings	18
Service transmission pointer	3
Repair overdrive	1
Total	870
Percent of total jobs	5.86

Table 37. Frequency of service related to the starting system

Jobs	f
Service battery cables	170
Check and/or rebuild starter	156
Replace solenoid	50
Replace bendix	47
Service starter ignition switch	37
Starter exchange	31
Total	491
Percent of total jobs	3.31

Table 38. Frequency of service related to the charging system

Jobs	f
Alternator testing and/or rebuild	120
Adjust drive belts	78
Test and/or adjust voltage regulator	65
Generator testing and/or rebuild	51
Generator, alternator exchange	47
Replace voltage regulator	44
Total	405
Percent of total jobs	2.73

Table 39. Frequency of service related to the rear end

Jobs	f
Check or add fluid	127
Replace axles, bearings, and/or seals	80
Replace seals and gaskets	62
Rebuild differential	32
Replace pinion, bearings, and seals	16
Repair limited slip differential	15
Replace differential assembly	12
Replace ring gear	12
Adjust axle shaft end play	11
Replace carrier bearings	8
Replace axle and carrier gears	5
Total	380
Percent of total jobs	2.56

Table 40. Frequency of service related to the clutch

Jobs	f
Adjust linkage	83
Replace clutch and/or pressure plate	88
Replace throw-out bearing	36
Adjust clutch and finger height	35
Rebuild master or slave cylinder	14
Replace pilot bearing and/or lubricate	6
Total	262
Percent of total jobs	1.76

SUMMARY

The objectives of this study were:

1. To analyze the automotive repair field to determine jobs performed by automotive mechanics.

2. To determine the proportion of time spent in major areas of the automotive repair field.

3. To determine the level of training expected of post-secondary automotive program graduates.

4. To determine the skills, competencies, and characteristics expected in automotive mechanics.

5. To determine personal characteristics of mechanics surveyed.

The objectives of this study were fulfilled by conducting 40 personal interviews with the service managers or owners of garages and dealerships selected by the Iowa Auto Dealer's Association and the Independent Garage Owners of Iowa. A five-point rating scale was utilized to evaluate the importance to an automotive mechanic of personal characteristics and competencies, the ability to use major automotive repair equipment, the importance of technical knowledge, and the importance of technical skills. In addition, they estimated the percentage of jobs that were completed each year in 11 major areas of automotive service and further, how their specific shops serviced 17 specific automotive components. Personal data sheets were completed by the 242 automotive service personnel employed in the 40 shops. In an effort to determine the frequency of the jobs being completed by service personnel each year, in excess of 5000 service records were drawn for a final compilation of almost 15,000 individual jobs. Results were evaluated by an advisory committee consisting of automotive mechanics, managers, and educators.

Sixty percent of the automotive service personnel employed in the shops surveyed were general line mechanics. Only 30 percent of the 242 men were specialists in one area. Sixty-seven percent reported a completion of four years of high school. Training in the military, high school, and trade school automotive programs appear to be the most utilized form of training before entering the trade. Company schools and apprenticeship programs were listed as being popular after entering the trade. A week at a company training center was the first choice of 105 service personnel and seemed to be the most popular and most widely accepted means of additional supplementary training preferred.

Sixty-three percent of the 40 service managers interviewed indicated the desire to employ graduates of post-secondary automotive training programs as general line mechanics. An additional 25 percent indicated a preference of entry as a mechanic's assistant.

Weighted means were computed for the items evaluated by the 40 service managers on the basis of a five-point rating scale, ranging from one, "very little importance", through five, or "essential".

Most personal characteristics or competencies listed rated desirable or higher. Ability to prepare records and reports and ability to write neatly and legibly ranked lowest. A desirable quality of work, safe work habits, and punctual and dependable ranked most important.

Automotive repair equipment receiving the highest mean values were the valve grinder, timing light, compression gauges, and lifting devices. Machine shop equipment ranked relatively low. Most equipment common to the automotive repair shops received a rating of desirable or above. Fourteen pieces of equipment received a rating of highly desirable or above.

Forty-three of the 51 items listed under technical knowledge related to the automotive repair field received a rating of desirable or above. History of the automobile, shop algebra and geometry, radio fundamentals, and matter and atomic energy received the lowest ratings. Items rated at the top were gauges, safety, timing, principles, and brakes and friction.

Service managers rated the importance of an automotive mechanic being capable of performing technical skills. Sixty-four of the 73 items listed were rated as desirable or higher. Items ranking highest were the ability to install points, plugs, and condenser; check, drain, refill fluid supplies; adjust electrical timing; adjust dwell; test battery; service carburetor; service automatic choke; and service turn signals. Those rating lowest were bore a cylinder, service radios, repair radiators, and regrind crankshafts.

Service managers estimated the total jobs completed each year in 11 major areas of automotive service. Few major areas were estimated to encompass greater than 21 percent or more of the jobs completed. Most of the areas fell in the range of one to ten percent, although general service work; alignment, suspension, balance; engine repair; carburetion; and electrical did rate several responses in the 11 to 20 percent column. No responses were listed as greater than 60 percent in any one area.

Methods of servicing 17 major automotive components were evaluated by service managers. Each reported percentages of components rebuilt in their own shops, the percentage of units sent out to speciality shops for servicing, those purchased as new or rebuilt units, and lastly, the percentage replaced as used units. A majority of the engines serviced were rebuilt in the dealer's own shop. Forty-seven and one-half percent reported in excess of 80 percent of the carburetors as being rebuilt in their own shops, and another 35 percent indicated 61 to 80 percent fell in this category. Very few fuel pumps are being rebuilt in the dealer's shop; most were replaced with new or rebuilt units.

Most distributors, generators, alternators, or starters were reported rebuilt in local shops or replaced with new or rebuilt units.

Seventy percent reported 81 percent or more of the radiators serviced were sent out to speciality shops. Most faulty water pumps were replaced with new or rebuilt units.

Most clutches were reported being replaced with new or rebuilt units. A majority of standard and automatic transmissions were repaired in the dealer's own shop. Differentials presented much the same picture, although a few more were replaced with new, rebuilt, or used units.

A large portion of the radios serviced were sent out to speciality shops.

The last section of the study utilized information obtained by drawing shop service records and determining the number of jobs completed in each category. Major divisions were further divided into specific jobs. Specifically, percentages were engine, 27.27; general, 10 2; chassis, 9.75; electrical system (wiring), 8.84; fuel system, 8. accessories, 7.14; brakes, 6.13; lighting, 6.02; transmission, 5.86; starting, 3.31; charging system, 2.73; rear end, 2.56; and clutch, 1.76.

Recommendations are that: (1) a review and revision of existing programs be made in light of the study findings, (2) findings of this study be presented to area school administration and automotive instructors, (3) two-year programs be organized, the first year devoted to application of basic fundamentals and the second year to more advanced work. (4) a direct line of communication be established between the automotive servicing industry and the schools serving it, (5) early career education and counseling be provided, and (6) the development of acceptable personal characteristics and positive attitudes be stressed.