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Job characteristics of automotive mechanics in selected Iowa dealerships and garages

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JOB CHARACTERISTICS OF AUTOMOTIVE MECHANICS IN SELECTED IOWA DEALERSHIPS AND GARAGES

by

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INTRODUCTION

The modern technological world has been dramatically influenced by the dynamic evolution of the automobile. During 1968 Americans traveled one trillion miles by motor vehicles which consumed 80.9 billion gallons of fuel. Automobile industries in the United States produced 10,820,000 passenger cars and commercial vehicles and consumed 20 percent of the steel and 60 percent of the rubber produced in the nation. Currently 17 percent of the U.S. businesses are related to the automobile, totaling in excess of 800,000 firms. One-sixth of current U.S. employees, or over 14 million people, earn their livelihood in some phase of manufacturing, distributing, maintaining, or commercial usage of motor vehicles.

Currently there are in excess of 87 million vehicles registered in the United States and 95 million licensed drivers. Twenty-three billion dollars worth of new vehicles and service are sold annually. By 1975, experts predict 110 million motor vehicles will be in use in this country, and 500,000 new mechanics will be needed to repair and service these vehicles.

Modern automobiles are more technically sophisticated in nature than those of the past, with complicated devices and systems being incorporated into their basic design. An automobile manufacturer's development department executive related the following example:

> "In the first 'one lungers', there was a wire from the spark plug to a magneto, connected through a simple on-off switch and grounded. Then someone added a second cylinder, and two more, and then you needed a distributor to make sure the cylinders fired in the right order. Then came electric head lamps, and then tail lamps and parking lamps, and turn signals and backup lights and warning lights for overheating and low oil pressure and cigarette lighters and ammeters and lights in glove compartments and under the hood and in the trunk, and lights overhead with switches in the doors, and an upper beam indicator and

> electric clocks and courtesy lamps and tape players and fuel gauges and a light to tell you your emergency brake is set, and electric two-speed windshield wipers and power windows and power seats and air conditioning.....Our little straggle of wires has become a mass of colored conductors tied into bunches half as big around as your arm" (5, pp. C-4, C-5).

Historically, the automotive industry has been deeply concerned with and characterized by change. Keen competition between rival automobile manufacturers has resulted in the elimination of over 500 of the weaker and less competitive companies from the auto manufacturing business. Since the very inception of the automobile, each year has been characterized with new models, colors, styles, options, and a multitude of other choices made available by rival companies to entice consumers to buy their product. The Automobile Manufacturers Association recognizes this change and its effect on the auto industry and describes it as:

> "a manageable process that has not displaced nor rendered obsolete overnight the skills of large groups of employees. At the present time there is no evidence that a substantial change in the pace or the nature of technological change will occur in the automotive industry.....For the foreseeable future, as in the past, a large proportion of the blue collar job assignments in the automotive industry will be ones that can be learned quickly. In any event, as in the past, any change in skill requirements which do occur will no doubt be met by training industry employees for the new jobs as they appear" (8, p. 2).

New technological developments have resulted in the need for more employees. Since 1961 the number of automotive industry employees has increased by almost 300,000 persons. Parallel to this change has been an increase in the number of motor vehicles and improvements such as power steering, power brakes, power seats and windows, anti-air pollution devices, anti-skid devices, stereo tape players, in addition to changes in basic systems.

Consumers and their spokesmen have voiced complaints and demands for reliable and adequate automotive service in recent years. Purdy (70), in a recent issue of Parade Magazine, described how a customer was charged 189 dollars for new transmission parts. Later another mechanic whom the customer knows and has faith in informs him that no work has been done. It is suggested in the article that consumers deal with reputable stores and shops and get written guarantees for work and parts clearly spelled out on the bill.

John L. Feirer (35), in a recent editorial, spoke out on the same issue when he asked:

> "Where are the Big Three? Just a year ago, we bought a semi-luxurious, middle range, new car. In checking over this high cost, four-and-a-half ton leviathan, we found an electric clock that didn't work, a piece of trim missing, and a door handle defective. These defects were promptly reported to the dealer. A full year has gone by and there is still an empty hole where the electric clock should be, the door handle still doesn't work and the piece of trim is still missing; yet, supposedly, there is a solid warranty on this automobile. What is the major problem? Obviously, service. But for adequate service we need personnel. Automobile manufacturers tell us that 1969 will be another banner year for sales. Over nine million cars will be produced; cars with more glamor and accessories (including power steering, brakes, and windows). Over half of them will have air conditioning. A great year for automobile manufacturers. A great year except for one very loud and discordant note: service, or the lack of it" (35, p. 19).

One possible solution to the problem of too few qualified service personnel has been suggested by the National Association of Manufacturers. Their proposal is that leaves-of-absences be granted to qualified automotive mechanics to serve as teachers in automotive programs, thus placing men with actual trade experience in the classroom.

Most citizens of the United States are concerned about quality education at all levels. Polley (69) says that the people of the United States

have more opportunities to take advantage of higher education than any other nation in the world. In 1967, 2,840 students per 100,000 people were enrolled in higher education, compared with 1,674 per 100,000 for the second place nation, the Soviet Union. Free or low cost public education has always been an American ideal, basic to the development and continuation of the democratic form of government. Education relative to transportation, and more specifically the automobile, is certainly no exception. The need for developing new programs and updating old ones is very real. John B. Teeple (85), principal investigator for educational projects in the Center for Priority Analysis at the National Planning Association, predicts that by 1975, fourteen million people will be employed in transportation. Blue collar workers will make up 70 percent of this labor force. "Most of these are operatives who do not require formal training, but there may be over 100,000 job openings where post-secondary vocational-technical education is relevant. Half of these openings will be for automotive mechanics and many others will be for aircraft and railroad repairmen" (85, p. 33).

Consequently, due to the increasingly heavy American demands for faster, more reliable transportation, educators constantly face the challenge of developing sound educational programs in vocational-technical education to train workers in servicing and repairing motor vehicles. A great deal of thought, planning, and research is necessary for an excellent program.

Swanson, Nelson, and Meyer (84) enumerated eight imperatives for a modern vocational curriculum:

"1) That educational programs must make provision for occupational instruction for all students, irrespective of future goals.

"2) That the first goal of vocational programs be to equip students with saleable skills, intellectual and manipulative, and to give them a base of occupational experience that will add relevance and adaptability to their vocational goal achievement.

"3) That maximum effort be given to curriculum development which can accelerate the rate of skill achievement and retard the rate of skill obsolescence.

"4) That vocational education provide experience which will help the student to identify his talent, to relate those talents to the world of work, to identify an occupational interest, and to develop such talents as will widen his choices and improve the skills required for success.

"5) That curriculum innovators determine what and how much generalized vocational preparation and specialized vocational preparation will make a graduate employable in the current and future job market.

"6) That competence to enter the job be held as the minimum requisite for graduation and that eligibility for placement be regarded as the minimum completion requirement.

"7) That the vocational curriculum satisfy the needs of learners in their vocational development as well as the needs of employers in their competitively productive environments, with the ultimate goal of producing competent, well-adjusted workers and citizens.

"8) That curriculum developers engage in research to determine the most effective and efficient program for preparing individuals for occupational employment" (84, p. 24).

A great deal has been written in recent years concerning curriculum development and implementation. Numerous ideas, opinions, and concepts have been proposed, implemented, appraised, and evaluated. Automotive Service Association Vice-President J. L. Wiggins expressed the need for quality education programs in motor vehicle servicing: "The day of hit-or-miss education is gone. Modern engines and automotive components are scientifically designed and cannot be repaired with bailing wire or untrained help" (100, p. 35). In recent interview, Mel Turner (100), Curriculum

Director for the Automotive Service Association, stressed the need for continuation of programs emphasizing basic fundamentals, rather than specialization in the lower level training programs for automotive mechanics, expressing the idea that certain fundamentals must be acquired first to serve as a base for areas of specialization.

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.

The Iowa State Department of Public Instruction in 1968 issued a policy statement on vocational-technical education in Iowa, listing several guiding principles:

> "1) Vocational-technical education shall provide adequate and timely instruction in both preparatory and supplementary training which will reflect occupational trends and will meet the changing needs of job requirements.
>
> "2) There shall be an identified and established need for the program.
>
> "3) The primary purpose of the program shall be to prepare students for occupational entry or advancement. For those students enrolled in vocational classes in the secondary schools, the training shall be directed toward competence in gainful and useful skills. Flexibility and adaptability must be essential characteristics.
>
> "4) The content of the programs shall be based on the skills and knowledge required in the occupations and shall be developed and conducted in consultation with persons actively engaged in the occupations. Vocational education needs the close cooperation of the community. Vocational educators need the periodic help and criticism of the real work-a-day world to be sure the preparation for an occupation is useful" (44).

Schumacher's (78) study concerning the needs for automotive mechanics in Iowa definitely established that additional qualified mechanics are needed in Iowa. Research should be undertaken to determine what the automotive

repair and service industry wants when it hires new employees. Currently, instruction is being offered in the field of automotive mechanics in all organized areas. These programs, and others similar to them, can help alleviate the need for qualified mechanics in the state and nation. To produce a qualified graduate, the course content and curriculum must be relevant, comprehensive, and based on the latest curriculum concepts and innovations. Graduates must be well educated to perform the jobs they will hold. With excellent teachers, adequate facilities and equipment, and the appropriate learners, the nation can be assured of a supply of automotive mechanics for the world of tomorrow.

The Purpose of This Study

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

Objectives

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.

Limitations

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

Various aspects of 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. Specific dealerships were selected by the Iowa Auto Dealers Association and the Independent Garage Owners Association, which further delimited the study. Only dealerships were included that offered general automotive service and repair, exclusive of auto body work. An attempt was made to select businesses of all sizes distributed over the entire State of Iowa.

Definitions

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

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

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

Service manager. - A person who oversees and manages the dealership service department. He must be a good administrator, public relations and customer relations man, building morale, and at 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.

REVIEW OF LITERATURE

The National Picture

American vocational-technical education today is an institution of paramount importance to the future strength and well-being of our national economy and security; hence, it is at the very foundation of keeping America strong. Ever-increasing numbers of men and women are demanding more and more education and training to enable them to compete in the labor market and thus earn a larger share of America's wealth as they enter the everyday world of work. Government analyists predict 600,000 teen agers and young adults are expected to be added to the nation's work force annually in the decade from 1964 to 1975, a 50 percent increase over the previous decade. Levitan and Mangum (54), in a research report completed at the University of Michigan concerning federal manpower policy, stated:

> "Concern with measures to increase the employability of those with limited skills has grown so rapidly since 1960 that there are currently between fifteen and thirty separate programs administered by public and private agencies, in each metropolitan area, and supported by federal funds. These activities include the training and basic literacy education conducted under the Manpower Development and Training Act, the Job Corps, the Neighborhood Youth Corps, the work experience programs for unemployed parents of dependent children, vocational rehabilitation for the handicapped, the job creating activities in community service, and beautification projects conducted in connection with the community action programs, and similar efforts" (54, p. 12).

Government at all levels, local, state, and national, is deeply concerned with the education of the national work force. Projections of the United States Department of Health, Education, and Welfare indicate that:

> "with continued progress in education, it is likely that, by 1975, about 16 percent of those employed will have received an education amounting to eight years of schooling or less, as contrasted with 26 percent in 1964. The proportion of the labor force with four years or more of higher education is projected to

> increase, but at a somewhat less rapid pace -- from under 10 per cent of the total early in the 1960's to nearly 15 per cent in the mid-1970's" (92, p. 56).

Statisticians project that by the year 1975, the U.S. civilian labor force will be 91 million people. Lecht (53) showed the need not only for training but for retraining.

> "Accepting a 1 per cent of the population training need standard as a reasonable target for the United States would mean using retraining to increase the employability and earning capacity of approximately 900,000 people a year in the next decade. Achieving the 1 per cent standard for the retraining goal is estimated to involve expenditures for training, basic literacy, education, research, and subsistence for trainees amounting to slightly more than $3 billion in 1975 (in 1964 dollars). This compares with the federal government's appropriations of $931 million to support all remedial skill training, manpower research, and adult basic education in the 1966 fiscal year" (53, p. 52).

Consequently, it is imperative that modern programs be relevant, well-planned, administered properly, and be of an essential nature. Giachino and Gallington (41) say that:

> "A sound educational plan is essential to the effective and efficient operation of any school system. An educational plan may be defined as any learning environment wherein adequate experiences are provided which permit pupils to develop their abilities to their maximum potentialities. Specifically, this means that boys and girls are given the opportunity to participate in a democratic society.
>
> An adequate educational plan implies instructional organization. Without good organization, learning is likely to be haphazard and wander aimlessly over doubtful avenues of attainment. Actually, success in any field of endeavor hinges materially on the degree of organization established. Time and time again a business enterprise of private venture has failed because of improper organization, likewise, the success with which any school system can discharge its responsibilities depends considerably on how well it has organized its instructional plan" (41, p. 1).

Educational Requirements for Automotive Mechanics Across the Nation

Mel Turner (100), Curriculum Director of the Automotive Service Industry Association, expressed the belief that several areas of training deserved to be emphasized:

> "Product performance indicates that sales of ignition parts, including generators and armatures, is in the first place, mufflers and tailpipes, second; motor and chassis parts, third; and so on. Therefore, tune-up is an important training area; so is motor repair, brakes, and chassis alignment. But an area that we don't talk enough about is auto body and refinishing. This is in the fifth place in product performance. It's an increasingly important training area.
>
> Exhaust emission control will be important in a few years. California already has a law and you can bet other states are talking about it" (100, p. 35).

Turner theorized that training programs of the future would need to be much the same as those of the past, providing new mechanics with basic fundamentals. Although a trainee might think that he wants to specialize in a particular area, Turner felt he should still have a broad base and understand how his speciality fits in with the rest of the total automobile. A broad nonspecialized basic course would allow him to seek employment in one of the other areas of automotive service if the market was saturated with his speciality at the time he was available for employment. He suggested that speciality programs could be offered to students demanding them during the last year, the last six months, or the last 400 hours of instruction. Programs should be then offered to fit the students, their needs, and the needs of the community.

In response to the question of "Do you want to talk about what you consider shortcomings of automotive training programs?", he answered:

> "it is in the fact that persons in the industry don't always communicate with educators. The neighborhood garage men and automotive wholesalers, for example, are usually reluctant to go to a school and offer their assistance in the automotive training program. Sometimes it is necessary for the educators to seek out and ask for their help. Tradesmen will give advice willingly if they know their advice is welcome" (100, p. 36).

One area of speciality would be a person trained to work in the new diagnostic centers that have swept the nation in the past few years. Turner stated he felt this was:

> "about the only place where the word 'technician' applies. Such a person would work with automotive principles and testing equipment for diagnosis. He would evaluate the mechanical condition of the car, and if needed, suggest repairs. The need for such a technician training program is great. Right now there is no way to get such a technician except by 'pirating'. I think there are some 500 of these centers already in operation and the trend is upward" (100, p. 36).

Table 1 summarizes eight different automotive course outlines of course content lists collected from state departments of education, government agencies, and automotive associations. An examination of the course outlines indicated they were basically much alike, yet certain areas were grouped or stressed to a different extent in each case, revealing 38 different divisions in the various programs offered. Not all categories were necessarily mutually exclusive, with overlap occurring in several cases. No attempt was made to divide combinations such as suspension and brakes, for example, into individual parts.

Robertson (72) wrote a proposed course for high school automotive mechanics in Georgia in 1962. One hundred thirteen factory and dealer service personnel were included in the study to evaluate the importance of automotive repair jobs and interest units, and 154 Georgia industrial arts teachers identified their ability to teach auto mechanics. Objectives were:

Table 1. Curriculum content of nine selected automotive program outlines

Main Divisions of Curriculum Content	Hours of Instruction							
	A[1]	B[2]	C[3]	D[4]	E[4]	F[4]	G[5]	H[6]
1. Orientation	15	15	39	180	115	65		21
2. Automotive vehicles	15		842					
3. Basic automotive electricity				60	45	29	144	71
4. Electrical systems	120	355	78	210	110	85	72	160
5. Ignition			130					
6. Cranking and charging circuits			238				272	
7. Trouble shooting and tune-up				180	105	60	90	219
8. Power train	210		238	305	180	70	90	524
9. Automotive engines	240	270		90	60	60		252
10. Internal combustion engine repair and overhaul				180	100			
11. Fuel and fuel systems	60		121	145	80	50		133
12. Automotive intake and exhaust systems				45	30	15		
13. Engine lubrication	30							
14. Cooling systems	30							
15. Brakes	120		238	135	80	30		124

[1]New Mexico Industrial Vocational Program in Automotive Mechanics (62).

[2]New Mexico, A Guide to the Development of a Course Outline for Automotive Mechanics (61).

[3]Utah Trade and Industrial Automotive Mechanics (99).

[4]Colorado Curriculum Guide; Automotive Mechanics (27).

[5]Automobile Manufacturers-American Vocational Association Industry Planning Council Curricula for an Associate Degree in Auto Service Management (5).

[6]Automobile Mechanic, Entry-United States Department of HEW (90).

Table 1. (Continued)

Main Divisions of Curriculum Content	Hours of Instruction							
	A[1]	B[2]	C[3]	D[4]	E[4]	F[4]	G[5]	H[6]
16. Chassis		386	238					
17. Suspension	60							
18. Suspension and brakes							162	
19. Chassis suspension and steering systems				260	105	55		163
20. Steering control	30							
21. Wheel balance								26
22. Wheel alignment	90							
23. Ventilating systems								71
24. Automobile air conditioning				60	20		72	
25. Instruments	15							
26. Auto accessories							90	
27. Auto body repair	45							
28. Auto lubrication and body services				60	25	13		
29. Service orientation and maintenance							126	
30. Business management		27						
31. Service management							72	
32. Parts management				60				
33. Accounting and business organization							54	
34. Communication skills							108	
35. Mathematics							108	
36. Science							180	
37. Electives							126	
38. Colorado state safety inspection				30	15	8		
Total	1080	1050	2162	2000	1080	540	1566	1764

"1) To determine the content of an auto mechanics course intended to meet the objectives of industrial arts.

"2) To determine the necessary facilities and equipment for teaching such a course and to compare the cost to that of the more common industrial arts subjects.

"3) To analyze the qualifications of industrial arts teachers to teach auto mechanics and to investigate means whereby they might become better qualified" (72, p. 1).

Course content for vocational automotive mechanics was divided in the major headings of: (1) theory, (2) maintenance, (3) repair, (4) testing and diagnosis, and (5) general information topics (72, p. 12). Each major division was further subdivided into ten units. Respondents were asked to indicate the value of each item: whether it was considered to be essential, desirable, or necessary to a course in vocational automotive mechanics. A brief description of the objectives of an industrial arts auto mechanics course in high school was included to insure validity of responses.

Robertson concluded that:

> "an auto mechanics course designed for industrial arts purposes should place the greatest emphasis upon the understanding of basic principles followed by testing and diagnosis and then the performance of maintenance and repair operations. The development of attitudes which promote highway safety should be stressed throughout the course" (72, pp. 33, 34).

Crim (29) completed a study in 1965 to study the problem of whether Memphis Technical High School auto mechanics course offerings were meeting the needs and requirements of the Memphis auto service industry. Various types of service businesses were included in the survey comprised of automobile agencies, independent garages, specializing shops, private garages, service stations, and parts distributors. The writer attempted to identify the occupational requirements for each of these jobs.

The instrument used to collect the data was divided into ten major areas concerning automotive components and systems, each having one or more subdivisions, for a total of 73 responses. Participants were asked to check the items which were a requisite of the company represented for a person employed in the automotive service department. Thirty-eight of the 73 jobs listed were rated as a requisite skill by at least one half of the businesses responding. Adjusting the carburetor on the engine, battery checking, adjusting brakes, removing and replacing generator and starting motor, replacing brake shoes, replacing master cylinder, removing and replacing carburetor, replacing ignition points, checking for shorts and open circuits were rated as necessary by the largest number of respondents, with 16 additional items receiving a very close rating just below these. From the study, the author concluded all training should be directed toward agency employment and that the findings of the study needed to be applied to the present automotive program.

Clelland (25) completed a study in 1966 of San Diego senior high schools' automotive programs utilizing job sheets to ascertain the course content of the automotive programs and its relationship to the job sheets and equipment utilized. Purposes listed were to:

> "1) Show the availability of job sheets in San Diego City and County schools.
>
> "2) Determine the usability of the job sheet in the automotive mechanics courses.
>
> "3) Indicate the equipment used in the automotive laboratory when utilizing the job sheets" (25, p. 2).

Ninety-six percent of those responding indicated the utilization of job sheets in automotive classes, with over half indicating that the job sheets

used were commercially prepared. Most instructors required that the job sheets be completed and assigned some measure of value to them.

Clelland concluded that:

"1) Job sheets are extensively used in the beginning automotive mechanics programs in San Diego City and County School Districts, and programs utilizing job sheets are thereby provided with a flexible teaching aid.

"2) When job sheets were used, definite provisions were made for their procurement and duplication.

"3) For the most part, job sheets were required by the automotive mechanics instructors. When they were required some type of recordable value, was assigned in the form of letter grades, credits, or numbers" (25, pp. 85, 86).

Rumble (73) evaluated a high school course of study in auto mechanics at Arcata Union High School to determine its effectiveness under a different plan of instruction proposed for the following year. The course of study was divided into 15 main divisions:

"1) Introduction to Transportation

"2) Frames and Suspension

"3) Lubrication

"4) Electrical System of an Automobile

"5) Engine Theory and Design

"6) Mechanical Troubles and Repair

"7) Engine Block and Overhaul

"8) Brakes

"9) Steering

"10) Tires and Tire Troubles

"11) Transmissions

"12) Differential

"13) Open Period or Open Shop

"14) Special Activities

"15) Inventory and Close Down" (73, pp. 42-113).

He concluded that the course of study could be adapted to the new situation by adding more detail to demonstrations and lectures and by increasing time allotments for supplementary reading and work experiences. The author felt more time was needed in frames and suspension, electrical systems, and engine theory, and the program could be further strengthened by additional oral reports, notebooks, and written reports. Instructional equipment and facilities also needed updating and additions.

Binns (16) completed a survey in 1967 encompassing 103 general automobile and truck repair businesses to determine occupational opportunities and training needs in the automotive and truck repair field in metropolitan Nashville and Davidson County. Among the various purposes of the study were to ascertain:

"1) The type and size of general automobile and truck repair garages and the relationships, if any, between the type and size of garages and their employment requirements and training needs.

"2) Formal education requirements by employers and their compatibility with the practice of offering the high school diploma as a certificate of satisfactory completion.

"3) The importance which employers placed upon certain personal characteristics as a qualification for employment in their establishments, and its relation to possible teaching and counseling practices as a means of improving upon these characteristics.

"4) The importance which employers placed upon manipulative jobs common to most general automobile and truck repair garages, and its relationship to the need for updating the training courses by the elimination of obsolete practices and the initiation of new procedures which were in effect in modern garages.

"5) The importance which employers placed upon certain related subjects as a part of the automobile mechanics curriculum and its relation to current requirements in high schools in which automobile mechanics was taught" (16, p. 2).

To determine instructional information, participants were asked to respond by rating items on a five-point scale. The major divisions were broken into several subheadings, and these were divided into specific processes, jobs, or procedures common to the automotive trade:

"The Chassis

The Brake System
The Suspension and Steering System
The Chassis Lubrication System
The Electrical System, Exclusive of Ignition

"The Power Plant

The Engine
The Engine Lubrication System
The Fuel System
The Cooling System
Ignition

"The Power Transfer System

The Clutch
The Transmission, Conventional
The Transmission, Automatic
The Propeller Shaft and Universal Joints
The Differential and Rear Axles

"Accessories

Heaters
Radios
Air Conditioners

"General

Safety
Trouble Shooting
Foreign (Imported) Automobiles

"Desirable Related Subjects" (16, pp. 110-116).

Results were reported by size of industry, small, medium, and large, responding. Means were computed for each category to give a figure in each of the three divisions to denote the value and importance of the item.

Personal characteristics were rated by garage owners. Among those rated highest, in descending order of importance, were honesty, willingness to work, mechanical aptitude, ability to get along with others, ambition to get ahead, personal appearance, good health, with a high degree of intelligence being rated last.

Binns found that small garages placed less emphasis on the use of charts, manuals, and theory than the medium and larger garages did. Smaller garages rated jobs pertaining to major overhaul as jobs with less value, which seemed to indicate a trend of smaller shops "to replace faulty or worn-out power plants and components with new or rebuilt parts" (16, p. 86). Information indicated that many smaller shops sent complicated or specialized work out to larger or specialty shops.

Precision measurement, shop safety, shop mathematics, and employer-employee relationships were the top four related subjects rated in descending order of importance. Other subjects that ranked lower were applied physics, blueprint reading, technical report writing, algebra, geometry, and trigonometry.

Studies for Manpower Needs and the Development of Technical Curriculums Nationally

Donald Kjarsgaard (50) studied the problems and implications of curriculum planning for the community college. Guidelines evolved from the research conducted that can offer guidance to community college programs and in curriculum development. Kjarsgaard found that the division of

school programs into vocational and transfer often creates problems. A tendency was found in which some students choose the transfer program, when in reality they were better suited to the vocational program. Technicians could possibly be served best by making use of both divisions. Evidence revealed that needless problems resulted when adult education was separated from the rest of the program. Close cooperation with high schools, universities, and the community is essential for a successful program, so much so that a public relations or community service program would be unnecessary. General education courses separated from other programs often resulted in irrelevance and a lack of interest. Guidance and counseling should be closely integrated with the teaching function of the school. Close understanding should be pursued between the administration and faculty of the college. Teaching should not be separated from learning, but the students and faculty should work closely together.

Bessire (15) conducted research in 1965 relative to the development of occupational vocational-technical education programs at Shasta College, Redding, California, by utilizing student and community needs and opinions as a reference. Data were collected by analyzing reports and documents in addition to interviewing 90 citizens and school administrators and mailing questionnaires to students. One phase of the research dealt with the history of occupational education at Shasta College. The study was aimed at determining the extent to which the occupational education program at Shasta College was meeting the needs of the students and community it was serving. Respondents indicated they were generally satisfied with instructional quality and course availability, but a majority expressed the opinion that instruction could have been improved. Most indicated that the training

offered by Shasta College was meeting their occupational needs, with the majority of the respondents indicating that they had found work in their major field of specialization. Students felt the program could have been improved if placement services were upgraded. Some data were obtained by examination of documents and statements of purposes made by educational institutions and by interviewing educational personnel to determine if student and community needs were of primary interest in developing programs. Administrators stressed a lack of administrative time in proportion to the increased student enrollment which did not allow them to develop the curriculum. They also felt that no one person had the responsibility of systematic vocational-technical curriculum development.

Bessire analyzed stated procedures for curriculum development and census data and interviewed community employers and labor leaders. Industrial personnel responses seemed to indicate the trend that local industry was not recognizing the college as a potential source of training of needed workers. Data also indicated that Shasta College was not meeting the needs of the two major industries of the community, lumber and wood manufacturing, in proportion to the number of people employed in these occupations.

Arnold (3) utilized the cooperation of 130 management and technical personnel of 40 Illinois industries, each employing 200 or more employees. Respondents provided viewpoints and data to provide recommendations for the development of technical curriculums. The study also yielded information relative to the management and technician group which might be useful to members of local curriculum committees and other groups. Each participant sorted a 99-card curriculum deck into related, somewhat related, and unrelated piles. The cards listed course descriptions of many areas of

subject matter related to technical work. Ten research hypotheses were postulated and tested by means of chi square, product moment correlation, and two-way analysis.

Arnold concluded by use of an analysis of variance test that not all levels of management personnel selected the more general areas of subject matter, as he had hypothesized. Significant evidence was found to reject his original statement. He also noted the cooperation and willingness of industry to provide assistance and information in developing educational programs, even though their specific company is unlikely to benefit directly. Indications are that this might be due to a social concern for the nation by company officials.

Kavieff (47) conducted research in 1961 to ascertain current trends and historical factors in post-secondary technical education relative to the Detroit area automobile manufacturing industry. A second purpose was to determine the number of present technical personnel and future manpower needs to serve as guidelines for future educational programs. Objectives of the study were:

"1) To review and report historic factors which have influenced technical education at the post-high school level as published in the literature from 1930 to 1960.

"2) To review and report current trends in technical education on the post-high school level as published in the literature from 1930 to 1960.

"3) To review and report current trends in technical occupations at the national, regional, state, and local levels as gleaned from the literature prepared by census agencies.

"4) To survey and report the manpower count of technical personnel in selected occupations, industrial in character, requiring training at the post-high school level for the Detroit automotive industry.

"5) To identify technical occupations requiring training at the post-high school level in the automotive manufacturing industry.

"6) To determine the replacement needs and growth trends of selected technical occupations identified in the study" (47, p. 1).

Information was collected by utilizing personal interviews and checklists. Participants were asked to judge the minimum qualifications for technicians filling openings in their companies. Both educational and experience backgrounds were considered. Respondents were asked to base judgments on 1) company size, 2) rank, 3) authority, and 4) basic knowledge.

Kavieff reached the following conclusions:

"1) In industry there remains considerable difficulty in identifying the technician.

"2) A definite need exists for the development of such educational programs and facilities at the post-secondary level, and that this need will increase in the years to come.

"3) It was determined that there were two technicians to every engineer in the Detroit automotive manufacturing industry in 1960.

"4) It was estimated that about five per cent of the total work force in the automotive manufacturing industry is involved in technical occupations concerned with research, engineering, and manufacture.

"5) The Detroit automotive manufacturing industry has been characterized by rather sharp fluctuations in employment, but in general, this trend has been upward for personnel needed for its technical occupations.

"6) Technicians have been one of the fastest-growing occupational groups in the nation.

"7) The number of entry occupations in the automotive industry is small.

"8) Industrial personnel men showed a definite preference for graduates of post-secondary educational institutions.

"9) Approximately 14 per cent of the technicians were expected to possess a degree in engineering.

"10) The educational thought in the United States for technical education has been strongly influenced by the early technical schools which were founded in Europe as far back as the sixteenth century.

"11) Private technical institutes in the United States tend to limit their offerings to specialized areas.

"12) By 1960, the community colleges of Michigan, while performing a major share of the technical education at the post-secondary level, still placed greater emphasis upon the offerings of a pre-professional character for the transfer subject of the first two years of college than on direct occupational experiences. It was concluded that this was true throughout the nation.

"13) There is sufficient need to suggest that both the technical institute and the community junior college with strong offerings in technical education are needed in Michigan for furthering an adequate program of technical education" (47, p. 194).

Studies for Manpower Needs and the Development of Technical Curriculums in Iowa

Researchers in Iowa have conducted studies in several vocational areas in recent years to determine needs for additional workers and the competencies, skills, and knowledge desired in workers. Data were then utilized in the consideration and planning of vocational programs if they were considered to be warranted. The researcher considered it essential to review a few selected studies of this type to reveal methodology used and for the purpose of comparison and evaluation of the information reported.

Seigler (79) investigated training needs of engineering draftsmen in Iowa by having supervisors of engineering drafting departments complete a questionnaire and by personal interviews. Information was collected relative to (1) areas of drawing, (2) desired qualities of draftsmen,

(3) desired educational background of draftsmen, and (4) equipment, materials, and methods used by the draftsmen (79, p. 2). The information gathered was then presented to indicate trends and facts to indicate curriculum and course content for engineering drafting programs at the high school and post-secondary levels. The study included responses from 173 supervisors of drafting departments. Respondents completed a questionnaire on which they rated items on a four-point scale of very important, important, little importance, or not important.

Seigler found almost 100 percent of those completing the questionnaire considered dimensioning practices, blueprint reading, line weight, sectional views, lettering, and the use and care of equipment as being important or very important. Almost unanimously supervisors rated neat work habits, pride in work, ability to visualize, accuracy, judgment, and initiative important or very important. Responses were also collected relative to educational background desired and the importance of being able to use various pieces of equipment common to the drafting field.

Zook (108) studied Iowa plastics industries by means of a mailed questionnaire. All Iowa industries engaged in the manufacturing or fabrication of plastics were included in the initial list. Ninety-six industries responded to the final form, and 27 personal interviews were conducted.

Objectives of the study were:

"1) To identify Iowa plastic industries.

"2) To identify the employee training needs of all Iowa plastic industries.

a. To ascertain the skills and knowledge desired of prospective employees by Iowa industries.

b. To categorize employee training needs for each area school district according to the number of skilled workers needed and specific skills required.

"3) To ascertain the number of trained and skilled employees needed at the present time and in the next five years.

"4) To ascertain the present source of plastic workers being hired by the Iowa industries.

"5) To ascertain the extent and type of in-service training being conducted by the Iowa plastic industries.

"6) To ascertain the production processes used by the various plastic industries of Iowa.

"7) To ascertain the production materials used by the Iowa plastics industries and the types of products for which they are used.

"8) To ascertain the extent of use of various processes as indicated by the Iowa plastic industries.

"9) To draw some implications for the development of instructional programs" (108, p. 160).

Figures indicated 28,252 employees in the use or manufacturing of plastics, with 2,122 of these considered to be skilled plastics workers. The two divisions of "rubber and miscellaneous plastic products" and "miscellaneous manufacturing industries" encompassed 56 percent of the industries surveyed. Seventy-five percent of the industries indicated in-company training was their main source of skilled plastic workers, with 33.3 percent listing other companies as their main source of skilled workers. Sixty-eight companies reported "on-the-job training" as the most frequently used training technique.

Zook found those industries whose major production process was molding showed the most critical need for skilled workers, indicating a projected demand for 285 additional workers by 1969. Several topics were considered to be important by respondents. These included an understanding of auto-

matic control systems, blueprint reading, A-C circuits, operating the machine lathe, and arc welding. Over 50 percent of those responding gave general mathematics a rating of important or very important. Speech and a knowledge of grammar were also considered to be important. Zook concluded that:

"1) The manufacturing industries of Iowa have a definite need for skilled workers in the field of plastics.

"2) The training needs vary with the size of the industry, merged area, principle process used, and product manufactured.

"3) It is very difficult for industries to predict the number of additional employees beyond one year.

"4) The main source of skilled plastic workers is in-company training programs.

"5) On the job training is the most frequently used type of in-company training by the Iowa plastics industries.

"6) Molding is the major plastic production process used by plastic industries in Iowa.

"7) The major production material used is thermoplastics.

"8) There is a need for the development of instructional programs in the field of plastics in the Iowa area vocational schools" (108, p. 165).

Wilson (106) completed a study in 1968 designed to determine architectural draftsmen needed in Iowa, the knowledge and skills that they were desired to possess, and the present method of educating this group. The questionnaire was sent to 297 industries, and respondents were asked to respond to the importance of items listed on a five-point scale, one being "no value" through five being considered as "essential". Personal interviews were also conducted to major selected areas of the state.

Objectives of the study were:

"1) To identify the Iowa industries, architects, and engineering firms which employ architectural draftsmen.

"2) To ascertain the skills and technical knowledge which the Iowa industries, architects, and engineering firms desire their architectural draftsmen to possess.

"3) To determine the number of architectural draftsmen needed to fill the needs of Iowa industries, architects, and engineering firms now and projected for the next five years.

"4) To determine the present source of architectural draftsmen being hired by Iowa industries, architects, and engineering firms" (106, p. 3).

Wilson found respondents desired draftsmen to:

"be proficient in verbal communication, spelling, listening, and note taking, advanced arithmetic, plane geometry, and basic algebra, as well as the drafting practices of architectural blueprint reading, dimensioning, architectural lettering, architectural symbols, types of lines and line quality, detailing, architectural conventions, sections, elevations, and floor plans."

In addition, skills and technical knowledge in construction practices of main structure familiarity, roof construction, and surfaces, structural steel, reinforced concrete, and site considerations were desired.

Wilson ascertained that in 1968, 533 persons were employed as architectural draftsmen in Iowa, with the results of this study indicating 599 additional draftsmen needed in the next five years. Employers indicated that a vocational-technical school or some college education was a necessary requisite to supplying their needs.

In 1969, Dukes (33) completed a study of the radio-TV servicing firms in Iowa cities of 2,500 or more population to provide information useful in instigating new vocational training programs and upgrading existing training programs. Objectives of the study were:

"1) To describe the population surveyed by this study with respect to the number of technicians employed by each firm, the location of the firm relative to area, and the types of electronic appliances serviced.

"2) To determine the additional manpower needed by firms employing radio-television service technicians due to business expansion and employment turnover at the time of the study and over the next one, two, and three-year periods, as estimated by firm owners or operators.

"3) To determine the sources of training completed by the radio-television service technicians presently employed in relation to the area of the state.

"4) To determine the interest for in-service up-grading for technicians presently employed, as felt by the owners or operators of the responding firms.

"5) To determine the interest by firm owners or operators in the development of training programs to provide service technicians specialized in repairing one appliance.

"6) To determine the technical knowledge and skills felt important by the radio-television service technicians contacted.

"7) To propose educational programs for training radio-television service technicians relative to the reported needs in the respective areas of Iowa" (33, pp. 7, 8).

Seventy-nine percent of the respondents indicated difficulty in employing qualified service technicians. Findings indicated that more emphasis should be placed on the quality of instruction, rather than quantity, since many new technicians were judged as being incapable of performing jobs expected of them without supervision. Dukes found that 807 radio-TV service technicians were employed in the 355 firms participating in the study, with 115 additional technicians needed in the next three years. Fifty-four percent of the technicians presently employed had received their training in schools sponsored by manufacturers, with the next sources listed as vocational and trade schools, correspondence courses, armed services schools, with college technical programs in last place.

Participants were asked to respond to nine main areas of possible training by means of a five-point rating scale. Core subjects of English skills, business practices, and technical mathematics skills were considered of lesser importance in technician training programs. Highest general ratings were accorded AC and DC circuits and machines, electronic components and circuits, test equipment, antenna systems, technical drafting, and mechanical operations and skills. The author proposed that new training programs for service technicians:

> "be highly practical in nature. The initial training courses should basically consist of electronic theory and components and emphasis should be placed on the direct application to the different electronic devices. These curriculums should include some core courses, such as a certain degree of communication skills and mathematics" (32, p. 109).

Research Concerning Automotive Mechanics in Iowa

Schumacher (78) completed a study in Iowa in 1969 concerning Iowa automotive service industry personnel needs. The questionnaire study included 1031 firms doing automotive service work in Iowa who were members of the Independent Garage Owners of Iowa or the Iowa Auto Dealers Association. Purposes of the study were:

> "1) To determine personnel needs of Iowa's automotive service industry both state-wide and by merged area.
>
> "2) To determine the number of automotive service personnel needed to fill the present needs in Iowa and to determine the projected needs for the next three years.
>
> "3) To determine the number of employees that could profit from part-time evening classes and to identify the major emphasis for these classes.
>
> "4) To identify the in-service training programs now being operated by the automotive service industry in the state of Iowa.

"5) To determine a state-wide employee turnover percentage for each job classification" (78, p. 4).

Over 80 percent of the respondents to the questionnaire indicated that they would be willing to hire graduates of area vocational schools but did not state preferences for graduates of these programs. Firms reported a need for additional personnel in several areas. Classifications showing the most critical needs were for general auto mechanics, auto salesmen, auto body repairmen, used car reconditioning men, auto mechanic apprentices, truck mechanics, lubrication men, and parts men. Firms reported 1945 men employed as general mechanics in December, 1968, that 622 additional employees would be required in 1969, 580 in 1970, and 512 in 1971. The supply of lubrication men, service managers, parts men, and radio men was judged to be adequate at the present time.

In addition, Schumacher surveyed automotive service firms to determine the number of present employees that should attend additional training classes. Additional training in electrical systems or components was deemed most critical. Statistics indicated that 639 employees could profit from additional study of modern tune-up equipment, 587 from the study of electrical diagnosing, 454 from alternator servicing, in addition to the areas of customer relations, automatic transmission diagnosing and servicing, and automotive air conditioning serving received demand of a lesser degree.

Schumacher drew the following conclusions:

"1) There is a definite need in the state of Iowa for well-trained automotive service personnel.

"2) There is a definite need in the state of Iowa for additional part-time evening classes.

"3) It was very difficult for firms to predict the number of additional and replacement employees needed beyond one year.

"4) There is a need to consider both the general auto mechanic and the specialist in the training program.

"5) Area vocational schools training programs in the automotive service industry should be maintained and extended" (78, p. 45).

Rich (71) conducted a study in 1969 of nine north central Iowa counties of 90 independent garage and auto dealerships to ascertain skills and knowledge needed by vocational automotive mechanics. The objectives of this study were:

"1) To determine whether the basic skills and competencies necessary to the beginning auto mechanic are being provided by the training program at North Iowa Area Community College.

"2) To determine to what extent dropouts of the automotive program at NIACC may be employable in the automotive repair field.

"3) To determine the order in which skills should be taught to most benefit the student and prospective employer.

"4) To determine the importance of selected personal traits of the beginning auto mechanic.

"5) To determine the desirability of an 8 or 9-week on-the-job training period for auto mechanics students sometime during their second year of auto training.

"6) To determine the ways in which employees in garages and dealerships receive additional training in automotive repair work" (71, p. 4).

Rich found employers mostly believed that the NIACC program was covering the material necessary for a person to begin working as an auto mechanic. Tune-up, diagnosing electrical systems, and brakes were mechanical areas rated by owners or service managers as being essential in a large percentage of cases. Service managers related that the weakest areas

of competence of beginning automotive mechanics was "confidence in understanding and working with the auto electrical system".

Rich found that certain personal traits of beginning employees were considered essential or important in a majority of cases. Among those listed were conscientiousness and efficiency in work, ability to get along with other employees, customer relations, ability to read and interpret technical manuals, getting to work on time and being absent a minimum number of times, and keeping clean. Participants were asked to respond to two different automotive mechanics programs, each structured in their form.

"PROGRAM A	PROGRAM B
1st level	1st level
Introductory, engine theory, engine repair.	Introduction, engine theory, engine repair.
2nd level	2nd level
Clutches, manual transmissions, drive lines, rear ends.	Cranking circuits, charging circuits, ignition systems
3rd level	3rd level
Suspension systems, front end alignment, brakes, tires.	Fuel systems, carburetion, tune-up" (71, p. 52).

Respondents were then asked to indicate how employable a student would be as he completed each level. Most indicated that a trainee completing the first level of either program would not be much in demand. At the second and third levels, most favored Program B due to the expressed need for mechanics with more electrical training.

Upon the completion of his study, Rich recommended that:

"1) There is a need to study the methods of screening prospective students for the auto mechanics program in order to reduce the attrition rate.

"2) Develop a shorter parallel program to train those with less ability, to fill positions in service stations, tire stores, and in areas of repair work in garages and dealerships where less technical knowledge is required.

"3) Develop a short interim on-the-job training program for NIACC auto mechanic students in garages and dealerships.

"4) There is a need for certification or testing program so that auto mechanics can be recognized according to their skill and knowledge of the various areas of auto repair.

"5) Much work must be done by auto mechanics and employers to upgrade the public image of the repair man, and recognize the amount of training and experience necessary to make a good mechanic" (71, p. 39).

In summary, this section has emphasized that the need for high-quality vocational education has never been greater than it is at the present time, and all indications are that this need will grow more critical as time progresses. Well planned comprehensive curriculums and course content are essential to an adequate supply of well trained personnel. The present amount of knowledge is expanding at an ever increasing rate, with society demanding employees with more skill and training than ever before. Studies reviewed have stressed the need for comprehensive formal training programs in automotive mechanics. Numerical projections indicate the demand for additional qualified mechanics to service and repair the ever increasing numbers of vehicles on the nation's roads will continue to rise. The challenge facing the schools of today must be met now that our country can be assured of an adequate supply of competent automotive mechanics.

METHOD OF PROCEDURE

Introduction

Senate File 550, enacted in 1965 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 has emerged concerning the development and planning of curriculums and meaningful course content that meet student and community needs. This need is related to the great diversity of the programs being offered at the post-secondary level in Iowa in the automotive mechanics training programs. 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, with implications for curricular development in this area.

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 ended July 31, 1970, included a list of proposed staff, an estimated budget of expenditures, review of literature, objectives, method of procedure, and a time schedule of the proposed project.

Population

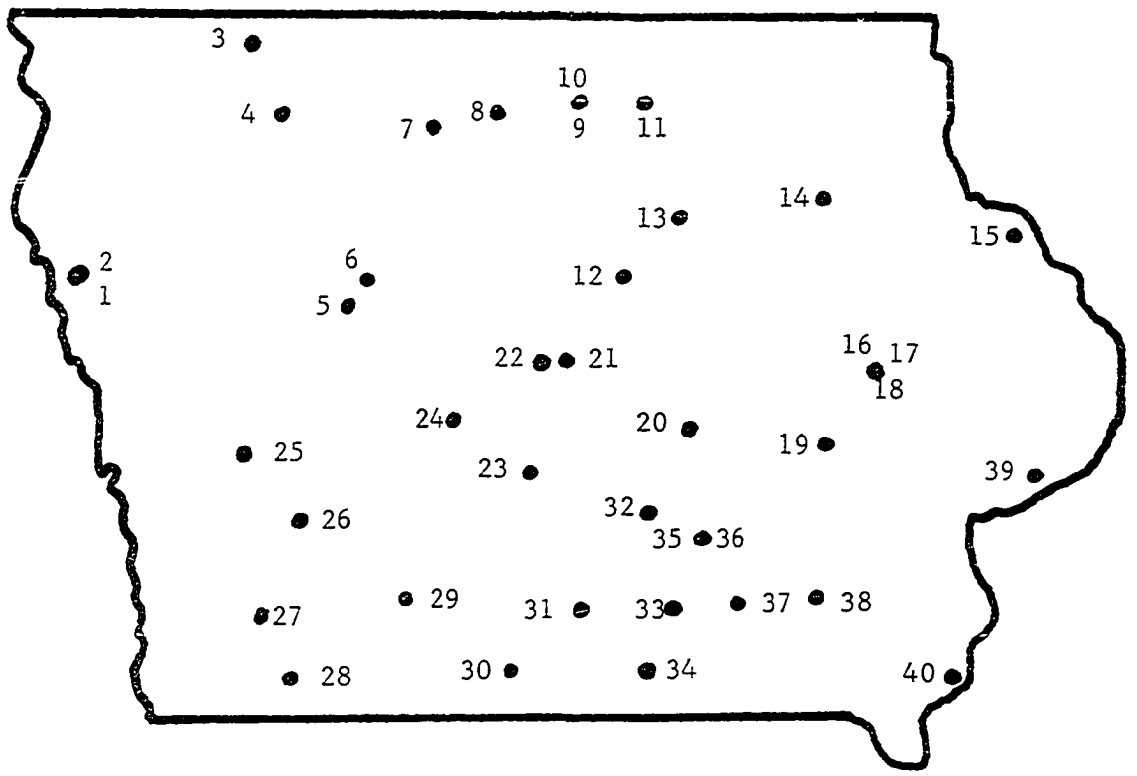
The automobile dealerships and garages included in the study were selected by two state automotive associations in Iowa, the Iowa Auto Dealers Association (IADA), representing the franchised dealers, and the Independent Garage Owners' Association (IGO), representing the independent garages. Each association 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 (78). The final sample consisted of six IGO members and 34 IADA members. The IGO association notified its members of the study and asked their cooperation in the study. The IADA supplied a cover letter of introduction and gave their approval to the study (see Appendix C). A letter of introduction (see Appendix C) 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 location and names of the firms cooperating in the study are given in Figure 1.

Instruments

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. A let-

Figure 1. Location of the garages and dealerships surveyed

	City	Business
1.	Sioux City	Edwards Garage
2.	Sioux City	Ever Ready Auto Hospital
3.	Lake Park	Burns Chevrolet
4.	Spencer	Lee Holt Motors, Inc.
5.	Lake City	Miller Motor Company
6.	Rockwell City	Hinton Motor Company
7.	Algona	Taylor Motor
8.	Britt	Pritchard Auto Company
9.	Mason City	Dale's Service, Inc.
10.	Mason City	Sedars Pontiac-Cadillac
11.	Nora Springs	McNamara Garage
12.	Eldora	Wood Auto
13.	Parkersburg	Kyhl Chevrolet-Buick
14.	Oelwein	Iowa Motor Company
15.	Dubuque	Anderson Weber, Inc.
16.	Cedar Rapids	Fox Garage, Inc.
17.	Cedar Rapids	Allen Motor Company
18.	Cedar Rapids	Modern Auto Service, Inc.
19.	Iowa City	Hartwig Motors
20.	Grinnell	Van Wechel Motors
21.	Nevada	Coover Chevrolet-Oldsmobile
22.	Ames	Motor Sales and Service
23.	Des Moines	Cars, Inc.
24.	Perry	Lauterbach Chevrolet
25.	Harlan	E. M. Christensen Auto
26.	Atlantic	Deter Chevrolet Buick
27.	Red Oak	McAlpin Motors
28.	Clarinda	Opitz
29.	Creston	Kerr Cochran Chevrolet
30.	Leon	Ray Crouse Chevrolet-Buick
31.	Chariton	Golliet Chevrolet
32.	Pella	Ulrich Motor
33.	Albia	Duea Chevrolet
34.	Centerville	Carmer's, Inc.
35.	Oskaloosa	Green's Ford, Inc.
36.	Oskaloosa	Walker Olds-Cadillac
37.	Ottumwa	Vaughn Chevrolet
38.	Fairfield	Wean Chevrolet-Olds
39.	Davenport	Strieter Motor Co.
40.	Fort Madison	Thomas Motors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ter 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 useful information could be obtained. (See Appendix A for letter of inquiry.) The instruments, upon completion, were pretested and revised before final printing and actual usage.

Collection and Analysis of Data

Data were 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.

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. Thirty-nine of the 40 samples made from the service records were utilized in the study. The sample drawn from the service records of one garage was eliminated from the final report because the system of record keeping differed from the others and was not parallel to them. 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 sufficent data, hence 24 times the number of service personnel. A period of 12 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 should 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 were 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 automobile 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 (see Appendix D). 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. In addition, service managers were asked to estimate the percentage of jobs each year that were completed in 11 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 management, and auto mechanics. The following men served on the committee in an advisory capacity:

Al Uitermark, automotive mechanic with 27 years of experience, highly respected in the area as an auto mechanic.

Bill Bone, manager of an independent shop, 30 years experience in all phases of auto sales and servicing.

Leo McGowan, service manager at Dewey Ford, Des Moines, with many years experience in the automotive trade.

Bob Voss, Hertz Rentals agent and representative for consumer interests, operates the rental of large fleet of cars, trucks, trailers, and miscellaneous rental equipment.

Ole Modtland, Area 11 Community College instructor in automotive mechanics, 16 years experience as a service manager.

A very careful attempt was made to select men who were well informed and interested in the improvement of educational programs in automotive mechanics. The author attempted to obtain representatives from various different areas to represent each point of view relative to an educational program.

The committee met formally 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 the auto servicing industry relative to the development of quality educational programs to train automotive mechanics. To satisfy the proposed objectives of the study, information is presented in four sections: (1) personal characteristics of automotive mechanics, (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 were obtained from 40 interviews conducted with service managers or 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 for a final total of 14,849 individual jobs completed by automotive mechanics and service helpers encompassing a one-year span of time. Cooperation with the project was generally excellent. One business contacted indicated that they would not cooperate in the project, one was no longer in business, and two businesses indicated that they could not cooperate with the project at the present time due to extenuating circumstances but would be willing to cooperate in the project at a later time. These businesses were replaced in the original population to keep the final number of shops surveyed at 40.

Table 2 is a breakdown of the job classifications of the personnel employed in the forty garages included in the study. It is interesting to

Table 2. Distribution of job classifications in the 40 shops surveyed

Classification	Number
Automotive mechanics	193
Salesmen	119
Secretaries	82
Parts men	54.5
Service helpers	49
Others	38.5
Total	536.0

note that there was approximately one service helper for every four automotive mechanics employed. A majority of the job categories listed under the heading of "others" were either auto body men or members of the janitorial staff. The large number of salesmen seems to indicate that a sizable part of the firms surveyed depended on the sale of new and used cars for a good part of their livelihood.

Personnel employed in the service departments of the 40 shops surveyed were asked to list the area of their major responsibility at the present time. Table 3 summarizes the responses, ranked from high to low. The classification of "general line mechanic" far exceeded any other, for 60.7 percent, or 147 of the 242 responses, were in this category. All others ranked comparatively low. Only a few specialities were indicated. Those

listed most often were alignment, tune-up, brakes, automatic transmission, and air conditioning.

Table 3. Major responsibilities of automotive personnel in shops surveyed

Responsibilities	f	%
General line mechanic	147	60.7
Service manager	32	13.5
Specialist in one area	30	12.4
Mechanic's assistant	14	5.8
Lubrication man	12	5.0
Used car reconditioning man	6	2.5
Service advisor	1	.4
Total	242	100.00

Each of the members of the service departments listed years of experience in the trade. Responses are summarized in Table 4. One hundred 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.

Respondents indicated education completed and additional training desired if it were available to them. In Table 5, 58 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. Table 6 reveals the formal training in the field of automotive mechanics received by the 242 men surveyed. Three sources of training appear to have been utilized most by the service personnel employed in the businesses surveyed before actual entry into the trade. These were the military, high school automotive programs, and trade school automotive programs. Forty-seven men reported having

Table 4. Years of experience as an automotive mechanic or service man

Years of experience as a mechanic	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	100.00

Table 5. 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 6. Months of training received specifically related to automotive mechanics as reported by 242 mechanics and service personnel

Months	Type of Training							
	High School	ACC AVS	Trade School	College University	Military	Correspondence	Co.	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

received at least part of their training in the military. High school automotive programs were listed by 33, with six to 12 months being the most common length of attendance. Trade schools were listed 32 times, and like high schools, programs of six to 12 months were the most popular.

Company schools and apprenticeship programs were two methods of training used most often after being employed as a member of a service department. The company school appeared to be the most popular and well liked choice of the service personnel surveyed. Personnel expressed the opinion that these programs were very well organized, well staffed and equipped, and usually current and up-to-date with the new model autos. Service managers indicated they favored the company school after an employee had been with the company for a reasonable length of time because the company school was specifically related to the make of the auto that they serviced most. Respondents listing training in the apprenticeship program did not list information concerning the type of program. Many of these were no doubt on-the-job supervision and not supervised by a local committee and registered by the Bureau of Apprenticeship Training. It might be further noted that at the time of this survey, only a small proportion of the mechanics and other service personnel employed had received training at an area community college or area vocational school.

Service personnel indicated their preferences for supplementary training desired, or that would be most beneficial to them personally, by ranking their first three preferences. Some did not want any further training and, therefore, indicated no preference. Responses are summarized in Table 7 and in Figure 2. A week at a company training center was the first

Table 7. Preferences for supplementary training and methods of instruction by the automotive service personnel surveyed

Type of school	Preference 1	2	3	Total
Adult evening school	56	52	41	149
Week at company training center	105	40	27	172
1-2 day session by a manufacturer	38	81	47	161
One-night service school	20	34	68	122
Vocational school	1			1
On-the-job with Dan Gurney			1	1
Business law		1		1
Tune-up			2	2
Local mechanics meetings	6	1	1	8
Correspondence school		1	1	2

choice of 105 service personnel and seemed to be the most popular and widely accepted means of additional instruction.

The one- or two-day session conducted by a manufacturer or the one-night service school seemed to be judged by the personnel interviewed as too short a time to be really worthwhile. It often turned out to be a social function or a means of advertising for some companies' equipment. Meetings of local mechanics were highly rated by several mechanics. Several service managers also related that they conducted these meetings locally once or twice a month with attendance required by his staff. One service manager went so far as to assign reading material to his staff concerning the servicing of automobiles. Members of the service staff were then given a quiz over the material and were paid according to their individual test score.

Service managers indicated whether they had previously employed graduates of post-secondary automotive mechanics training programs. From Table 8

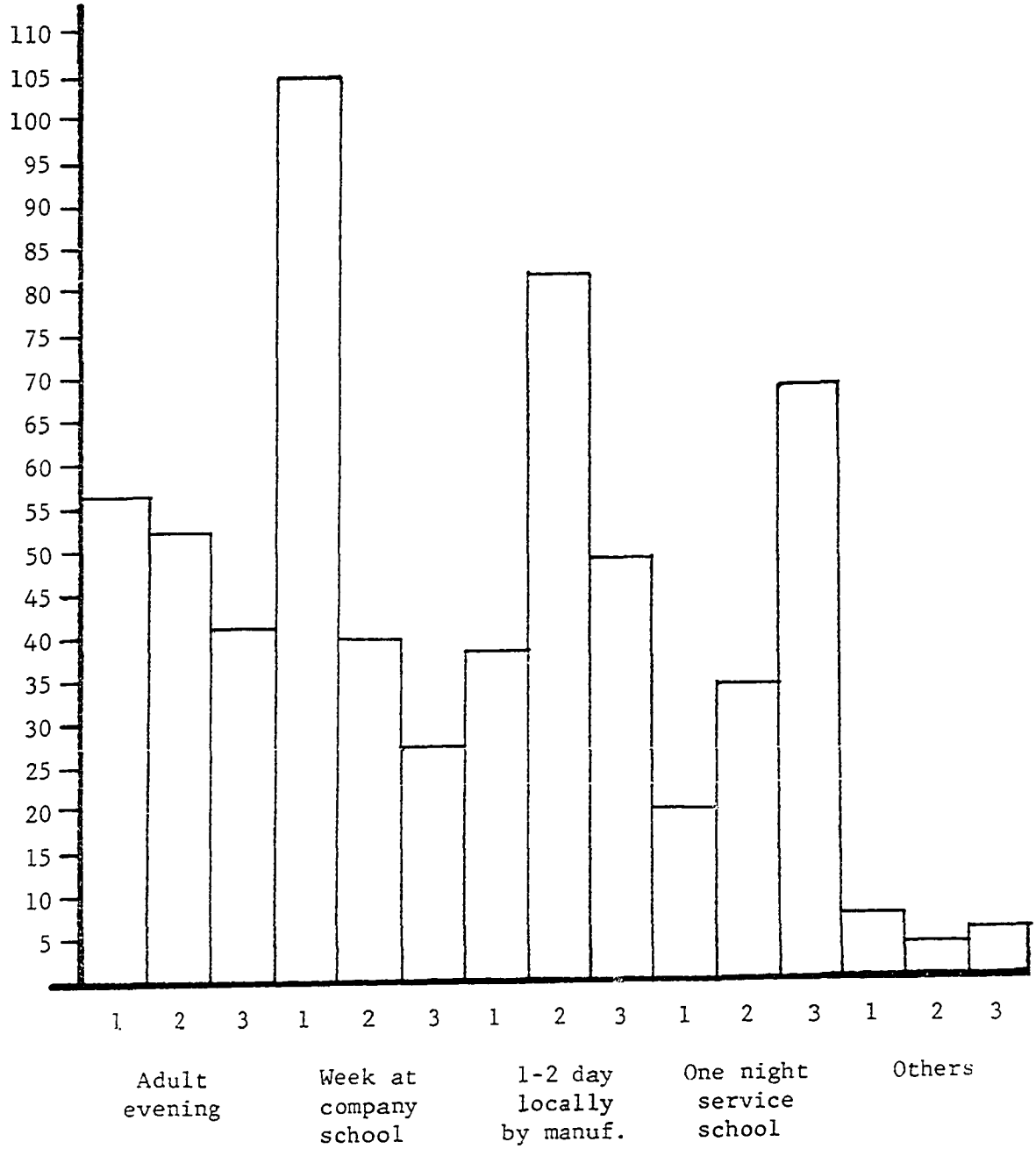

Figure 2. Preferences for supplementary training and methods of instruction

Table 8. Previous employment of post-secondary automotive mechanics program graduates and a rating of their performance by 40 service managers

	Responses (N=40)	%
	f	%
Performance		
Good	10	25.0
Fair	2	5.0
Bad	6	15.0
Indifferent	6	15.0
Yes	24	60.0
No	16	40.0
Total	40	100.0

it may be determined 24 reported having employed post-secondary program graduates, and 16 had not. The service managers who had employed graduates of these programs also rated these employees. Only 25 percent were given a rating of good. In addition, managers were asked to comment on the graduates they had employed. The following is a list of some of the comments received. The respondents were probably more likely to give an opinion if the man he had employed had not been satisfactory to his business than if he had come up to his expectations.

1. "I couldn't tell him anything. He knew it all. He knew some of the major things but not the basics."
2. "Very bad, not worth.....lose us all our customers."
3. "No good. They're trying to make something out of nothing. The boys aren't suited to be auto mechanics."

4. "They want to start at the top of the ladder and start drawing top wages; it takes ten years to start out."
5. "Electrical is the most important; if a boy doesn't have this, there are many jobs a service manager simply can't give him."
6. "Scope diagnosis is the biggest item in the business today; it is the biggest money maker that there is."

Service managers were then 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 9, 63.75 percent indicated that they would prefer to employ the graduate as a "general line mechanic", with an additional 25 percent utilizing the graduate as a mechanic's assistant to start out.

Table 9. 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 11 major areas of automotive service, as recorded in Table 10. Values are

Table 10. 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

listed in percentages. It should be evident to the reader that the service managers estimated total jobs completed each year and not 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.

Service managers evaluated how 17 major automotive components were serviced in their specific shops. Perhaps the data in Tables 11 through 27 can be more easily interpreted if the reader refers to the form that was utilized to collect the information (see Appendix D, Part 4). 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 11 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.

Information recorded in Table 12 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

Table 11. Percentage of engines serviced by four methods

Percentage of engines serviced	Methods: Rebuilt in own shop N	%	Sent out to spec. N	%	Purchased new or rebuilt N	%	Replaced as used units 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

Table 12. Percentage of engine heads serviced by four methods

Percentage of engine heads serviced	Methods: Rebuilt in own shop N	%	Sent out to spec. N	%	Purchased new or rebuilt N	%	Replaced as used units 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

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

Table 13. 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

Table 14 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 another 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.

Table 14. 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

Information is listed in Table 15 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.

The next component surveyed was the distributor. From Table 16, 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.

Utilizing data from Table 17 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 approxi-

Table 15. 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

Table 16. 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

Table 17. 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

mately 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.

Data collected on generator servicing is recorded in Table 18. Sixty-seven and one-half percent indicated over 40 percent of the generators serviced were rebuilt in their own shops. Eighty 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.

Information relative to alternators is summarized in Table 19. The category of rebuilt in own shop contained values over the entire percentage

Table 18. 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

Table 19. 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

range. Almost 50 percent stated 20 percent or less of the alternators were replaced with new or rebuilt units.

Information relative to radiators is recorded in Table 20. 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 20. *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 21. 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

Table 21. 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

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 22. 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 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 23. 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

Table 22. 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

Table 23. 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

is almost identical when one analyzes Table 24, 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.

Table 24. 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

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 25.

Table 26 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 25. 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 26. 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 27 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 27. 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 technical 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 28-31. 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 28. 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 29 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. The proper use of impact wrenches and hand tools were two items listed in addition to those listed in Table 29.

Table 30 summarizes the responses to 51 items of technical knowledge related to the automotive field. It was the researcher's purpose to deter-

Table 28. Importance of personal characteristics and competencies of automotive mechanics

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
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 29. Importance of an automotive mechanic's ability to use major automotive equipment

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
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 29. (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	13	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	

mine 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

Table 30. 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 generation	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

[a]Very little importance.

[b]Only background needed.

[c]Desirable.

[d]Highly desirable.

[e]Essential.

Table 30. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
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
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

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 31. 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.

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 32 for each of the 13 major areas of automotive repair. Tables 33 through 45 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 33 through 45 and are summarized in rank order in Table 32.

Table 31. 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
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

[a]Very little importance.

[b]Only background needed.

[c]Desirable.

[d]Highly desirable.

[e]Essential.

Table 31. (Continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
Check starter amperage draw	0	2	12	11	15	3.975
Service direct current generator	0	2	14	8	16	3.950
Fit bearings	0	2	11	9	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	4	16	6	13	3.650
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

Table 31. (continued)

Item	Rating 1[a]	2[b]	3[c]	4[d]	5[e]	Mean
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

Table 32. 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 33. 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
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

Table 33. (Continued)

Jobs	f
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 34. 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
Install seat belts	1
Total	1,577
Percent of total jobs	10.62

Table 35. 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 36. 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 37. 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 38. 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 39. 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 40. 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 41. Frequency of service related to the transmission

Jobs	f
Check and/or add fluid	156
Replace or rebuild universal joints	138
Repair automatic transmission	128
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 42. 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 43. 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 44. 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 45. 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

DISCUSSION

The information presented in this study will be valuable in the improvement and development of future automotive mechanics training programs at all educational levels offering instruction in automotive mechanics. The data were derived from the eventual employers of the program graduates; hence, the logical source of information relative to the competencies, knowledges, and skills desired in future employees to serve in automotive servicing positions.

The average age of the 242 service personnel surveyed was 37.5 years. Likewise, 44 percent listed having ten years of experience or less working in the automotive servicing trade. This seems to indicate a small amount of experience of the men working as automotive servicing personnel and that they are of a relatively young age. This might present implications for the future updating of programs. A majority of these men were employed as general line mechanics. Few were employed strictly as specialists in one area. This appears to indicate the need to train more young men to be general mechanics in all the areas of automotive service.

Most of the owners or managers in the businesses participating in the study were aware of the area vocational school's automotive programs as being operational, but the majority did not seem to consider them as a good source of competent mechanics. The usual comment was that good mechanics are difficult to find and that often young men are not ready to settle down and accept the responsibilities of servicing customers' cars. Likewise, the consumers often do not seem ready to trust their automobiles to a young, inexperienced mechanic for repairs.

The question of what should constitute a good training program for future automotive mechanics and the length of program required to train a mechanic has been a much debated issue in the past and will no doubt be challenged in the future. It is the opinion of the author, based on the data collected, comments by an advisory committee, and from reviewing current literature on the subject, that the auto servicing industry would much prefer to employ general line mechanics who possess as much knowledge and skill as possible. The problem is that they are not always willing to offer wages, working conditions, and fringe benefits comparable to those received in other occupations for a like amount of education, experience, and ability. Consequently, the profession is in many cases not attracting or holding the best qualified young men. When asked to complete one personal data sheet, one mechanic of approximately 55 years of age said, "You mean there are still young guys wanting to be auto mechanics? Why, if my kid wanted to be an auto mechanic, I'd take my hammer and knock him in the head". Several mechanics expressed the idea that they could not earn as much today as they could ten years ago working flat rate. The lack of labor unions for auto service personnel in most of the shops in the smaller cities and towns greatly lessens their bargaining power and thus the hope of better conditions.

The employers are often caught in a vicious circle with customers who they must keep happy or lose them because of a serious shortage of competent mechanics. In addition, employers are saddled with keeping up warranty claims and the handling of all the service problems connected with the operation of a national franchise. The garages must have personnel to

handle whatever the auto manufacturers make, no matter how bad or elaborate it may be.

The popularity of the company schools, as indicated in Table 7, is probably not due necessarily to better or more up-to-date instruction than those that might be conducted locally but more likely due to the fact the company sponsored schools are usually attended on company time with full pay. There was some indication that mechanics dislike attending local night schools after working at their regular job during the day. It is highly desirable that a mechanic possess a good background and know basic fundamentals before company schools can be utilized to their fullest extent.

Company sponsored service schools appear to be a popular means of keeping employees up-to-date on new model changes and innovations. This provides a possible means of allowing an individual to specialize in a preferred area after he has gained some experience. Most employers would no doubt allow an employee to attend a service school in a preferred or favorite area if it were possible.

The data in Table 9 indicate the automotive service industry desired to employ men to enter the trade as general line mechanics. As one advisory committee member summarized the discussion, "They're saying, don't send me someone who needs a lot of training, send me someone with some background". The old system of apprenticeship is too slow, and the one student to one teacher relationship makes it too inefficient to meet industry demands. School programs offering students fundamentals and then an opportunity to apply them appears to be the best choice.

All of the items in Table 28 have a high enough value to warrant consideration and inclusion in automotive mechanics' training programs, but

several individual items should be stressed. One is the importance of diagnosing automotive service problems. Probably very few students could become good diagnosticians without at least several years of practical on-the-job experience. The recommendation is made that diagnostic ability could at least be improved by teaching system analysis, or the breaking down of complete systems into their respective parts, and from this, attempt to locate the trouble or malfunction. A diagnostician must recognize symptoms and have a good understanding of "why". The committee expressed the idea that teaching how to diagnose is much less effective when done on models and mockups or spare parts than if real live units are pulled in off of the street and utilized.

Safety can be taught best by making the shop safe, by keeping the shop and equipment in good shape, and by establishing and enforcing safety rules.

Cleanliness appears to be important in the automotive service field. The personal cleanliness of mechanics is considered to be very important, especially in the larger shops. Parallel to this is the importance of a clean shop and well cared for equipment. Some consumers tend to rate the quality of service they will obtain by the cleanliness of personnel, equipment, and facilities.

The number of engines reported by the 40 garages (Table 11) replaced from auto wrecking yards is probably accurate for the garages surveyed, but this figure seems low for the state as a whole. It is believed that the number of younger drivers and do-it-yourselfers are utilizing this system of engine repair. The Hertz Rental Committee representative indicated that one of his most popular rental items was an engine hoist.

The data of Table 26 listed under the heading of rebuilt in own shop should be interpreted as the replacement of small parts such as valves and gaskets in most cases and not total rebuilding jobs, unless it was warranty work.

The weighted means that were computed for each of the items evaluated by the 40 service managers should not be rigidly interpreted in numerical value but should be used only as a relative scale of importance. The small number of respondents evaluating the items using the five-point rating scale could have influenced the mean values obtained. Variation in any one response could change its value and thus its rank, with no real change in significance.

Automotive mechanics' training programs must begin by giving instruction in basic fundamentals. Related instruction should be taught by personnel who are capable of aiding students in the direct application of this to the automobile. Direct application is imperative to help eliminate the rapid loss of the student who sees no relationship between what he is learning out of a book and what he thinks he wants to be or do. The grasp of technical knowledge is critical for several reasons. First, it is essential to the development of diagnosticians. Second, the young mechanic can advance more rapidly in his education and his job. Third, he will be a more efficient worker in most cases, and last, it will aid a mechanic in making a decision on how to repair a component or system, whether to rebuild or replace it, and this eliminates mistakes and inefficient learning by trial and error. Students should know why they perform an operation or test. Practically anyone can be taught how to change spark plugs or

make elaborate tests on components for example, but knowing why and when is just as critical, or more so, than how.

The importance of reading and the comprehension of what is read is very important. Many new devices such as curburetors, electrical components, engines, and transmissions, for example, have many critical adjustments, settings, and service procedures that require reading and studying service manuals. The new mechanic should not attempt to memorize these, due to the complexity and the fact that the situation changes each year as the new cars are produced. The idea should be instilled in the students that it is not the sign of a poor mechanic to have to look something up or to read for further information.

The fact should be emphasized that the knowledge of certain equipment and the operation and jobs that could be completed utilizing it would be very beneficial to future automotive mechanics as background information. Some information and skills must be taught, even though chances are good that he will never be expected to use them. Such items would be taught for background information to give the mechanic depth. Although the graduate might never be expected to regrind a crankshaft or replace valve seats, it is still important that he be exposed to the equipment that he might realize what could be done to repair a component, even though someone else in a speciality shop might complete the job. Students need to be exposed and familiar with these and similar operations so they may be aware of possibilities or alternative methods to consider in repairing a component or system, in deciding if one should replace parts, replace with a new or rebuilt unit, or send it out to a speciality shop. A major reason some equipment is not found in many shops is because personnel are not knowl-

edgeable in its use. In the past, the operations have always been done in some other manner. Schools training automotive mechanics should take the lead and give instruction in not only the common automotive equipment but also in the latest modern equipment available in the field. One advisory committee member put it quite aptly when he said, "Just because you don't find tools in a shop today, you will tomorrow, if we put somebody out there who knows how to use them, not that they can't get the job done without them, because obviously they're doing it, but it involved a lot more guesswork".

Models and mockups can serve a very important function in the introductory stages of a lesson, but it is very important for the students to move to real live units at the earliest opportunity. It is important to force the students to accept the responsibility for making the unit perform under actual operating conditions, that he learn how to "dig in the grease and scrape off dirt and loosen rusty nuts and bolts, even though it might take longer". One committee member gave an example of a boy he had employed who had learned to service the front wheel assemblies utilizing models and dead units. Grease seals were not replaced each time a student tore down the unit and reassembled it because the unit was not going to be used again under actual conditions and, therefore, due to cost, were not replaced. He did not replace the grease seals after he was employed either and had no doubt gained a false impression of how the job should have been completed.

Accounting for individual differences and motivating students appear to be two areas of major concern needing attention in the training of automotive mechanics. All students cannot progress at the same rate, neither

will all students be interested in the same area as much as in another. The instructor is then faced with the dilemma of proceeding at a rate slow enough to insure that the slower student does not become frustrated and disinterested, yet at the same time challenging the better student with problems and questions at his level.

It appears to the author, based on the information collected, that young men in automotive mechanics training programs would receive more personal satisfaction and be more employable if they possessed certain fundamental competencies, skills, and knowledges. One fact was brought into focus again and again while conducting the study; many employers seemed to be as much interested, or even more so, in a young mechanic's attitude than in his automotive knowledge and skills. Service managers kept repeating, "Give me a boy that's willing to learn, one who knows how to work and take responsibility, one who respects the boss and does what he is told, one who will give an honest day's work for his check". Negative attitudes to the aforementioned traits appeared to be responsible for much unhappiness and ill feelings. Information obtained from employers indicates that a young mechanic will be much more employable in an auto service department if he has the ability to perform certain basic skills and operations well, reinforced with the needed knowledge to perform them. Those included are the performance of general service work, tune-ups, including electrical and carburetion, and to a lesser extent, brakes and alignment. Trainees should gain as much experience and proficiency in these areas as possible.

Indications are that young men should not attempt to become specialists first. Many of the shops that are sites of future employment upon the student's graduation are not of a large enough size to be in a position to

employ specialists in each major area of automotive service. The smaller shops must employ men qualified and knowledgeable in several areas. Even in the larger shops, the work often seems to run in cycles and with periods of slack time and extremely busy periods. It seems that a person desiring to specialize in one specific area must first get a general background in the entire automobile, in order that he might understand how his speciality fits in and functions as part of the whole.

It is the author's opinion that a two-year program in automotive mechanics can be justified. A logical two-year plan would encompass basic fundamentals and some practical application the first year, with much more experience and practical application the second year. The program would not have failed for a student who did not complete more than the first year because he would still have received the basic information and its application and would make him employable to a certain extent, depending on his individual abilities and skills. Some students might conceivably desire to enroll for only one year or less because of a lack of interest, a desire to earn money, inability, or other personal reasons.

It is imperative that the individual needs of each student be determined and met, that the instructor's duty is to provide for the slow learner, as well as the person with average or high ability. Students should be allowed and required to progress as rapidly and as far as possible, as determined by individual ability and desire. No definite length of time was agreed on for optimum instruction to train men to become automotive mechanics because of the many variables involved. The school should provide the students with an opportunity to gain practical experience before he left to take a job, simply because many of the garages that might

employ him would not or could not give him the further training required and might instead place him in some mediocre capacity, such as changing oil, which would tend to discourage him from the start.

The author advocates a strong guidance function of the automotive instruction staff at each of the schools training automotive mechanics. New students should be interviewed at the beginning of the program and evaluated. This function should be continued throughout his tenure at the school and upon graduation, or at the time he desired to leave the program, aid be given to help place the student in a suitable position. A continuing follow up study could then be made of program graduates, to aid in updating and improving the program.

The area vocational schools need to consider their role in conducting good public relations between the school and the industries they serve. The garages and dealerships need to be informed of programs and activities and should be utilized to serve formally on advisory committees and boards at a local level. It is the researcher's opinion that the teachers in an automotive program could be of real benefit to future employers by helping place students in appropriate jobs as determined by individual abilities and motivations. Teachers are probably in the best position to evaluate and make a judgment on a student's potential and most apparent level of success. A written and skill performance evaluation device might be developed at a later time to evaluate merit and achievement.

This researcher suggests that future studies of the Iowa automotive service industry not be conducted again until a few years have elapsed and that they be well planned and coordinated at that time. Several participants in this study expressed the opinion that they had already partici-

pated in a study or studies conducted by educational or commercial organizations concerning automotive service and were tiring of them being repeated again and again. Perhaps coordinated well-planned studies would help alleviate this feeling of ill will toward useful essential research.

In conclusion, the following recommendations are made:

1) That existing automotive programs be evaluated and revised by utilizing the data that have been collected in this study. Further research should then be undertaken to determine optimum program structure and efficiency.

2) That the findings of this study be presented to the administration and automotive instructors of all area community colleges and vocational schools in Iowa.

3) That whenever possible, programs two years in length be implemented that are structured as follows:

   First Year: Emphasis placed on basic theory and fundamentals with a laboratory application to operable automobiles as time permits. Suggested major blocks of instruction and their related time allocations are: introduction and general, 11 percent; engines, 35 percent; electrical, 28 percent; chassis, 16 percent; and power train, ten percent.

   Second Year: Study of advanced theory, with the major part of the time spent in the laboratory in directly applying theory to real life situations, i.e., development of an understanding of how, why, when, where, and what.

4) That new emphasis be placed on communication between the automotive servicing industry and the schools serving it. The automo-

tive servicing industry needs to become more aware of the needed supervision and capabilities of program graduates, and the schools, in turn, have a good understanding of the needs of the industry.

5) That new emphasis be placed on career education at the junior and senior high school levels to make students aware of working conditions, opportunities, and responsibilities of a specific occupation. The career of being an automotive mechanic, as most other vocational programs, demands early counseling if it is to be developed to the fullest potential.

6) That the development of acceptable personal characteristics and positive attitudes be stressed throughout the automotive mechanics training programs.

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 at least 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 mechanics 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, 10.62; chassis, 9.75; electrical system (wiring), 8.84; fuel system, 8.01; 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 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.

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APPENDIX A: LETTER OF INQUIRY FOR INFORMATION

William Penn College
North Market Street
Oskaloosa, Iowa 52577

I am conducting research relative to an automotive curriculum, geared to post-secondary education in the Community College and Area Technical School programs of Iowa, as a proposed doctoral study.

I am interested in receiving automotive trade analyses dealing with jobs performed and knowledge needed by auto mechanics. I am also interested in receiving any automotive curriculum guides, outlines, curriculum units, or related information you might supply. This information would be used in a review of literature and as a basis of information upon which the author could draw to develop the curriculum.

The study will be conducted under the direction of Iowa State University and the Iowa State Department of Public Instruction.

After a tentative curriculum is developed it will be presented to an advisory committee for consideration and study, and then will be tested in an actual classroom situation.

Thank you for your time and consideration.

Sincerely,

Jim Drost

JLD:jls

APPENDIX B: LETTER OF TRANSMITTAL AND POSTAL CARD QUESTIONNAIRE

1330 Barclay
Oskaloosa
Iowa
August, 1969

Dear Sir;

I am conducting a research project relative to the automobile servicing industry in Iowa. As a preliminary step in my procedure, I need to determine the number of servicing personnel employed in selected garages. Would you please complete the enclosed card and return it today? Thank you for your cooperation.

Sincerely,

Jim L. Drost
Graduate Student
Iowa State University
Ames
Iowa

Dear Sir;

Please complete the following.

Number of automotive mechanics and service helpers employed _____

Thank you.

APPENDIX C: LETTERS OF INTRODUCTION

Iowa Automobile Dealers Association 415 Tenth Street / Des Moines 50309 / Telephone 244-2245

Alfred W. Kahl, Executive Vice President

Dear IADA Member:

This letter will serve to introduce Mr. Jim Drost, a graduate student at Iowa State University. Mr. Drost is doing his dissertation, for a Doctors degree, on Automotive Mechanic Curriculum for Post Secondary Education in Iowa. From this study he hopes to develop a practical course of instruction to be used in Area Vocational schools in Iowa to train mechanics. As we are all aware of the great need, now and in the future of qualified service people we feel this is a study we should support. Please give him any assistance you can.

Alfred W. Kahl, Executive Vice President
Iowa Automobile Dealers Association

AWK:njr

Dear Sir:

You have been selected by your State Automotive Association as a progressive, modern, up-to-date businessman, who is concerned about his profession and business. Your cooperation and assistance is badly needed to aid in the development of a State Curriculum for Automotive Mechanics, at the post-secondary level in Iowa. I believe you can furnish us with valuable information concerning the future training needs of automotive mechanics. Without your assistance and others like you across Iowa, a quality education program simply cannot be developed. Will you help us when we call on you, by giving 15-25 minutes from your busy schedule for an interview, and then allowing me to make a frequency check of your service records covering a one-year span to determine, what jobs automotive mechanics are actually performing in Iowa? Let me assure you all information is and will remain strictly confidential, and our purpose is certainly not to make a comparison of individual businesses. This project is funded by the Federal Government, the Iowa State Department of Public Instruction, and Iowa State University.

Thank you for your time and consideration. Hoping to see you soon.

Sincerely,

Jim L. Drost
Graduate Student
Iowa State University

JD/fd

APPENDIX D: SERVICE MANAGER INTERVIEW SCHEDULE

NAME OF BUSINESS_____ TOWN_____
SERVICE MANAGER/FOREMAN_____ 121

Number of Automotive Mechanics_____ Salesmen_____ Secretaries...._____
Service Helpers....._____ Parts_____ Others....._____

1. Have you employed graduates of a post-secondary Automotive Mechanics Program?

___ Yes Impression of employee: ___Good ___Bad ___Indifferent
___ No Comments:

2. If you did hire a graduate of a post-secondary Automotive Mechanics Program, what would you expect him to be capable of doing?

___Specialist in one area
___General line mechanic
___Mechanic's assistant
___Lubrication man
___ Used car reconditioning man
___Other

3. What percentage of total jobs per year are completed in each of the following areas? (Total of all columns must equal approximately 100%)

0	1-10	11-20	21-40	41-60	61-80	81-100	
							General service work
							Carburetion
							Electrical
							Complete engine overhaul
							Engine repair
							Transmission
							Drive shaft
							Differential
							Alignment, suspension, balance
							Brakes
							Accessories

4. What percentage of the units listed below are:

A. Rebuilt in your shop?
B. Sent out to specialty shops for rebuilding?
C. Purchased as new or rebuilt units?
D. Replaced as used units from wrecking yard?

A	B	C	D	
				Engines
				Heads
				Blocks
				Carburetors
				Fuel pumps
				Distributors
				Starters
				Generators
				Alternators
				Radiators
				Water pumps
				Clutches
				Standard Transmissions
				Automatic Transmission
				Differentials
				Power brake units
				Radios

Rating Scale (check(✓) appropriate rating)

1. Very little importance
2. Only background needed
3. Desirable
4. Highly desirable
5. Essential

5. How would you rate the following personal characteristics and competencies of an Automotive Mechanic?

1	2	3	4	5	
					Adequate command of needed knowledge and skill
					Cooperative and friendly
					Hard, efficient worker
					Adequate communication skills
					Ability to prepare records and reports
					Ability to write neatly and legibly
					Ability to use manuals and charts
					Acceptable customer relations
					Possesses a positive attitude
					Favorable personal cleanliness and appearance
					Ability to diagnose problems
					Punctual and dependable
					Desirable quality of work
					Safe work habits
					Socially acceptable
					Self-confident
					Accepts responsibility
					Plans work logically

6. Rate the importance of an Automotive Mechanic's ability to use the following listed equipment.

1	2	3	4	5	
					Ignition scope(console)
					Lathe and attachments
					Tach-dwell meter
					Timing light
					Remote starter
					Generator regulator tester
					Drill press
					Battery-starter tester
					Combustion analyzer
					Distributor stroboscope machine
					Diode tester
					Coil-condenser tester
					Milling machine
					Compression gauge
					Fuel pump tester
					Vacuum gauge
					Tachometer
					Chassis dynamometer
					Jack, lifts, hoists, stands
					Shaper or planer
					Battery hydrometer
					Battery cell tester
					Cylinder leak tester
					PCV tester
					Radiator cap tester

No. 6 continued

1	2	3	4	5	
					Armature growler
					Multimeter (volts, ohms, amps)
					Wheel balancer
					Valve grinder
					Boring bar
					Oxyacetylene welder
					Oxyacetylene cutting torch
					Arc welder
					Valve seat refacer
					Micrometers
					Dial indicators
					Pressing equipment
					Ridge reamer
					Honing equipment
					Soldering tools
					Plastigage
					Magna Flux
					Set up dye
					Brake drum lathe
					Magnetic caster camber gauge
					Projection caster camber unit

7. Technical Knowledge

Indicate how important it is for an Automotive Mechanic to have an understanding of the following related areas.

1	2	3	4	5	
					Theory of gases and fuels
					Volumetric efficiency
					Piston displacement
					Principles of lubricants and lubrication
					Filters
					Combustion fundamentals
					Principles of carburetion
					Pressure differentials
					Read and trace electrical schematics
					Ohm's Law
					Fundamentals of electricity
					Electrical circuitry
					Principles of electrical generation
					Principles of electric motors
					Solid State fundamentals
					Electromagnets, magnetism, solinoids
					Radio fundamentals
					Timing
					Electrical sending units
					Gauges
					Principles of reading and interpreting measuring scales
					Horsepower formulas and measurement
					Basic machines (screw, wedge, inclined plane)
					Laws of Motion
					Torque
					Mechanical linkage
					Brakes and friction
					Theory of cooling and coolants

No. 7 continued

1	2	3	4	5	
					Air-conditioning
					Heat exchangers
					Hydraulic fundamentals
					Pumps
					Bearings
					Principles of springs and shocks
					Tires and construction
					Balance
					Types of gears
					Gearing and gear ratios
					Gear arrangements
					Engine theory
					Safety
					Vacuum and pressure
					History of automobile
					Reference books and manuals
					Flat rate manuals
					Current publications in the field
					Characteristics of metals
					Shop arithmetic
					Shop algebra
					Shop geometry
					Matter and atomic theory

8. Technical Skills

Indicate how important it is for an Automotive Mechanic to have the following skills.

Jobs

1	2	3	4	5	
					Service DC generator
					Service alternator
					Service cranking motors
					Service pistons
					Service lubrication system
					Service cooling system
					Service fuel pump
					Service valves and valve train
					Service carburetor
					Service automatic choke
					Service air pollution equipment
					Service exhaust system
					Service tires
					Service front end (alignment)
					Service drum brakes
					Service disc brakes
					Service power brakes
					Service suspension system
					Service wheel bearings
					Service drive shaft
					Service rear axle units
					Service lights
					Service heaters
					Service radios

No. 8 (Jobs) continued

1	2	3	4	5	
					Service power windows
					Service power seats
					Service power tops
					Service turn signals
					Service air-conditioning sustem
					Service windshield wipers
					Service dash instruments
					Service drive belts and chains

Operations

1	2	3	4	5	
					Perform scope-console diagnosis
					Install points, plugs, condenser
					Adjust dwell
					Adjust electrical timing
					Adjust voltage regulator
					Test battery
					Make voltage drop test
					Check charging rate
					Check cranking and/or charging voltage
					Check starter amperage draw
					Check circuit resistance
					Fit rings
					Align or replace connecting rods
					Check and align crank and camshafts
					Check crankshaft end play
					Regrind crankshaft
					Measure cylinder taper
					Ridge ream a cylinder
					Bore a cylinder
					Time valves
					Fit bearings
					Service seals
					Repair radiators
					Check fuel pump volume, vacuum, and pressure
					Balance wheels
					Turn brake drums and discs
					Rebuild wheel and/or master cylinders
					Fit shoes to drums
					Make major brake adjustments
					Adjust or repair manual steering
					Adjust or repair power steering
					Check and adjust alignment angles
					Replace ball joints
					Replace control arm bushings
					Replace and/or adjust clutches
					Repair and adjust standard transmission and o. d.
					Repair automatic transmission
					Adjust automatic transmission
					Repair differential
					Repair locking differential
					Check, drain, refill fluid supplies

APPENDIX E: SERVICE PERSONNEL INTERVIEW SCHEDULE

NAME _____ AGE _____

PLACE OF EMPLOYMENT _____ CITY _____

1. Please circle highest grade in school completed.

   1 2 3 4 5 6 7 8 9 10 11 12 College 1 2 3 4 Over 4

2. How many years of experience have you had as an Automotive Mechanic?

____ Less than 1	____ 6-8	____ 20-30
____ 1-2	____ 8-10	____ 30-40
____ 2-4	____ 10-15	____ 40 +
____ 4-6	____ 15-20	

3. In which one of the following capacities are your major responsibilities now?

____ General line mechanic	____ Lubrication man
____ Mechanic's Assistant	____ Used car reconditioning man
____ Specialist in one area (please list specialty) _____	____ Service manager
	____ Other

4. What training specifically related to Automotive Mechanics have you had? Please list months completed in each area.

____ High School	____ Military
____ Area Vocational-Technical School	____ Correspondence School
____ Trade School	____ Company School
____ College or University	____ Apprenticeship
	____ Other

5. In upgrading your skills and knowledge, which of the following would you be interested in participating in? (Please rank first three choices)

____ Adult evening classes
____ A week at a company training center
____ A one or two day session, conducted locally by a manufacturer
____ One night service schools (jobbers)
____ Others
____
____

APPENDIX F: LIST OF JOBS PERFORMED BY AUTOMOTIVE MECHANICS

JOBS PERFORMED BY

GENERAL
1. Wash car
2. Complete lube
3. Find mechanical noises
4. Pack bearings

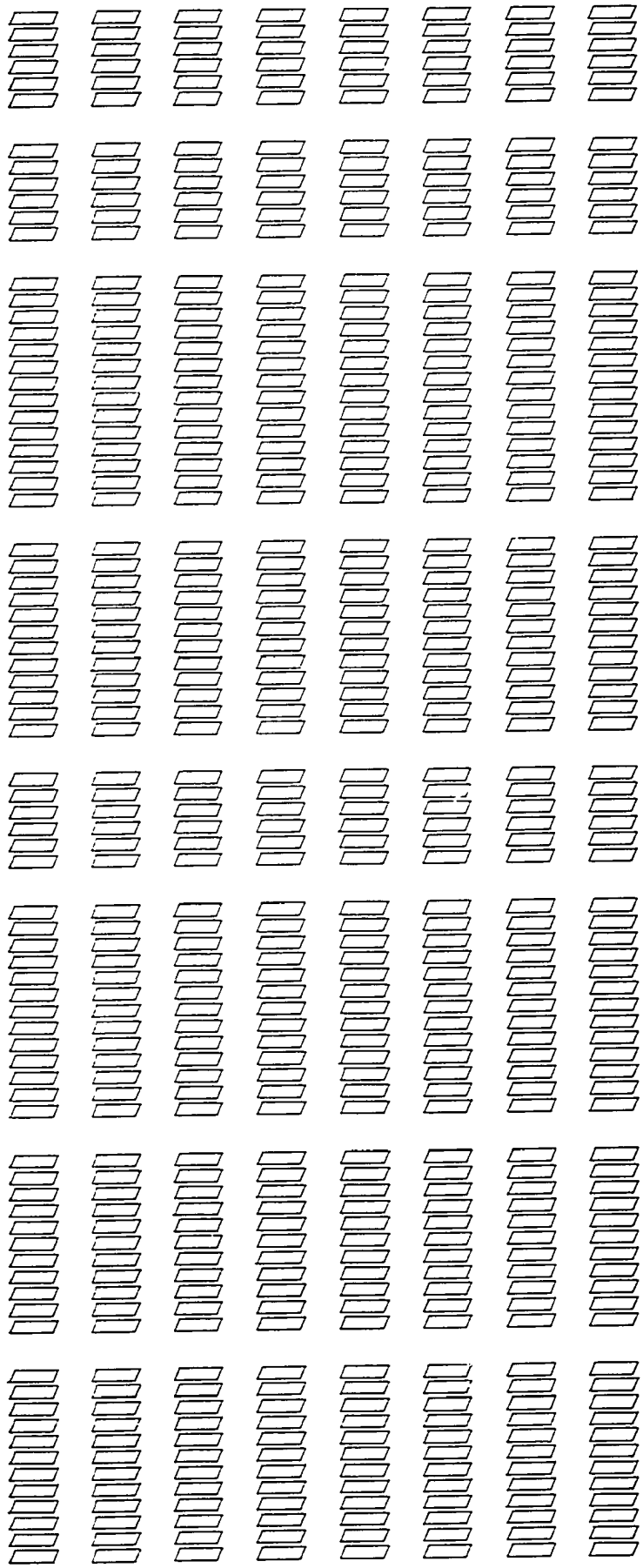
ENGINE
1. Tune up
2. Wash engine
3. Change oil
4. Complete engine overhaul
5. Replace engine
6. Ring job
7. Fit wrist pins
8. Replace pistons
9. Knurlize pistons
10. Align and/or replace connecting rods
11. Replace rod inserts
12. Replace main bearings
13. Replace or regrind crankshaft
14. Replace camshaft and bearings
15. Replace timing chain and/or sprocket
16. Replace vibration dampener
17. Replace flywheel and/or starter ring
18. Replace frost plugs
19. Repair oil leaks
20. Replace or repair oil pump or lines
21. Replace engine mounts
22. Replace oil gauge or light
23. Replace valve cover gasket
24. Replace head and manifold gaskets
25. Replace seals and miscellaneous gaskets
26. Replace or repair head
27. Regrind or replace valves or seats
28. Free sticky valves, check valve guides
29. Service or replace valve lifters
30. Replace pushrods
31. Replace rocker arms
32. Replace rocker arm studs, check oil passage
33. Replace valve springs
34. Replace valve stem seals
35. Service or replace PCV
36. Check compression
37. Check engine vacuum
38. Check engine efficiency
39. Clean oil passages
40. Test and align crankshaft and camshaft
41. Check and/or correct oil pressure
42. Check and/or add coolant
43. Repair or replace radiator
44. Replace hoses, over flow
45. Test and replace thermostat
46. Replace heat gauge, or indicator transmitter
47. Service oil cooler and lines
48. Service fan and belts
49. Test and replace radiator pressure cap
50. Replace water pump
51. Flush cooling system
52. Install muffler
53. Replace ex. manifold
54. Replace header or tail pipes
55. Replace or free heat valve

FUEL SYSTEM
1. Service fuel line and filters
2. Service fuel pump
3. Service air cleaner
4. Carburetor exchange
5. Rebuild carburetor
6. Adjust carburetor
7. Repair and/or adjust fuel injection system
8. Clean and/or adjust automatic choke

ELECTRICAL SYSTEM (WIRING)
1. Repair ignition wiring
2. Replace points and condenser
3. Clean or replace, gap plugs
4. Check vacuum and mechanical advance
5. Set dwell and timing
6. Install or repair solid state ignition
7. Replace distributor
8. Replace distributor cap
9. Replace distributor rotor
10. Check, charge or replace battery
11. Check and/or replace coil
12. Service ammeter or indicator lights

STARTING
1. Service battery cables
2. Replace solenoid
3. Service starter ignition switch
4. Starter exchange
5. Check and/or rebuild starter
6. Replace bendix

MED BY AUTOMOTIVE MECHANICS



CHARGING SYSTEM
1. Generator, alternator exchange
2. Alternator testing and/or rebuild
3. Generator testing and/or rebuild
4. Adjust drive belt
5. Replace regulator
6. Test and/or adjust regulator

LIGHTING
1. Replace bulbs
2. Replace light switches
3. Replace fuses
4. Headlight adjustment
5. Check for shorts or grounds
6. Fix lights

ACCESSORIES
1. Remove and replace radio, antenna
2. Replace heater hoses and/or core
3. Replace or repair ventilation equipment
4. Repair wipers
5. Horn repair
6. Repair clock
7. Repair cigarette lighter
8. Accessory installation
9. Charging freon (AC)
10. Test and adjust AC parts
11. Adjust cruise control
12. Adjust speed warning
13. Service air-pollution devices
14. Service speedometer and odometer

BRAKES
1. Turn drums
2. Replace drums
3. Check and/or replace shoes or lining
4. Recondition wheel cylinders
5. Recondition master cylinder
6. Bleed brakes
7. Repair and/or replace disc brakes
8. Adjust brakes and linkage
9. Replace other parts of brake system
10. Rebuild P.B. unit, vacuum unit
11. Adjust air brakes
12. Check and/or add fluid

CLUTCH
1. Replace clutch
2. Replace throw-out bearing
3. Adjust clutch and finger height
4. Replace pilot bearing and/or lubricate
5. Adjust linkage
6. Rebuild master/slave cylinder

TRANSMISSION
1. Replace transmission
2. Adjust transmission linkage
3. Repair transmission (manual)
4. Repair automatic transmission
5. Adjust automatic transmission
6. Check and/or adjust vacuum control press.
7. Rebuild or replace U-joints
8. Replace drive shaft
9. Replace carrier bearings
10. Replace seals or gaskets
11. Check and/or add fluid
12. Repair over-drive
13. Replace filter in automatic transmission

REAR END
1. Rebuild differential
2. Replace pinion, bearings, seals
3. Replace diff. assembly
4. Replace ring gear
5. Replace carrier bearings
6. Replace axles, bearings, and seals
7. Replace axle and carrier gears
8. Repair limited slip diff.
9. Adjust axle shaft end play
10. Replace seals and gaskets
11. Check or add fluid

CHASSIS
1. Balance wheels
2. Repair tires
3. Service springs, shocks and sway bars
4. Manual steering gear repair or adjust
5. Repair and adjust power steering
6. Alignment
7. Replace front wheel bearings and seals
8. Replace stabilizer bar
9. Ball joints upper and lower
10. Replace trunnions
11. Replace wheel studs
12. Lube suspension