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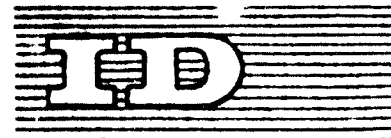
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United Nations Industrial Development Organization

The Seminar on the Establishment and Development  
of the Automotive Industry in Developing Countries

Karlovy Vary, CSSR, 14 October - 1 November 1968

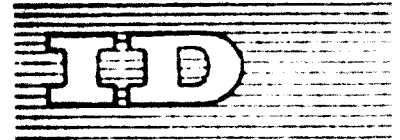
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THE USE OF OLD AND SECOND-HAND ROAD  
TRANSPORTATION EQUIPMENT<sup>1/</sup>

by

Max Alth  
Port Chester, New York

<sup>1/</sup> This study was conducted during the period 30 June 1965 to 1 September 1965.  
The views and opinions expressed in this paper are those of the author and do  
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The Seminar on the Establishment and Development  
of the Automotive Industry in Developing Countries

Karlovy Vary, CSSR, 14 October - 1 November 1968

THE USE OF SECOND-HAND  
TRANSPORTATION EQUIPMENT<sup>1/</sup>

by

Max Alth  
United States of America

SUMMARY

1. The paper examines financial, maintenance and operational factors involved in the purchase and operation of both new and used vehicles and provides a plan indicating how used vehicles should be purchased.
2. The factors that influence the resale price of automobiles and trucks are reviewed, e.g. type of vehicle, original price, manufacturer, appearance, mechanical condition etc. Changes in road laws, loading regulations etc. can make trucks obsolete.

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\* This is a summary of a paper issued under the same title as ID/WG.13/14.

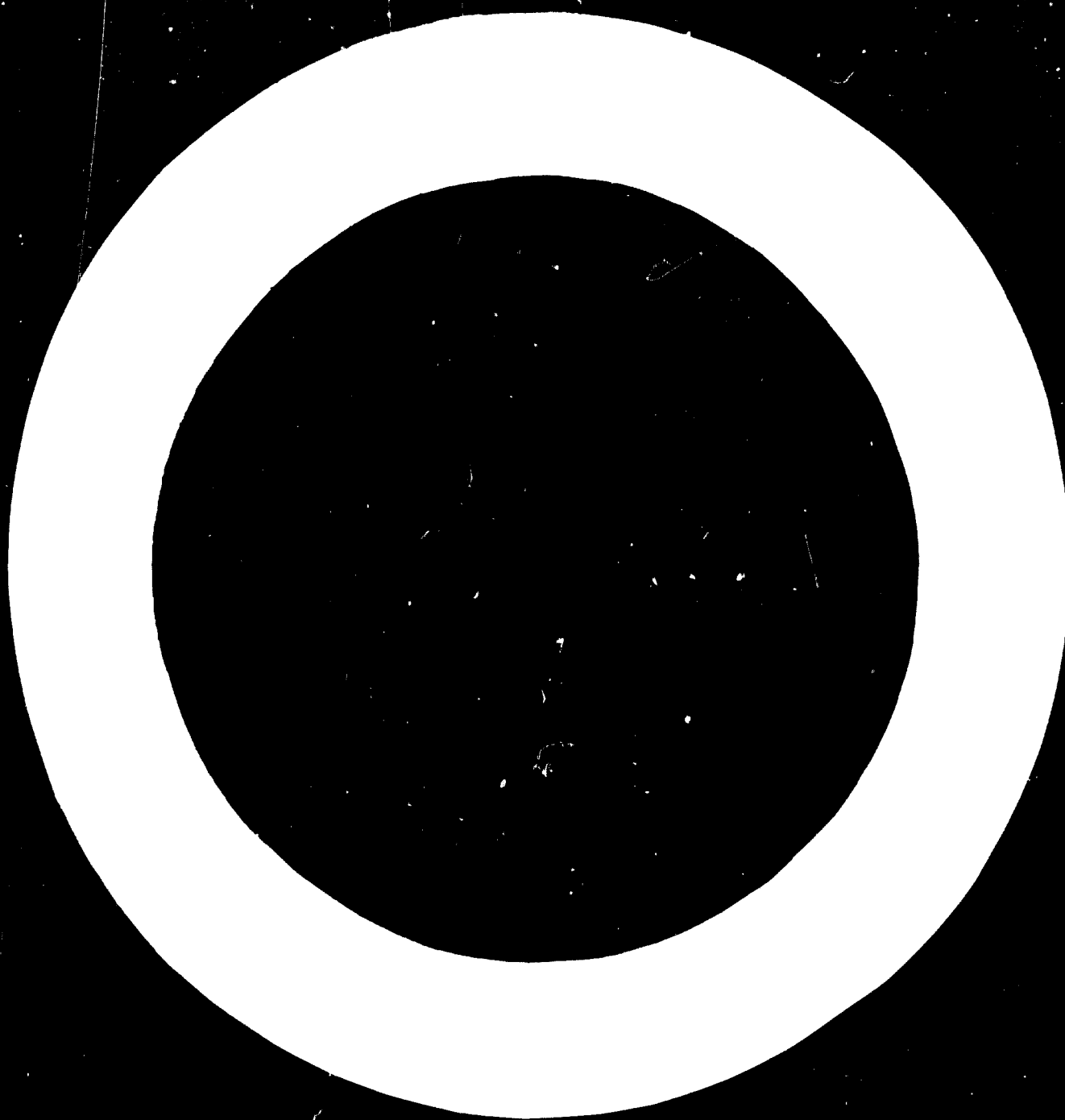
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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

3. The situation of the second-hand automotive market in the United States is described and information on the useful life of cars and trucks is given. In 1963, the average age of the trucks in use in the United States was 8.07 years, a relatively high figure.
4. Initial and operating costs of new and old vehicle fleets are compared. The considerations that must be taken into account prior to purchase of a fleet of vehicles are discussed.
5. Emphasis is placed on the need for skilled mechanics, who are indispensable for both new and old fleets of vehicles.
6. The conclusions of this paper are:
  - (a) Used vehicles can provide transportation at low cost, but only under special circumstances and only if the purchaser is prepared and equipped to cope with the problems presented by used vehicles.
  - (b) In a vehicle fleet, each model should be represented by at least 1,000 units. There should be a 20 per cent inventory of spare parts. The more frequently requested parts should be stored in greater quantity.
  - (c) A complete repair and overhaul shop must be installed and staffed with experienced mechanics, supervisors etc. (A fleet of 1,000 vehicles would require a crew of approximately 100 men.)
  - (d) A well-equipped overhaul shop can be the starting point for the entire automotive industry of a country.



## I. DEFINING A USED VEHICLE

1. The phrase "used vehicle" has many meanings and shades of meaning to the people involved in the motor transportation industry. Therefore, before one can discuss the used vehicle and its applications and problems, the term should be clarified.
2. A used vehicle is generally considered to be any vehicle from a two-wheeled motorcycle to a multi-axle truck train that is sold for a second time. As long as the manufacturer of the vehicle, his distributor, wholesaler or dealer possesses the vehicle and it is not resold, although it may have been driven for a considerable distance, the industry considers the vehicle new. Should one dealer sell to another dealer, the vehicle is still considered new.
3. The vehicle becomes used when any individual or company purchases it with plans to operate it. Technically, as far as the industry is concerned, the vehicle is considered as used on the day the dealer sells it. This is a very important point, for it indicates that a used vehicle may be in any condition and may have been operated for only a few miles and for only a few days to hundreds of thousands of miles and many years of operation and still bear the same simple designation "used vehicle". The term vehicle is thus so broad as to be nearly meaningless as a yardstick for indicating the remaining life and value of a truck or automobile. However, as shown below, the appellation itself can make the selling price of a used vehicle far lower than it should be when measured against the actual amount of potential usefulness that it may have when resold.
4. For the purposes of this report, all vehicles are rated by their years of service. A vehicle that has just been purchased and put to use is said to be less than one year old; a vehicle that has been operated more than one year but less than two is said to be one year old, and so on.

## II. DETERMINATION OF THE SELLING PRICE

5. The price at which a used vehicle is sold depends upon many factors. Obviously, the usual market factors prevail: the eagerness of the purchaser to acquire it and the relative eagerness of the seller to dispose of it. These factors are the same as those that operate in any commodity market anywhere; that is, supply and demand. However, the selling price of a used vehicle is subject to many other factors.

6. The factors that set the selling price of a used passenger automobile are the following:

- (a) its original cost,
- (b) the reputation of its manufacturer,
- (c) its age (as measured from the date when the model was first announced and not necessarily the exact date on which it was first purchased); for example, a 1960 Ford automobile, introduced in December 1959 but actually purchased in December 1960, would be considered one year old if it were offered for resale in the same month. The 1961 models would be on display so the 1960 would be last year's model,
- (d) its appearance,
- (e) the time of year in which it is offered for sale,
- (f) its type (large, small, station wagon etc.), and
- (g) its mechanical condition.

7. Each of these factors must be considered as variable, as each varies with time, place, country, make and model, changes in public taste and the like.

8. It would appear that, the higher the original price of the automobile, the greater its resale price. However, this is not true over the life of all automobiles. For a few kinds this rule holds true for their entire lifetime, but for certain expensive ones it holds true only for a year or two, after which age acts as a detriment, and these cars become less desirable than others that were originally lower in price by half or even more. The resale prices of some kinds of cars fall off very rapidly, those of other makes hold up excellently.

9. The practice in the United States (but not in other countries, although the general trend is very similar and is increasingly like the situation in the United States as the developing country grows in material comfort and in the number of its automobiles) is that an automobile drops in price by one third after one model year, one fourth more the following year, one fifth by the end of the third year, one sixth the next year and so on. Countries in which it is difficult to purchase automobiles, as because of high import duties, do not follow this abrupt drop in value but follow a more gradual scale.



10. The reason for the great drop in price during the first year is, of course, human vanity. In the United States, the public has been conditioned to look upon the purchase of a new car every year as a sign of luxury and wealth. The condition of the car at the end of one year, its appearance, its useful remaining life and its comparison to the new model have no bearing upon the drop in price of one third after the first year. Assuming that the average new car is driven approximately 10,000 miles, a one-year-old car is in better mechanical condition in a number of ways than a brand new one. Most engines are not fully broken in until they have been run for 10,000 or 20,000 miles; until this point is reached, optimum power and fuel consumption are not realized. When it is considered that the average new car is good for about 100,000 miles without an engine overhaul or replacement (although certain parts will have to be replaced), the financial waste of the new-car-a-year habit becomes obvious.

11. The price-drop schedule is different for different makes of cars. In general, the luxury cars such as the Bentley, Rolls and Ferrari tend to hold their prices very well, dropping them only gradually. The exceptions are cars with some special and expensive equipment. An example might be that of a film star who has her Rolls upholstered with wolf skins. Things like this usually have little or no resale value.

12. The prices of cars of the middle luxury group, which includes the Mercedes, Lincoln and Cadillac, drop very rapidly with the years; indeed, far more rapidly than do those of less luxurious makes. The reason is that they appeal most to the group that is most conscious of new models. The very wealthy purchase new cars less often than do members of the upper-middle income group, many of whom purchase for display, seeking to appear more wealthy than they are. Still another factor for the very rapid depreciation of these cars is that replacement parts are very expensive. Furthermore, despite glowing sales messages, cars such as these wear out and break down almost as often as other and less costly ones. To put it in figures, a US \$7000 Lincoln does not last two and a half times longer than a US \$2000 Ford.

13. Lower-priced automobiles such as Fords, Chevrolets, Austins and Fiats, suffer no more than the usual annual price drop given at the beginning of this section. However, with these cars, the prices of those with special equipment such as automatic transmission and air conditioning also tend to

drop more rapidly than plainer, simpler ones. In general, the lower its initial price and the plainer and more utilitarian it is, the more slowly its price drops over the years.

14. Some typical prices are the following: In 1965, a new Cadillac four-door sedan (Calais model) cost US \$5144, and a 1955 Cadillac cost US \$245; a new Lincoln Continental cost US \$6798, and a 1961 Lincoln Continental cost US \$1945 (in four years this car's market value dropped US \$4000); a new six-cylinder Ford Falcon sold for US \$2037, and a 1962 Ford Falcon for US \$510; a new Plymouth Valiant, six-cylinder, four-door sedan sold for US \$2050, and a 1962 four-door Valiant for US \$395.

15. The used-car-buying public is generally concerned with the appearance of the vehicle far more than with its mechanical condition and, in some instances, more than with the actual or model age of the automobile. The only group of buyers that is not particularly interested in the appearance of a vehicle is a very small group of car buyers who purchase for mechanical condition alone. Even this group is somewhat influenced by appearance, because the outside of the car is frequently indicative of its mechanical condition. In general, the poor appearance of a used automobile tends to depress its resale value far more rapidly than its mechanical deficiencies and equally as rapidly as its age.

16. The season in which the used vehicle is offered or sought influences the buying public considerably. The point of highest price asked and received in the United States is the Fourth of July national holiday. Prices taper off after this point to a low at the time when new registration plates are required in January. This low point occurs at nearly the same time that new car models become available. However, the tendency is to try to sell as many of the new-model cars as possible before the new year begins. The price of a used car on January 1, can be 10 to 20 per cent lower than it was on the preceding July 1.

17. In general, the price of used cars follows the original price line, except that the prices of used station wagons holds up better than those of other models because this type of vehicle is widely used by small businessmen, and because the station wagon is often desired as a second car for private use. It can be used conveniently for hauling goods, whereas sedans cannot.

### III. THE MECHANICAL CONDITION OF A USED VEHICLE

18. Like many of the other factors mentioned that affect its price, the mechanical condition of a used vehicle does not follow logic but rather the fancy of the buying public. Every used-car purchaser wants a perfect vehicle. Unfortunately, however, very few buyers, other than professional dealers, have any real knowledge of how to test and evaluate a used car. If it is not noisy, if it displays more power in relation to its weight than the purchaser is accustomed to, if its gears operate smoothly, if there is no smoke from the exhaust and the radiator does not leak, the car is considered satisfactory. Many private buyers take the vehicle to a mechanic for an evaluation. His examination is likely to be somewhat better but still far from perfect. In fact, it can be said that the incompetence of the average automobile mechanic is so great that, after vanity, mechanics as a group, are the greatest cause of new car purchasing. Many people buy a new car every year just to avoid dealings with them.

19. The motoring public itself is largely to blame for the incompetence of the average mechanic that serves it. A good mechanic is a field engineer, worth in the United States US \$8000 to US \$10000 per year. Few repair shops pay this rate, and few motorists are willing to pay the US \$10 to US \$15 per hour necessary to keep so well qualified a man working in a well-equipped shop. Instead, the average car owner takes his car to the cheapest mechanic he can find at the moment.

20. One direct result of this situation is the sudden growth of giant automotive diagnostic centres, constructed and operated by the large oil companies, at which a motorist can have his car tested, but not repaired, for US \$8 to US \$10. He is told exactly what is wrong, and then he can have the work done elsewhere. However, some centres do have repair facilities.

21. Until this point, the present study has considered only the time factor in the depreciation of used automobiles. However, some people wear out their cars well before they reach the bottom of the depreciation curve as plotted against time. Prominent in this group are commercial drivers, operators of municipal vehicles, salesmen and taxi drivers. Some of these people will drive their cars 50,000 to 100,000 miles in a year, and some soon burn out their transmissions by keeping their cars in second gear much of the time.

Taxicabs tend to wear out very rapidly, since their drivers tend to run them at high speed so as to increase their incomes. In some cities, taxicab operators are required to spell out the word TAXI, in holes drilled into the dashboards of their vehicles, so as to warn unsuspecting purchasers of worn-out ones. People who have had unhappy experiences with used cars that were actually older than their years often join the group that prefers new cars; at least they then know what they are buying.

#### IV. THE RELATIVE VALUE OF A USED AUTOMOBILE

22. It can be readily seen from the foregoing that it is quite possible, by judicious study of the habits of the automobile-buying public and a knowledge of motorcars, to purchase a used vehicle in a selected period of its price/age curve that offers considerably more transportation than would a new vehicle on a cost-per-mile basis. In four to five years an automobile will lose on an average of 75 to 90 per cent of its original sales value. However, since the average automobile is good for 100,000 miles, and the average driver uses it for only about 10,000 miles per year, by a car's fifth year it will have one half of its useful life remaining, while its cost may be but one tenth of its original price. In a dollar-per-mile term, that is roughly a 5:1 improvement. For example, if a new US \$4000 car will last for 100,000 miles, and if a used, five-year old car costing US \$400 will go for 50,000 miles, the new car mileage costs US \$4.00 per 100 miles, while the used-car mileage costs but eighty cents per 100 miles. While this relationship is not exactly true, it is closer than is immediately apparent because, although one- and two-year-old cars may not require repairs, the three-, four- or five-year-old cars certainly will.

#### V. THE USED TRUCK

23. The factors that affect the selling prices of used trucks are quite similar to those that influence the prices of used passenger cars, with the important exception of the far smaller influence of human vanity. The general rule of depreciation for trucks is one fourth the first year, one fifth the second year, one sixth the third year and so on until the truck reaches a level below which its sale price never drops as long as it is able to operate or can be repaired.

24. However, there are other factors that operate to reduce the selling price of a used truck below what its remaining operating life would warrant.

25. Automobiles become obsolescent artificially. The manufacturers put out new models each year, and their sales efforts are, in effect, condemnations of past models. The actual changes in automobile efficiency, carrying capacity, safety, comfort and dependability do increase each year, but not as rapidly as the decrease in resale value.

26. Mechanical improvements come slowly. The great change in braking occurred about a third of a century ago when the hydraulic brake was introduced, and the only major change since has been the gradual introduction of disc brakes. The only change in transmission was the introduction of the automatic transmission after the Second World War and it is not superior to manual shifting, except in special applications; otherwise it is merely more convenient. The introduction of the alternator was a definite improvement, but not a vital one. A transistorized ignition is another example; it is important to high-speed (racing) engines, but to the average motorist it offers somewhat better cold-weather starting and, indirectly slightly improved efficiency. On the other hand, most mechanics do not know how to repair a transistorized ignition system, and many manufacturers provide special plugs so that, in emergency, the ignition can be returned to standard.

27. Slow but definite improvements in efficiency are constantly being made in trucks. The future holds promise of some important changes, but these are still years away. However, trucks are being constantly made obsolete by changes in road laws, improvements in roads, changes in packaging, increases in drivers' wages and the constant competition for business between truckers and trucking companies where private enterprise prevails.

#### VI. THE EFFECT OF ROAD LAWS ON THE RESALE PRICES OF USED TRUCKS

28. When a country improves a road to permit faster movement of vehicles over it, that country acts to reduce the number of vehicles required in the area served by that road. When a country acts to increase the speeds permissible over its roads or acts to permit greater axle loading of vehicles on them, that country acts to reduce the number of vehicles that its transportation industry requires. These changes occur constantly, in varying degrees, in countries throughout the world.

29. Obviously, when the top permissible speed is increased by 10 per cent, for example, vehicles capable of operating 10 per cent faster can make their trips in roughly 10 per cent less time; thus, 10 per cent fewer vehicles are required. The same is true when permissible loads are increased. Ten per cent may not appear to be a large factor, but this amount reduces almost all other costs. Not only are 10 per cent fewer vehicles needed, but also 10 per cent less fuel, fewer drivers, fewer mechanics, fewer spare parts, less capital investment, insurance, garage space and so forth.

30. It can be readily seen then that, as the roads of the world improve, as greater speeds and heavier loads are permitted, groups of vehicles will be taken from service despite their remaining useful life and replaced by vehicles capable of greater speeds and greater loads.

#### VII. VEHICLE OBSOLESCENCE

31. Existing vehicles are not made obsolete by mechanical improvements as rapidly as they are by changes in roads and road laws. Mechanical improvements in all fields of vehicular transportation are made constantly, but their day-to-day effects are negligible; their cumulative results being noticeable in certain fleets of vehicles only over long periods, and in limited areas at any given time.

32. One reason is the nature of technological advance. An inventor develops a concept, and after some time a manufacturer reluctantly carries it into the development stage. Manufacturers develop new products from necessity only. If they do not, their competitors will; therefore they must. The progress of a new product from development to manufacture is slow, painful, risky and highly expensive. Not only the public but the users, mechanics and other field personnel must also be prepared for the change. In addition, there are problems of design, tooling, manufacturing and, last but not least, the new idea or product must pass actual trial by use. There are dozens of inventions and improvements that come readily to mind that were introduced with great expense and fanfare but that were found to be unacceptable, many through no real fault. Chrysler's uni-frame car, coupled with its air-flow design, which are two basic and accepted principles of automobile and truck design today, almost destroyed this company when produced in volume in 1935. Free-wheeling is another idea that never succeeded, but this was not considered

a good idea. The air-filled rubber bumper, which is still occasionally claimed to be an important protection that could drastically reduce the impact of a crash, has never been accepted because it is less attractive than the chromium-plated steel bumper.

33. Inventions under development and field testing include the turbine engine, the differential diesel engine and the Wankel rotary engine. According to their manufacturers, none of these will be in general production for many years, but have passed testing in the laboratory and are now awaiting field trials and public acceptance.

34. It is a truism that a vehicle can be operated for as long as its owner wishes to operate it. For example, some Mack trucks that have been in constant commercial use for 25 years. Unlike a living creature, a vehicle has no fixed life span; it has parts that wear out but which can be replaced. From the practical point of view, the life of a vehicle can be said to be ended when it is no longer financially advantageous to its owner to continue to repair it.

35. This is not a simple decision, nor can any such decision be applicable to all vehicles in service in all parts of the world. Each type of vehicle wears at a different rate. Each type of service affects a vehicle differently; much depends upon the driver, the maintenance or lack of maintenance given to the vehicle.

36. The average pleasure car can be operated with its original engine, transmission (if manual) and rear end for about 100,000 miles if care is taken. This would include the use of five or more sets of tires, three to five storage batteries, three or four mufflers, exhaust pipes, point adjustment and perhaps replacement every 10,000 to 15,000 miles, four to eight sets of brake shoes, at least one complete front-end overhaul and a complete transmission overhaul for an automatic transmission. These would be the minimum repairs that could be expected if the vehicle were not used as a taxi, not confined to fast city driving nor limited to slow driving as in cruising as a police car, not operated by a bad driver and not carelessly lubricated. Poor driving or lack of maintenance can easily double, triple or even quadruple these needed repairs.

37. The life of a truck depends upon many of the same factors: its work, its load, its engine, the skill of its driver and the quality of its

maintenance. A truck with a engine may be expected to go for 40,000 to 55,000 miles without engine replacement or complete overhaul when engaged in house-to-house (so-called retail-delivery) work. When used for city delivery work, with longer runs between stops and less shifting of gears, the same truck might go 75,000 miles with the same engine. Used for inter-city ("over-the-road") work with long hauls and few stops, the same truck will easily go far more than 100,000 miles and, with special care, even 200,000 miles with the same engine. With a diesel engine, the vehicle could easily double and triple these figures.

38. In retail-delivery work, depending upon the driver, it is not unusual to replace a transmission every 20,000 to 30,000 miles and the brakes every 10,000 miles. Wholesale delivery work, which requires fewer stops per working day, would permit the vehicle to go farther without repairs. Over-the-road work would give even more life. Transmissions on road trucks can be expected to go 300,000 to 400,000 miles between overhauls. Tire life is also greater when the driving speed is constant and the road is smooth and straight. An over-the-road truck can be expected to run 100,000 miles on one set of tires, and several hundred more if the tires are recapped. A retail delivery truck seldom gets 20,000 miles before its tires must be recapped.

#### VIII. TRUCK MAINTENANCE

39. The total average cost of maintenance to truckers in the United States is about 10 per cent of their total income. Maintenance includes repairs, replacement parts, labour, lubrication, inspection, washing and painting. The exact figures varies with different fleets and different types of loads and work, but this percentage is useful as a typical one. It was determined by a study conducted by the American Trucking Association, from 1958 to 1962.

40. This study further determined that Diesel-powered tractors engaged in long-distance hauling required repairs once every 1,758 miles or every six calendar days. Engines were the most expensive component to maintain, requiring one third of the total repair cost. Engines required a repair every 13,000 miles, or once every seven and a half weeks. Failures on the road in the fleets studied amounted to about one per vehicle for each two years of vehicle operation. (It should be noted that these figures are representative of vehicles with an average age of six to eight years.)



41. At a labour cost of US \$4.50 per hour, direct labour charges amounted to 2.65 cents per mile of operation. Sixtysix carriers were studied. Of the repairs required by these groups, 82 per cent were conducted in their own shops. All of the carriers surveyed were successful financially, and all displayed an above-average degree of self-sufficiency.

42. For a number of years Fleet Owner, a McGraw-Hill trade magazine directed to the trucking industry, has conducted a yearly competition among truck fleets to determine which fleets (20 of trucks and 30 buses) were the best managed and directed during a particular year. One winning fleet was Adley. During one year, Adley's vehicles did more than 20 million miles of city and inter-city hauling and operated a total of 652 power units (tractors or self-powered trucks). Of this group of vehicles Adley had 90 trucks between 6 and 10 years of age, 90 trucks over 10 years of age and 79 tractors between 6 and 10 years of age; the rest were younger. To maintain this fleet, Adley employed a crew of some 65 mechanics, or one mechanic for every 9.4 vehicles, or 14.5 man-hours of work for every 1000 vehicle miles.

43. In the same period, Indian Head Truck Lines operated 40 tractors less than 2 years old and 100 tractors between 2 and 5 years old. A few miscellaneous units brought this company's total number of power units to 151, which ran a total of 7,870,000 miles. Its crew of mechanics numbered approximately 22, averaging but 6.8 vehicles per mechanic, and 18.7 man-hours of work for every 1,000 vehicle miles.

44. In the year following, H. P. Hood and Sons operated some 2,000 power units of which 588 were 6 to 10 years old, 715 were at least 10 years old and 1,300 units that were 6 or more years old. The balance were younger vehicles. Roughly, this company needed 225 mechanics in all, achieving 1,000 miles of vehicle operation for every 17.8 hours of mechanics' labour and requiring one man for every 11.8 vehicles. The total fleet mileage was in excess of 21 million miles.

#### IX. THE PREVALENCE OF USED MOTOR VEHICLES

45. The rather surprising answer to the question, "Who operates second-hand motor vehicles?" is "Almost everyone". Even in the United States, which is thought of as the land of the late-model private car and the

brand-new truck, the average (not the median) age of the trucks on the roads was 8.07 in 1963. Furthermore, this figure was higher than in previous years: in 1941 it was 5.60 years; in 1962 it was 7.91 years, and in 1962 it had risen to 7.99 years. It can thus be safely assumed that the average age of the trucks in operation in the United States today must be close to 9 years.

46. In 1941 there were half a million trucks that were at least eleven years old. In 1963 there were almost four million trucks aged at least eleven years, two million aged between eight and eleven years, two million between five and eight years of age, and about 2.25 million over two years but under five years of age.

47. A breakdown, by percentage, of the ages of the motor trucks in operation in the United States in 1963 reveals no figure higher than 7.9 (vehicles aged 1 or 2 years), and that none is below 3.7. Motor trucks aged 16 years or more comprised 7.4 per cent of the total. In 1962, only 6.2 per cent of the trucks on the road were new (that is, less than one year old). Thus, in the United States, where the automotive industry is more highly developed than anywhere else, many more trucks aged 16 years or more are in use than are new ones. Indeed, it appears that most trucks are operated, with a fairly even change of ownership, for at least 16 years.

48. In 1963 the world-wide total of cars, trucks and busses amounted to 146 million, of which the United States had 79 million and Europe 37 million, the balance being divided among other areas. In 1964 the figure was 158 million for the world, 83 million for the United States and about 41 million for Europe. The estimated total world population of vehicles, as of the beginning of 1965, was roughly 168 million, a jump of 11.8 million over the previous year.

49. In 1964, Asia had a total of seven million vehicles. Canada, in contrast, had six million vehicles registered in the same period, and Oceania had only four million. As of the beginning of 1965, Africa had a total of 3.4 million motor vehicles, Asia 8.8 million, Western Europe 46 million, the United States 86 million, Central and South America 6.4 million and the Eastern European countries had 5.9 million.

50. In sharp contrast to these gigantic numbers, some very large countries had and still have but few motor vehicles. The 1965 figure for India was

but 657,000 and the number for 1964 was 632,000, representing a gain of but 25,000 units. This is far below the world 1964 to 1965 gain of 7.5 per cent.

51. The Philippines showed 242,000 in 1964 and only 266,000 by 1965. Algeria had 289,000 motor vehicles registered in 1964 and increased the number to 299,500 by the beginning of 1965. The Democratic Republic of the Congo had 75,000 units in 1964 and but 76,900 in 1965. Mozambique had 51,000 units in 1964 and 54,500 in 1965.

52. As has been noted above, the average age of trucks in the United States is eight probably about nine years. No figures are available for the average age of trucks elsewhere, but one can estimate from fleet reports (Fleet International, McGraw-Hill and other sources) that it is several years greater; at least ten to twelve years of age, and that the average age of passenger automobiles is also a third or more greater than in the United States.

#### X. COSTS AND CHOICES IN USED TRUCKS

53. When this was written (1965), in the United States, a 1958 Jeep sold for US \$375, a 1955 3/4-ton Ford for US \$360, a 1951 1-ton General Motors truck for US \$200, a 1956 Dodge dump truck for US \$485, a 3/4-ton 1960 Ford stake-body truck for US \$880, a 1953 Jeep station wagon for US \$105, a 1961 Chevrolet 2-ton truck for US \$1440 and a 1960 General Motors 2-ton truck for US \$1175.

54. At the same period, in the United Kingdom, a 1955 Atkinson (Gardner diesel engine) 41-seat bus sold for £575, a 1957 Leyland "tipper" (dump truck) for £325, a 1960 Guy 8-wheeled tipper with a diesel engine for £1600 and a 1959 Bedford 7-ton tipper for £245.

55. In considering the price of used versus new motor vehicles, certain comparisons must be made: (a) the initial (purchase) cost, (b) operating life expectancy, (c) cost of operation for the period of use expected, (d) resale value, if any, (e) choice of vehicle types available in relation to service required, (f) availability and cost of replacement parts and (g) special problems.

56. It takes only four years on the average for the market price of an automobile to drop to ten per cent of the original retail sales price. It

takes six years for the price of a truck to drop to this level in the United States. In other countries the drop is slower.

57. The life expectancy of an automobile in normal private use is 100,000 miles over a 10-year period without a complete overhaul. This distance may be extended indefinitely if extensive repairs are made. Thus, at the end of four years, an automobile normally has 60,000 useful miles of life remaining. Thus, a four-year-old car will provide transportation at a cost (aside from repairs) a little less than one fifth that of a new car.

58. The life of a truck depends greatly upon its type and use, but the same general rule applies, since the trucks that are worked harder, such as retail delivery vans, lose value more quickly than do over-the-road vehicles. A six-year-old truck may, on the average, be purchased for 10 per cent of its original price. It could have a life of about 40,000 to 50,000 miles with its original motor before an overhaul would be necessary. Unlike the passenger car, however, trucks are completely overhauled and given new engines several times during their useful lives. Consequently, one cannot state that a six-year-old truck has but 40 per cent of its useful life remaining. Even if this were true, the six-year-old truck offers transportation at roughly one fourth that of a new truck.

59. Comparison of the operating cost of a new vehicle with those for a similar but older one should include costs that are similar such as driver costs and taxes. The costs that are different include repairs, road breakdowns and fuel economy. The costs of garaging, washing, lubrication, inspection, driving, insurance (depending upon comparative conditions), record-keeping and fueling (placing the fuel in the tank) are also similar in used and new vehicles.

60. Fuel costs favour the new vehicle. However, most new vehicles do not achieve their best mileage until they have been operated a considerable distance. With private cars, this may be as much as 20,000 miles. On trucks, this may be between 10,000 and 20,000 miles. After this point, fuel efficiency drops rapidly at first, then less rapidly as the engine wears. The pistons in the new engine are relatively tight and act as a load on the engine. As their rings wear, the efficiency of compression

falls off, pressure against the cylinder walls decreases and spacing and lubrication increase. At 30,000 miles fuel consumption may be noticeably higher than at 20,000 miles, but at 40,000 and 50,000 miles the change is not quite as noticeably.

61. In general, when the efficiency of an engine drops by one third, the engine is overhauled. However, when a vehicle's yearly mileage is low, the savings in fuel would not be offset by a new engine or an engine overhaul, and the engine is not reconditioned or replaced.

62. Obviously, road breakdowns are more frequent with old vehicles than with new ones; however, not obvious to those outside the industry is the fact that road breakdowns are a direct reflection of a lack of maintenance and inspection, and not of a vehicle's age. It is possible, by modern techniques, to prevent breakdowns to the point of but one or two yearly. It is possible to know when an engine will throw a rod or burn a bearing and thus to prevent a possible road breakdown from occurring. Obviously, repairs are more frequent, more costly and more complicated with an older vehicle than with a new one. However, it is impossible to operate any vehicle, new or old, without some breakdowns and some repairs.

63. Individuals who are accustomed to owning their own cars have experienced periods of perfect service from their vehicles. Months and even years may go by without trouble of any kind, the vehicle needing nothing but routine attention. However, it is impossible to drive along any busy public highway without seeing a number of vehicles laid up at the side of the road for one reason or another. When one considers a fleet of vehicles, one must accept the fact that no group of vehicles, and this includes the very best that can be made, no matter how little used, can escape some kind of trouble indefinitely. The principal difference between a fleet of new vehicles and a fleet of old ones is only in the number of mechanics needed to maintain it. As has been shown, the number of mechanics needed depends as much upon their skill and experience and the quality of their supervision as upon the age of the vehicles they service.

64. Still another reason why public or private repair services should be available for all vehicles is that they are often involved in accidents. Trucks and cars go off the road, collide, fail to be supplied with fuel, lubricants or water, are driven improperly and so on. Mechanics and repair facilities must be available, if only for emergencies.

65. The resale value of trucks, buses and passenger cars drops most sharply during their first few years. Consequently, from the point of view of long-term investment, and the maximum return on invested funds, the older vehicle offers more than the new one, and the vehicle held the longest offers the most. A new motor vehicle that is sold after one year and operated for only one tenth of its expected life or mileage costs its original purchaser one third of its purchase price. For example, a vehicle purchased for US \$10000 and sold after one year at the normal rate of depreciation would cost US \$3300 for the year, while holding the same vehicle for 10 years would bring the average annual cost down to US \$1000.

66. At first sight, the prospective buyer appears to have a wider choice among new motor vehicles than among used ones. Here models and styles, each with its own real or imaginary advantages, are introduced by manufacturers every year. This is primarily due to the need for more specialized vehicles, but in some degree it reflects the high volume of business now being done and the competitiveness of the industry. Furthermore, new vehicles can be altered to specification at the factory. However, this range of choice is not as great as it seems. The decision to purchase should be based upon actual individual needs, the compromises that might be made and the relative costs involved.

67. Replacement parts are more readily available for new vehicles than for old ones. However, the cost of replacement parts for new models can, in certain circumstances, be several times greater than that of old parts.

68. New vehicles have problems that old vehicles do not. They almost incorporate some new idea or design that must be tested. However, laboratory and proving-ground tests cannot replace actual testing in the field by the user. As a result, new-model motor vehicles often have quirks and troubles that are costly to find and remove. Old vehicles may have had similar troubles but they have either been found and cured or the vehicle has been removed from the road. For example, the 1955 Plymouth passenger car was constructed with independent front-wheel suspension and hydraulic brakes. When the front end on this particular car became worn, the vertical play or movement of the wheels was considerably greater than when the car was new. As a result, this car had a tendency for the flexible front brake lines to break after the car went over a severe bump, leaving the car without brakes.

Many drivers suddenly found themselves without brakes, without any warning, when the car was two, three or more years old. Mechanics experienced with this car always replaced the front brake hoses with longer ones to permit the extra play. The point is that this particular weakness in design was corrected only after considerable field experience.

69. Assuming that the new and old vehicles are identical in power, load capacity and speed, and assuming further that they are sufficiently alike to make driving and road handling similar, the difference in operating costs between the new vehicle and the old one will be in fuel, lubricating oil and repair costs.

70. As has been noted above, it is impractical to operate any fleet of motor vehicles without repair facilities, if for no other reason than human fallibility, which can cause trouble at any time. Even if brand new vehicles alone are employed at the outset, it is financially impractical to replace them each year; they must therefore be kept for a number of years, and thereby become used vehicles.

71. Consequently, it can be stated that all financially sound fleets operate used vehicles and, further, that they all maintain crews of mechanics to care for their new and used vehicles.

72. Comparison between the cost of maintaining a fleet of trucks with an average age of two years, (that is, with vehicles replaced at the end of every two-year period) and a fleet of trucks with an average age of six years (vehicles replaced at the end of each six-year period) would in effect be a comparison between the numbers of mechanics employed, the parts used, the road breakdowns that occurred and the cost of replacing the two fleets at the different periods.

73. If trucks costing US \$10000 each were used, for example, the vehicle replacement costs for the two-year-old fleet would be roughly US \$4000 per vehicle every two years. The two-year-old US \$10000 truck would have a resale value of US \$6000. This works out to US \$2000 per year for the purchase cost for the trucks alone. The six-year-old fleet would cost US \$9000 per unit for the six years, which would work out to about US \$1300 per year. If held for ten years, the annual vehicle cost would come down to US \$1000. The financial decision as to which would be better would depend upon the relative costs of keeping the two fleets in repair

and, to a lesser degree, upon fuel costs, because repairs would reduce fuel costs when fewer motors were overhauled or replaced.

74. Most important to this study is the fact that repair costs are basically labour costs. More than half the cost of a repair is labour cost. This works to favour new trucks in the United States and other high-labour-cost countries, and to favour used trucks in countries with lower labour costs. However, it should be kept in mind that even in the United States the average truck age is over eight years.

75. This comparison does not include the factors mentioned above that tend to make trucks obsolete, such as better roads, more liberal road laws regarding speeds and axle loads, more efficient vehicles.

76. However, in a developing country whose road network is still inadequate, the vehicles suited to it could also be a number of years older than in a country with more modern roads. There is no point in purchasing a truck that can be operated at 60 miles per hour for use on roads that limit safe truck passage to 25 miles per hour. In fact, an over-powered truck is not only a financial waste, but its extra engine weight constitutes a non-paying load. An under-worked engine runs cold and is subject to sludging and excessive wear. It is desirable to have about 10 to 20 per cent extra engine power as a reserve, but more than that is undesirable and should be avoided.

77. The previous comparison between a two-year-old fleet and a six-year-old one demonstrated that the annual vehicle costs alone would be (starting with a US \$10000 truck) US \$2000 per year and US \$1300 respectively. The resale value of the six-year-old truck is roughly one tenth that of the new truck, or US \$1000. If it is assumed that the six-year-old truck is purchased at US \$1000 and operates for ten years, the cost per truck per year would drop dramatically to but US \$100 per truck. This is why fleets that are not forced by competition to reduce the number of drivers, for instance, and that have trucks well suited to their needs, continue to operate them for ten and more years. Once the shine has worn off a used truck, and the parts have begun to wear, it makes little difference whether the truck is five years old or ten years old if it is maintained properly.

78. It should be noted that there are definite time or mileage periods that are important: such as before or after an engine has been replaced;



before or after the vehicle has been repaired or after installation of new tires. Over the long run, however, there is little difference between a five-year-old truck and a ten-year-old one of the same manufacture. This is a slight exaggeration, of course, but it is intended to emphasize the fact that the difference between vehicles is not their age, per se, but their actual condition. It is quite possible for a ten-year-old truck to be in better condition than a five-year-old one.

79. Assuming a particular vehicle in a particular well-defined and clear-cut service and ignoring accidents and drivers' and mechanics' carelessness, a vehicle will wear out along definite and predictable lines. For example, it can safely be assumed that the tires of a long-haul truck will need to be recapped every 100,000 miles. If the engine uses gasoline it will need to be overhauled or replaced every 200,000 miles; if it is diesel-powered, overhaul or replacement will be required about every 300,000 miles.

Naturally, as time goes by, almost every part will need repair or replacement; indeed, some parts may need replacement several times. After this vehicle has reached a certain age, its parts replacement programme begins to repeat itself. Although there will be an increasing requirement for parts replacement as time goes by, repairs tend to stabilize somewhat and do not increase dramatically. A kind of level is reached and, with proper maintenance, repair costs remain fairly level.

80. Repair costs for a new motor vehicle differ considerably from those of an old one. Initially, repair costs for a new vehicle are negligible. There may be little or nothing the first year, a few hundred dollars the second year and a thousand or so during the third year. The curve of repair costs for a new vehicle thus rises very rapidly. This is why some fleet owners make a practice of disposing of their trucks at the end of the third or fourth year. By so doing, they avoid a complete overhaul, repainting, installation of a new engine and a new set of tires and so on. For fleets in which the appearance of the vehicles is very important and which have keen competition, high labour costs and the like, this can be good practice. But only when the savings exceed the high cost of vehicle replacement.

81. If two truck fleets are compared, one equipped with new vehicles that cost US \$10000 each and the other with six-year-old ones of the same type, and if the trucks of both fleets are operated for ten years, it will be found

that the vehicle cost per year will be US \$1300 for the first fleet and US \$100 for the other one. Obviously, no vehicle remains new, so all trucks in both fleets will require some repairs over the ten-year period. There will thus be a saving of US \$1200 per year per vehicle in the second fleet that can be used to finance maintenance and repairs.

82. As an illustration, it can be estimated that the fleet of older vehicles will require US \$2200 per year per vehicle for repairs. The cost of repairs of the newer vehicles will be far below this figure; indeed, the first year may see few repair costs or none at all. However, the cost of repairing the newer vehicles will rise very rapidly; so fast, indeed, that, by about the fifth year, repair costs for the newer vehicles will approach that of the older ones. Obviously, repair costs in the older fleet will be higher than in the newer one, but as time passes the difference will become ever smaller. A two-year-old truck is twice as old as a one-year-old one, but at the end of the ten years the age difference is only one tenth.

#### XI. A PLAN FOR VEHICULAR TRANSPORTATION IN A DEVELOPING COUNTRY

83. It is shown above that, while there will be some saving in maintenance costs with older vehicles than with newer ones, the difference is not great in the long run and thus seems not particularly significant.

84. However, one major fact, namely, the initial cost of setting up the two fleets was not considered. The fleet of new vehicles that cost US \$10000 each would cost US \$10,000,000 for 1,000 trucks. A 1,000-truck fleet of old vehicles would cost only one-tenth of this sum or US \$1,000,000. Furthermore, in the early years, the older fleet would require more mechanics than would the newer one. However, this is the very essence of successful motor transportation. The capital outlay that would be saved by buying the older fleet and the early establishment of a crew of mechanics would be most desirable.

85. No vehicle is more dependable than the mechanic who repairs it. No vehicle can go farther than the distance its available repair parts will permit it to go. In other words, no vehicle is worth purchasing unless repair service and replacement parts are available. A developing country that as yet lacks skilled repairmen needs such mechanics more than it needs the vehicles. This cannot be emphasized too strongly.

86. A fleet of old vehicles with a large, well-trained, competent group of mechanics and supervisors and a large well-equipped overhaul shop is the basis of an automotive industry. From this starting point an entire nation can be furnished with motor transport. Men can be trained in the shop to be sent out to establish other shops in which more men can be trained, and so on. Parts can be rebuilt for local and national vehicle repairs. Small parts can be manufactured locally for inclusion in the rebuilt components, and then component parts can be built, and so on. The most important needs are know-how and experience.

87. The following are some guidelines for establishing a fleet of vehicles in a developing country:

- (a) The fleet must consist of at least 1,000 power units, whether these are automobiles, straight trucks or tractors.
- (b) Each of the 1,000 units must be of the same manufacture and model.
- (c) There must be a 20 per cent inventory of most spare parts.
- (d) There must be an even greater inventory of parts for the more frequently replaced components such as tires, storage batteries, brake linings, nuts and bolts and the like.
- (e) A complete repair and overhaul shop must be installed. This shop should have its own supply of repair parts and it should include everything necessary for complete engine rebuilding, such as diesel engine pump testing and calibrating equipment, a dynamometer and a crankshaft grinder.
- (f) The shop must be staffed by an experienced crew of mechanics, supervisors, parts men and clerks. This group assures the fleet's running condition and no effort should be spared to find the right men. Untrained men can be added later to this cadre for training, but at the beginning the group must be able to do all that will be needed and have many years of experience. The most practical way to achieve this is to hire an experienced crew even if they must be brought into the country with their families. This will mean that the cost per man will probably be from three to five times local labour costs, and perhaps double what such men received in their home countries. It must be repeated, however, that there is no other realistic way to run a motor transport operation.

To make certain that the men hired have experience with the vehicles purchased, they can be hired possibly from shops that use this equipment. The man in charge of maintenance is a field engineer and his salary must reflect this; it should amount to at least US \$ 20000 per year. Top men in the United States are getting US \$15000 to US \$25000 for the same job.

(g) There are several ways in which vehicles can be purchased in practical numbers. Operators of large fleets may be contacted and arrangements and agreements made in advance so that, when such a fleet replaces its vehicles, the old vehicles can be purchased as a group at a better price than by individual purchase. Companies engaged in leasing fleets can also be contacted.

(h) One advantage of purchasing a group of used vehicles from a fleet is that the parts kept by the operator for repairs can be purchased at the same time. It may also be possible to hire a few men who are particularly experienced in servicing that type of vehicle.

88. It should be possible to purchase 1,000 trucks for US \$1,000,000. Another US \$500,000 will be required to construct and equip a repair shop and garage. One thousand vehicles will require a repair crew of 100 to 150 men. It is suggested that the larger number be hired at first, and that the crew be later reduced as experience grows.

89. A fleet of new trucks might cost US \$10,000,000. A repair shop and garage will still be needed, even if the vehicles are to be replaced at the end of three or four years, and a crew of 50 to 100 men will be needed. The maintenance savings would result from the smaller crew and repair shop. It is doubtful whether the difference between the complete shop and an average shop (for a fleet of 1,000 units) would be more than US \$250,000. At most, the difference between a new fleet and shop and an old fleet and shop would be almost US \$8,000,000.

90. Most important, the old fleet would provide the opportunity to teach and to learn, which will be more important to the developing country than the savings in capital outlay.

**XII. CONCLUSION**

91. The used motor vehicle can offer its purchaser transportation at a bargain price, but only in special circumstances and only when the purchaser is fully prepared and equipped to deal with it. Otherwise the used vehicle will be a financial trap, fraught with problems, disappointments and excessive costs.





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