The Manufacture of Low-Cost Vehicles in Developing Countries
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UNITED NATIONS
New York, 1978

Preface

After 10 years of experience in providing various types of assistance, on request, to the automotive industry in developing countries, the United Nations Industrial Development Organization (UNIDO) concluded that too much attention was being paid to the traditional means of private transportation and that technology of low-cost transportation to meet basic transportation needs was essential. A variety of relatively low-cost vehicles using two, three or four wheels existed, but the technology of their manufacture was not sufficiently widespread to have much effect and in some cases manufacturing and marketing policies were inappropriate.

To discuss the obstacles to the wider use of low-cost vehicles, UNIDO, in co-operation with the Department of Industry and Commerce of the Government of Australia, organized an Expert Group Meeting on Manufacture of Low-cost Vehicles in Developing Countries, which was held at Melbourne from 23-27 February 1976. The Meeting considered such questions as whether these vehicles were technically unsuited to market conditions, whether they were too expensive and what financial or other problems were involved in their manufacture. The Meeting devoted considerable time to discussing copious material on the manufacture of these vehicles in Asia.

This study is based on the data available and the findings of the Expert Group Meeting. Its main purpose is to assist in promoting the manufacture and use of low-cost vehicles in developing countries. It is designed to assist government officials responsible for formulating policies on modes of transportation in their countries and businessmen concerned with the manufacture of various types of transport vehicles. It describes the main types of low-cost vehicles, what is involved in launching their manufacture, and aspects of marketing them. It reviews recent developments in several Asian countries, with particular emphasis on India and the Philippines, where low-cost vehicles have significantly penetrated the market.

In the context of the forthcoming United Nations Conference on Science and Technology for Development to be held at Vienna in August/September 1979, several developing countries are devoting attention to the application of technology for meeting their basic transportation needs. This study, along with others to be prepared by UNIDO, is intended as a contribution to the Conference and its preparatory activities.

The annexes contain a descriptive listing of types of low-cost vehicles with names and addresses of manufacturers. The listing, based on responses to a questionnaire UNIDO distributed world-wide, does not pretend to be comprehensive, but it represents a fairly good overview of the low-cost vehicles available. The annexes also contain illustrations of representative two-, three- and four-wheelers.

Explanatory notes

References to dollars ($) are to United States dollars. The following abbreviations have been used in this document:

AUV	Asian utility vehicle
bhp	brake horsepower
DIN	Deutsche Industrie-Norm
GNP	gross national product
n.a.	not available
NCAER	National Council of Applied Economic Research (India)

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Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

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I. Background

In any country, the development of agriculture and industry requires improvements in transport. Changes in farming methods call for the transport of new farm inputs and for the delivery of the rural surplus to the towns. Industrialization requires increased movement of materials and products, while the growth of the cities creates new needs for passenger transport.

While long-distance transportation in developing countries is reasonably catered for by means of aeroplanes, sea- and river-going vessels, trains and trucks, local transportation is generally inadequate. This local transportation relies, on the one hand, on man- or animal-powered carts, little improved for generations, and, on the other hand, on passenger and commercial motor vehicles designed for use in the developed, high-income economies. Thus, despite the vast differences in climatic, social and road conditions in developed and developing countries, the motor vehicles in use are practically the same. In developing countries, therefore, most vehicles do not meet local needs. They are expensive and difficult to maintain.

Because of the expense, motor ownership for personal transportation is limited to the top social strata. This has often seemed to aggravate and perpetuate an unbalanced distribution of wealth.

The automotive industries existing in certain developing countries have been established through a technological transfer from the developed industrial economies that has been accomplished in stages. The developing country, concerned by the high foreign-exchange cost of importing conventional motor vehicles, first encourages local assembly of such vehicles and then proceeds to incorporate locally manufactured parts for which there is also a significant replacement market, such as batteries, tyres and mufflers. There follows a period during which local content is increased gradually by the incorporation of other parts easily manufactured locally. Then, at some stage, a decision is taken to manufacture the more complex items such as the engine, transmission and body panels. This policy of gradualism has reinforced the dependence of developing countries on the design and technical resources of the transnational corporations that make up the international motor vehicle industry. The assembler necessarily depends on the designs of the original manufacturer, and this dependence persists as local content is increased. In only a very few cases has development proceeded to a point where the local industry has been able to undertake significant initiative in vehicle design.

The normal process of development has thus tended to lock the developing countries into placing prime, and usually sole, emphasis on the manufacture of vehicles designed originally for operation under the very different conditions of high-income economies.

These vehicles can, of course, play an important role in industrialization, but the almost exclusive concentration on them has retarded commercial development of cheaper vehicles designed for local conditions, and so in turn has severely retarded economic development as a whole. Therefore, a need exists in developing countries for cheaper vehicles that could be more widely purchased by small businessmen, farmers and industrial workers. Only recently, and then only to a minor extent, has the need for more appropriately designed and cheaper vehicles been reflected in the production patterns of the main automotive manufacturers.

The typical motor car plant in a developing country produces far fewer vehicles than does its counterpart in a high-income industrialized economy and thus frequently suffers from the diseconomies of small scale, which has led some to query the economic sense of automotive-assembly programmes in developing countries. Nevertheless, the motor vehicle, whether a passenger automobile or a vehicle transporting goods, plays such an essential role in a modern economy that policy makers in almost all developing countries have actively encouraged motor vehicle production even though it may entail cost disadvantages in the short term.

Traditional vehicles need high outputs to be produced at international prices. The figures of 300,000 and 50,000 units per year have often been quoted as break-even outputs for passenger and commercial vehicles having 100 per cent local content. Although lower wage costs and transport savings have enabled many countries to offset the diseconomies consequent on small scale, the fact remains that restricted local demand has often led to high-cost production, particularly at higher levels of local content. In turn, high-cost production aggravates the existing market situation by further reducing demand.

In summary, the development of automotive production capacity in developing countries has entailed the transfer of models drawn from the basic array of motor vehicles produced in and designed to the market requirements and productive techniques and possibilities of the larger, high-income industrial countries. The high price of these vehicles (often

compounded by the increased cost of local production) severely limits their market in developing countries, as the data in table 1 indicate.

TABLE 1. VEHICLE OWNERSHIP AND INCOME IN 1970

	National income per head ($)	Vehicles per thousand persons	
		Passenger cars	Commercial vehicles
United States	4 289	430	88
Germany, Federal Republic of	2 752	223	17
Australia	2 633	312	78
Japan	1 636	84	83
Italy	1 591	190	24
Brazil	376	25	7
Malaysia	295	27	7
Philippines	225	8	5
Nigeria	135	1	1
Indonesia	98	2	1
United Republic of Tanzania	94	2	2
India	93	1	1

Source: Based on *Statistical Yearbook, 1974* (United Nations publication, Sales No. 75.XVII.1).

The fact of limited incomes has stimulated attempts to design cheaper vehicles and to redesign productive techniques so that they are less subject to economies of scale and more appropriate to the economic circumstances of developing countries. There has been considerable development in the design of low-cost two-, three- and four-wheeled vehicles.

In historical perspective, it is of interest that these design initiatives mirror the situation in Europe, particularly after the Second World War, where a wide variety of lightly powered vehicles were developed, including bicycles, scooters, simple motor cycles, cargo and passenger three-wheelers and very simple four-wheelers, which paved the way to the present widespread use of automobiles and trucks.

Low-cost is a relative term, and the boundary between low- and normal-cost vehicles is necessarily vague. The following vehicle types may reasonably be called low-cost:

Two-wheeler (see annex I)

(a) Motorized bicycle, consisting of a normal bicycle and a gasoline motor of up to 50 cc, adapted to power the front or rear wheel;

(b) Moped—bicycle designed with an integrated gasoline motor to power generally the back wheel. It may or may not have auxiliary pedals;

(c) Motor cycle, with engine from 51-350 cc, for sturdy use. May have a side-car for passenger or cargo transport.

Three-wheeler (see annex II)

Having an easily fabricated metal frame and body. The latter can be made in fibreglass reinforced plastic. The engine can be between 150 and 1,200 cc. Vehicle should preferably be for dual-purpose use—passengers and cargo. The single wheel can be either at the front or at the back of the vehicle.

Four-wheeler (see annex III)

As designed by many international companies for production and use in developing countries. They are basically small trucks with body, frame and suspension gear designed for hard usage and easy manufacture in small numbers with simple equipment and tooling. Can also be used as a passenger vehicle. The engine capacity can vary between 600 and 1,600 cc.

The actual cost of these vehicles varies according to the technical conditions, cost structure and tax rates in the country of production. Although one or more of these factors may mean that the final price of the vehicle seems high, the cost will certainly be considerably lower than that of a conventional vehicle produced under similar conditions.

The vehicles described above would thus seem to have a potential market among segments of the population in developing countries that cannot aspire to ownership and use of conventional types of vehicles because of the high cost. To date, however, this potential market remains undeveloped. Despite the existence of a wide range of proved low-cost alternatives, production in developing countries is still concentrated on the traditional means of transportation.

II. The automotive situation in selected countries

India

India, one of the world's most populous and poorest countries, had a vehicle population of 2.3 million in 1974, as shown below (thousand units):

Passenger cars	717
Jeeps	74
Buses	108
Trucks	415
Other four-wheeled vehicles	158
Motor cycles	275
Mopeds	110
Motorized rickshaws	55
Scooters	420

Over the years the Government has encouraged the development of capacity in all branches of the automotive industry, and India is now virtually self-sufficient at close to 100 per cent local content. All production is licensed, and it has been the policy to restrict the number of producers, the number of models and the frequency of model changes. The effect of this policy is most obvious in the motor car market, where production is concentrated on two main models, derived from Morris and Fiat models of the late 1950s: the Ambassador, produced by Hindustan Motors; and the President, produced by Premier Automobiles. In commercial-vehicle manufacture, one company, Telco, accounts for half of total output, with the remainder being spread among four smaller companies. All these are conventional motor vehicles.

In low-cost transportation, the main Indian emphasis has been on the development of two- and three-wheeled vehicles; the manufacture of a cheap people's car has not yet materialized. Production of two- and three-wheeled vehicles began in 1955, and, as can be seen from table 2, they have shown very much faster growth than have the various four-wheeled vehicles. The fifth five-year plan envisages a similar emphasis.

TABLE 2. INDIAN AUTOMOTIVE PRODUCTION

(Thousands)

Type of vehicle	*1959*	*1964*	*1969*	*1974*	*Demand target 1978/79*
Cars and jeeps	16.5	33.6	43.0	46.0	78.0
Commercial vehicles	19.7	31.8	33.4	39.6	92.0
Scooters	2.8	20.0	49.7	80.9	300.0
Motor cycles	3.2	13.9	34.5	53.2	130.0
Three-wheelers	1.5	4.2	6.9	13.8	40.0
Mopeds	1.2	1.4	11.0	29.4	130.0
Total	44.9	104.9	178.5	262.9	770.0

Source: Based on *Automotive and Ancillary Industry*, 1974 (Bombay, All-India Automobile and Ancillary Industries Association, 1974).

Numerically, the two-wheeled vehicles far outnumber three-wheeled vehicles and provide the urban middle class with a cheaper means of personal transport than the car. They are of conventional type and warrant no special comment at this point. The three-wheeled vehicle is a more recent development and is produced in much smaller numbers. Its main functions are in taxi and freight-handling services. The three-wheeled vehicles are powered by two-stroke engines and are usually motor-scooter derivatives modified by the addition of two chain-driven back wheels. In one instance a heavier commercial vehicle is built around a single front-wheel drive.

The four major producers in this field are (production figures for 1974 for three-wheelers are given in parentheses):

(a) Bajaj Auto, Poona (8,251). Three-wheeled vehicles based on the Italian Vespa motor scooter with a 150 cc engine, now manufactured to 98 per cent Indian content. The three-wheeler is mainly used

as a taxi, but the vehicle is also available in the form of a pick-up truck, delivery van and articulated trailer;

(b) Automotive Products of India, Bombay (4,368). Three-wheeled vehicles based on the Lambretta motor cycle, now manufactured to effectively 100 per cent Indian content, with 175 cc engine. The vehicle is available in a wide range of forms, but is primarily supplied as the basic body and cowl for adaptation to the final purpose of the user;

(c) Bajaj Tempo, Poona (1,163, having declined from 3,048 in 1973). Three and four-wheeled vehicles. The company was historically linked with Bajaj Auto but is now completely separate. The Tempo is a single front-wheel-drive vehicle derived from a Heinkel 395 cc engine based on an original design of a company in the Federal Republic of Germany, now effectively manufactured to 100 per cent Indian content. Unlike the motor-scooter derivatives. the Tempo has a fully enclosed driver's cab. Like them it is used for both passenger and goods carriage. The plant is now primarily engaged in manufacture of the four-wheeled Matador van;

(d) Scooters India Ltd., Lucknow. Two-wheeled and three-wheeled vehicles. The plant, although already producing, was still under construction in early 1976. The company, which is publicly owned, has acquired the Italian Lambretta plant and is currently bringing it into production. A separate foundry is under construction, and several semi-independent ancillary industries have been established. A research unit is working on the development of three-wheeled variants.

In the first three cases, the companies began life as Indian distributors for the foreign-made vehicle, then proceeded to local assembly, and, following government approval of motor-scooter manufacture in the late 1950s, moved progressively from an initial 25 per cent Indian content to an effective 100 per cent Indian content at the end of the 1960s. Scooters India is unusual in that it is attempting an immediate move to a 100 per cent Indian content.

There have also been moves to motorize cycle rickshaws, and at least two companies manufacture small two-stroke engines and conversion kits for fitting to rickshaws. One of these–manufactured by Kirloskar Kisan, Poona–uses a 35-cc, two-stroke general-purpose engine developed for agricultural and other use. It is used to provide chain drive to only one of the back wheels, which makes a differential unnecessary.

Apart from this collection of three-wheeled vehicles, a range of motor cycles, motor scooters, mopeds and power-packs for bicycles are manufactured in much greater numbers by several firms. The main motor-scooter manufacturers have already been identified. Motor cycles are manufactured by Ideal Jawa, Mysore; Enfield India, Madras; and Escorts, Faridabad.

Representative prices (January 1976) for these and other vehicles on the road, i.e. inclusive of all taxes, are given below in dollars. The prices were drawn from several sources and may not be exactly comparable. Conversion has been made at the rate of Rs 8.9 to $1.

Type of vehicle	*Price (dollars)*
Moped	250
Motorized rickshaw	300
Motor scooter	550
Motor cycle	600-1 000
Three-wheeled pick-up	1 350
Tempo Hanseat 3-wheeler	2 000
Fiat President	3 900
Matador van	6 000

Approximate ex-factory prices for some of these vehicles are: motor scooter, $400; three-wheeler with cab, $1,000; Tempo three-wheeler, $1,200; and Matador van, $3,200. Final on-road costs are substantially higher because of the imposition of excise taxes (of 9 to 22 per cent), state sales taxes (of 12 to 17 per cent) and minor interstate and municipal taxes. Nevertheless, demand has tended to outrun supply for most vehicles, although the recent rise in petrol prices–the price of petrol is now three times that of diesel–and other problems have led to shortfalls in demand for cars and the cheaper petrol-driven commercial vehicles, and to reduced unofficial market premiums for two- and three-wheelers.

The Philippines

The Philippines, with a population of 37 million in 1970 and a *per capita* income more than twice that of India, has followed a very different path. Completely knocked down (CKD) assembly began in 1952, but policies restricting the number of assemblers and of increasing local content proved abortive. In 1968, some 19 companies assembled 17,400 four-wheeled vehicles. Subsequently the Board of Investments formulated a programme restricting the number of assemblers to five and committing them to a rise in domestic content, from 10 per cent in 1973 to 60 per cent at the end of 1976. The domestic-content formula permits net foreign-exchange earnings to be accounted as domestic content, and several manufacturers have set up plants for particular components with capacity sufficient to supply a significant volume of exports to overseas markets.

In the Philippines, three low-cost vehicles have been developed that could be of interest to other countries: the Jeepney, the Asian utility vehicle (AUV) and the motor cycle and side-car.

Jeepney

The Jeepney is seen in the Philippines as the forerunner of the AUV. The Second World War virtually destroyed the Philippine vehicle population; and in the immediate post-war years, the United States army surplus jeep played an important role, first as a jeep and subsequently in the modified form of the Jeepney. The Jeepney has a lengthened body with a tray carrying two longitudinal benches mounted behind the driver's seat. These are covered by a canopy, and the whole vehicle is highly decorated with both paint and trim.

Francisco Motors, the main Jeepney manufacturer, began as an automotive paint shop in 1947, undertook body building in 1951 and proceeded to assembly and progressive manufacture in 1955. Today—apart from the engine, transmission, drive train and wheels—the Jeepney is manufactured in the Philippines. The prime mover is now usually an Isuzu diesel engine; and the vehicle, although clearly derived from the original jeep, is—effectively a Philippine vehicle.

Asian utility vehicle

Five firms manufacture versions of the AUV. Basically, a simple vehicle has been designed around a standard four-cylinder engine. The chassis is simple and easily fabricated. Maximum use is made of flat body panels that require little forming other than simple bending, usually on a press brake. The development of the AUV has been actively encouraged under the Progressive Car Manufacturing Plan. The lead in the design for the vehicles came from the two major United States manufacturers, Ford and General Motors, both of which have subsidiary assembly companies in the Philippines. Both companies viewed the development in a wider context. Ford developed its vehicle in Australia under the control of its regional office, with the assistance of a Philippine team, and introduced it on the market in 1972. The General Motors model was developed by its English subsidiary, Vauxhall Motors, as part of a world-wide programme with analogous developments in other markets.

In 1975, an estimated 12,500 AUVs were manufactured. The vehicles are all available as simple chassis and cab (in some cases also as chassis and cowl), as low-side pick-up, as high-side pick-up (with or without canopy), as a van and as a Jeepney. The five main models are listed below with sales figures for 1975:

(a) Fiera, manufactured by Ford Philippines at Rizal. Escort engine, 1,100-1,300 cc, imported, Philippine content 43 per cent, is also being assembled in Thailand. Sales 7,197;

(b) Harabas, manufactured by General Motors Philippines at Manila. United Kingdom Viva engine, 1,256 cc. In addition to the usual range, available as a station wagon. Design was adpated to local conditions in co-operation with the Francisco Motors Corporation. Sales 2,123;

(c) Cimarron, manufactured by Chrysler Philippines at Rizal. Developed by Chrysler and Mitsubishi in the Philippines. Neptune engine, 1,400-1,600 cc, imported. Sales 1,328;

(d) Trakbayam, manufactured by DMG Quezon. Volkswagen engine, 1,600 cc, imported from Brazil. Sales 739. (DMG also manufactures a 1,500 cc car, the Sakbayan);

(e) Pinoy, manufactured by the Francisco Motors Corporation at Rizal. Mazda engine, 1,200 cc, manufactured in Japan. Developed by Francisco Motors with benefit of experience of General Motors in developing the Harabas. Sales 589.

Motor cycle and side-car

About 90 per cent of the motor-cycle population (168,000 in 1975) is fitted with side-cars. From 1973 on, motor-cycle manufacture has been limited to four Philippine companies assembling Japanese vehicles. In accordance with the Progressive Motor-Cycle Manufacturing Programme, a local content of 50 per cent is to be achieved by 1980.

The usual form of the three-wheeler is a standard side-car arrangement with the side-car fixed through a rigid three-point connection. The power units are generally in the 80-125 cc range, and the complete vehicle is capable of carrying 250-400 kg or two passengers plus the driver. The side-car is usually fitted by a small, independent workshop, which needs nothing more than elementary metal-cutting and welding equipment. The vehicles are used extensively in both town and country. In the towns they are limited to feeder and secondary roads and are generally restricted by licence in their area of operation. In the country the vehicles have been found particularly versatile and able to cope with anything down to quite simple rural tracks.

Two other motor-cycle derivatives should be mentioned. The motorella, which has two rigidly fixed supplementary wheels trailing on either side of the rear wheel and supporting a body capable of carrying four passengers, is less versatile than the usual motor cycle, and few are obtainable. For a period after the Second World War, motor tricycles were introduced with two-wheel back drive. They proved unstable in operation.

Table 3 gives retail and ex-works prices of low-cost vehicles. The retail prices are based on

ex-works prices (1975) taking into account standard dealer margins. Actual selling prices may be somewhat less. The Philippines imposes a steeply progressive sales tax on automobiles, the effect of which is most noticeable in the Cortina prices quoted.

The ex-works factory prices still include import duties, usually at the rate of 30 per cent and, depending on the degree of local content, may account for 15-20 per cent of the ex-works price. Even with these duties taken into account, the prices of the motor cycle and side-car and the cheaper models of the AUV are at levels that suggest a high market potential. This is reflected in the production data for 1975 reported in table 4. AUV production is about the same as that for all other commercial units. About one AUV is manufactured for every two conventional passenger cars produced.

TABLE 3. RETAIL AND EX-WORKS PRICES OF LOW-COST VEHICLES IN 1975

(Dollars)

	Price	
Type of vehicle	*Retail*	*Ex-works*
Motor cycle	550-800	425-625
Motor cycle and side-car	750-1 100	575-850
Harabas	2 100-1 950	1 600-2 300
Pinoy	2 300-2 550	1 775-1 950
Fiera	2 550-2 850	1 950-2 200
Trakbayan	2 750-3 350	2 125-2 575
Cimarron	2 850-3 400	2 200-2 575
Mitsubishi Minicar	2 900	2 250
Jeepney	3 800	2 900
Ford Escort/Toyota Corolla	4 450	3 350
Ford Cortina	5 700-8 100	4 100-5 400

TABLE 4. BASIC REGISTRATION AND PRODUCTION DATA – PHILIPPINES

(Numbers)

Vehicle registration, 1974			*Production*	
Type	*Number*	*Type of vehicle*	*1970*	*1975*
Passenger cars	397 603	Passenger cars	7 375	27 500
Commercial vehicles	272 689	AUVs		12 500
Motor cycles	168 000 (approx.)	Other commercial	8 824	13 000
		Motor cycles (est.)	10 000	35 000
Total	838 000	Total	26 000	88 000

Republic of Korea

The automotive industry of the Republic of Korea dates from 1962, when the importation of assembled vehicles was restricted and the customs duty removed from imports of automotive parts. The Automobile Industry Protective Law (1962) requires government permission to establish assembly operations. An active local-parts manufacturing policy was adopted, and the use of local parts by local assemblers was from then on enforced. For one of the cars manufactured, local content stood at 67 per cent in 1975.

There are now four automotive plants in the country, three of which produce cars and trucks of conventional design. The cars assembled have been drawn from the standard models offered by the major international producers. One of the three plants is also associated with motor-cycle production. The fourth company produces buses and heavy trucks only.

Since 1976, one of the car-assembly companies has undertaken the complete manufacture of a 1300 cc car, the Pony, designed and engineered by an Italian design group. The designers have attempted to blend a rugged construction with modern international styling.

The development of the Pony is the first fruit of a new initiative in automobile industry policy. In 1974, the Government, faced with a vicious circle of low demand, low production, dependence on assembly of foreign cars and high prices, decided it was time to move to local production of bodies and engines.

It is hoped that the efficiencies of mass production will be able to be realized by eliminating frequent model changes and by rationalizing the production of components. Each of the three passenger car firms is establishing gasoline engine and body press plants designed to a production scale of 50,000 units. These plants will be heavily protected by tariffs. Imports of cars of a similar size will be restricted by licence and a tariff of 250 per cent is to be imposed.

In contrast to these planned developments, automobile production totalled only 36,300 (four-wheeled) units in 1975. Of these, 17,500 were cars; 3,800, buses; and 15,000, trucks. At the end of 1975, the total vehicle park had just passed 200,000 units, including 84,000 cars. Fast growth in demand is forecast, which is reflected in production plans. In 1975, GNP *per capita* was $531, which current plans envisage will nearly double by 1981. Over the same period, the number of vehicles per 1,000 persons is forecast to rise from the current 2.8 to 11.7.

In parts manufacture, the industry depends heavily on technical agreements with foreign firms, including many Japanese firms. It is planned to develop local design and engineering skills both as a means of adapting parts to local circumstances and to assist in the development of parts to be used in common by the various manufactuers. Policy changes to achieve these objectives are currently being considered.

In contrast to India and the Philippines, the Republic of Korea has placed little emphasis on the production of low-cost vehicles. Although this lack of emphasis may in part be due to judgement that the potential for such vehicles is limited (*per capita* income is high by developing country standards), it reflects, perhaps more fundamentally, the normal process of technology transfer through assembly and then full manufacture. Like India and the Philippines, the Republic of Korea is, through a policy of deliberate selection, restricting the number of firms, the number of models and the range of components produced. Throughout this process it has depended on the technical capacity of the major international automotive producers and has perforce operated within the options offered by them.

The use of Italian resources for the design and engineering of the Pony to some extent moderated this pattern, but the industry is still a long distance from the point where a fully developed productive base would enable it to contemplate significant initiatives in design.

Thailand

Vehicle numbers have increased rapidly in Thailand in recent years, by 14 per cent per annum in the country as a whole and by 30 per cent per annum in the more heavily roaded and metropolitan areas. The vehicle park was approximately 400,000 in 1973. This rapid growth has led to severe congestion in Bangkok, where new registrations of motor tricycles have been banned since 1971. In the same year, a daytime ban on heavy trucks was introduced, a measure that has encouraged the setting up of truck terminals and the transfer of goods to smaller utility vehicles.

Thailand is essentially an agricultural country with a food surplus and is unusual in having a well-developed canal and river system that links 27 of the country's 70 provinces and carries 25 per cent of the produce. Although traffic on this system has increased, road carriage has shown faster growth.

The Thai automotive industry, which dates from 1961, is fragmented and undertakes assembly at low local content, less than 25 per cent. Between 1961 and 1965, 10 companies were established, enjoying special promotional privileges. Subsequently, 6 more companies established themselves without the benefit of those privileges. Six of the 16 companies produce both cars and a range of trucks; 5 produce trucks and/or buses only, 4 produce cars only, and 1 produces a low-cost vehicle. In 1974, these 16 companies assembled 17,600 of the 19,100 cars placed on the market. Thai assembly of commercial vehicles, 10,300 units, was small in comparison with imports of 27,900 units.

Low-cost trucks are assembled by three companies, namely, Ford Motors, which produces the Ford Fiera; Prince Motors, which produces the Datsun Sing Siam; and Asoke Engineering, which produces the General Motors Plai Noi. The Ford and General Motors vehicles are closely related to the corresponding vehicles produced in the Philippines. They are produced in their light commercial-truck version and retail at $2,400-$2,500 as compared with $5,500 for the cheapest passenger cars. Sales volume is very small. In 1974, 2,700 units were sold; but in 1975, sales totalled only 1,500 in a market that absorbed 43,000 commercial vehicles.

Motor-cycle assembly has grown rapidly in Thailand. In 1975, 75,000 units were assembled—more than twice the number assembled in 1974.

The Thai industry displays many of the problems common to a wide band of developing countries. The principal problem is that a highly fragmented assembly industry produces at relatively high cost and low local content cars and light trucks of conventional design, most of which are destined to be used on the crowded roads of the major urban areas.

Plans to rationalize production have had little effect. Policies laid down in 1971 require assemblers to work towards 25 per cent local content as part of a three-phase programme designed to make Thailand a full-fledged car manufacturer, but to date progress has been slow. The proliferation of assembly plants and models (there are nearly 100 models) undoubtedly contributes to the high cost of vehicles, but is not as yet the focus of any specific policies.

With respect to future policy, it is important to consider those areas of demand that are most poorly served by the existing pattern of production. In urban areas the most urgent needs are those of the least affluent. These needs can perhaps be met most readily through the development of public transport for persons and goods. Although the main demand here will probably be met by vehicles of conventional design, there would seem to be room for a low-cost minibus or light commercial vehicle that can be used during business hours as a goods or personnel carrier, but that will also serve in a dual role as the family vehicle in the evenings or on weekends. In the rural market, the average annual cash income of farmers, about $300, is insufficient to enable the farmer to contemplate buying a vehicle even on the easiest of credit terms. For such a person the use of a public carrier will appear more economical than vehicle ownership.

Bangladesh

Bangladesh's 77 million inhabitants, 90 per cent of whom live in rural areas, is served by a vehicle population of only 60,000 units, divided almost equally into cars; commercial vehicles; and three-wheelers, predominantly in the passenger version.

There is only one automotive assembly company in the country. This company, Pragoti Industries, began assembling commercial vehicles in 1965, passenger cars in 1968 and the local variant of the General Motors low-cost vehicle in 1974. This last-mentioned vehicle is available in pick-up and passenger versions; and, as in other countries, the chassis and body are manufactured locally. The ex-works price of the low-cost vehicles, exclusive of duties and taxes, is $3,100-$3,300. The annual rate of production is about 650 units.

Three-wheeled vehicles are imported from India, as made-up vehicles complete with cowls. Wooden and composite bodies and seats are added to the vehicles in Bangladesh.

Papua New Guinea

Papua New Guinea's small economy has no automotive industry. The only related activities undertaken locally are battery manufacture, tyre retreading and general repair of vehicles.

Papua New Guinea faces the same problems many of the smaller and poorer developing countries face. Ninety per cent of its 2.3 million inhabitants live in rural areas, and half live at altitudes above 1,200 metres. The four largest centres (average population about 75,000) are connected only by very poor roads. Incomes are very low.

In this situation, motor-car ownership is almost entirely limited to the more affluent residents of the major centres, many of whom are foreigners. Registered motor vehicles of all types (i.e. including motor cycles and tractors) totalled only 39,000 in 1974. A policy of uncontrolled importation has led to an extraordinary variety of makes and sizes of vehicles. In the last six years sales have ranged over 117 makes and 436 make/size body type combinations.

This fragmentation has compounded the problems of vehicle repair and has inhibited the growth of the repair industry. Spare parts are in inadequate supply and expensive; there is a shortage of trained mechanics, drivers and spare-parts staff; service facilities are costly and inadequately maintained.

Official motor vehicle policies are currently being reviewed. It is planned to reduce the range of vehicles imported, perhaps by establishing a government monopoly of imports. Manufacturers of selected vehicles will be required to assist with the training of mechanics, and measures will be taken to assist the setting up of service facilities in remote areas. Attention is being paid to the possibility of reducing the demand for cars by providing a more satisfactory alternative public transport system.

There are no plans to undertake motor-car assembly, but there is some support for introducing a low-cost four-wheeler, which may lead to the establishment of local assembly. Local truck assembly is also being considered.

Summary

This brief review of circumstances in several countries emphasizes the importance of three points:

(a) Access to vehicles of conventional design is severely restricted by the low incomes of the masses in developing countries. Furthermore, the local manufacture of these vehicles is enormously expensive. Fragmentation of the market, which is common in countries undertaking assembly and endemic in countries entirely dependent on imports, increases the cost of maintaining the vehicle population;

(b) The main transport needs that are being met by conventional vehicles are those of long-distance movement of freight and of personal transport for the more affluent members of the urban community. There are major deficiencies in rural transport and in movement of urban passengers and short-distance movement of small loads of goods;

(c) The design and manufacture of low-cost vehicles of smaller capacity and reduced performance have come from two main sources. First, India—like Japan and Italy before it—has developed the manufacture of cheap three-wheeled vehicles of lower performance. In India, this development came after the successful local manufacture of conventional cars. Second, the recent initiative of a number of international companies has led to the widespread establishment of the local assembly of four-wheeled vehicles that are basically small trucks of very simple design.

III. Aspects of manufacture

Conventional automotive manufacturing operations are highly capital intensive. It is this high capital cost, particularly the part associated with model specific dies and tools, that leads to the economies of scale in automotive manufacture. These economies have tended to limit the spread of manufacture to developing countries in which unit demand is low. Furthermore, the motor vehicle is a complex product with a variety of parts whose manufacture depends on a wide range of manufacturing facilities and mastery of a range of industrial techniques.

In this situation, entry to automobile manufacture is limited to countries that have achieved some progress in industrialization and have a level of demand permitting the more important economies of scale to be realized and the necessary supporting educational and technical infrastructure (roads and related services).

For developing countries, these factors and the initial heavy capital cost of investment in automotive facilities impose severe restrictions. Yet the need for improved transport is central to economic development, and foreign-exchange problems usually limit the extent to which a country can resolve its problems simply by importing. As a result, most developing countries have felt a need to establish an automobile industry.

In terms of manufacturing technology, the low-cost vehicles represent an attempt to side-step the difficulty posed by the demand for domestically produced transport vehicles and the high costs associated with a limited volume of production. The initiatives undertaken have involved modification of the automobile and its process of production in ways that reduce the cost disadvantages normally associated with automobile production at low scales. The essential feature of each modification has been to reduce the cost of capital so that capital charges per vehicle can be reduced, or rather, so that the increase in such charges normally associated with low-volume production can be offset.

A common response has been to restrict the number of automotive producers and the range of vehicles manufactured as, for example, in India, the Philippines and the Republic of Korea. Many countries have found that conditions (either natural or induced) that encourage one manufacturer to enter the market are likely to encourage others to do so also. The consequence is increased total investment costs and reduced volumes per plant leading to increased costs per vehicle. Furthermore, in the absence of licensing, competitive pressures are likely to lead to increased product differentiation, much of it involving expensive changes in special tooling. In turn, such proliferation of models leads to increased investment, stockholding and operating costs in repair facilities. In extreme cases fragmentation can severely restrict the availability of spare parts, since it is uneconomic to hold a wide range of parts. Faced with difficulties such as these, a decision to licence vehicle production and assembly can lead to lower costs at most stages of production and use.

In planning automotive development, most countries, apart from the major industrial powers, have followed a process of backward linkage, proceeding from assembly, where capital costs are lowest, through manufacture of components to—in some cases—full local manufacture. Clearly this process of gradualism enables the developing country to avoid for a time committing resources in the more capital-intensive areas. However, as noted earlier, it tends to lock the design of vehicles to those of the originating manufacturer. Independent design, which presupposes the attainment of an ability to undertake the full range of automotive manufacturing processes, would require too great an effort for all but a few developing countries.

The installation of productive capacity designed to cater for a wider than national market has also been used, particularly in recent years, as a means of lowering unit capital costs. From the early days of the automotive industry in the developed countries, exports have enabled the major producers to lower unit costs. In developing countries the growth of exports is much more recent. Some of the international companies and several developing countries, the Philippines, for example, have attempted to secure economies of scale by promoting international specialization through the exchange of parts.

The Philippine AUV has participated in such programmes. In India, some export sales of the three-wheelers have been secured, and two of the major scooter manufacturers are actively extending export operations to include overseas assembly of vehicles manufactured in India.

Restriction of the range of models, backward linkage and export promotion are all ways in which the unit capital costs of producing conventional cars can be reduced. The prime emphasis in each of these is on lengthening the productive run and so spreading capital costs.

In addition, and of particular importance for low-cost vehicles, attempts to lower capital costs per vehicle frequently involve the use of more labour-intensive techniques and thus imply the substitution of labour for capital. Labour costs vary much more between countries than do investment costs, so that countries with lower wage rates can be expected to seek more labour-intensive processes. Although this substitution may appear inefficient in terms of man-hours per vehicle and related technical norms, there is no necessary implication of economic inefficiency. For example, it has been estimated that in 1965 the numoer of man-years required to produce 1,000 cars of conventional design was 1,061 in India, compared with only 72 in the United States of America. Differences in average annual wages per employed person, $462 in India as compared with $7,181 in the United States, meant, however, that the total wage cost per vehicle was almost identical. Table 5 gives details for a wider range of countries.

TABLE 5. LABOUR REQUIREMENTS AND WAGE COSTS IN SELECTED COUNTRIES, 1965

Country	*Labour required (man-years per thousand cars)*	*Annual wages per employee (dollars)*	*Wage cost per vehicle produced (dollars)*
Yugoslavia	1 230	491.5	604.5
India	1 061	462.1	490.3
Brazil	754	793.9	598.6
Argentina	489	–	–
Spain	329	949.3	312.3
Japan	227	1 455.7	330.4
Australia	221	3 012.0	665.7
United Kingdom	172	2 586.0	444.8
France	164	2 019.6	331.2
Germany, Federal Republic of	141	2 334.0	329.1
Italy	135	1 506.0	203.3
United States	72	7 180.8	517.0

Source: W. D. Rose, *Development Options in the New Zealand Motor Car Assembly Industry*, New Zealand Institute of Economic Research, 1971, p. 145.

Note: National wage data were converted to dollars at 1965 rates. Subsequent devaluations in Brazil, India, Spain and United Kingdom suggest that the exchange rates embodied above were overvalued for those four countries.

It is evident that plants producing low-cost vehicles in India and the Philippines are using less capital-intensive techniques than those used by plants in developed countries. There is noticeably less reliance on the use of sophisticated equipment for handling goods and for automatic transfer. Automatic conveyors are less frequently used; fork-lift trucks are rare; and automatic transfer in machining is unusual, although many multi-stage machines are used. In some plants considerable attention has been paid to production flow so as to ensure minimal manual movement. Nevertheless, in most such instances manual movement still pays a dominant part.

Basic metal cutting and forming is usually carried out in labour-intensive ways in factories in developing countries. An example of this is provided by the drawing, to a depth of some 10 centimetres, of the roof panel for a Jeepney cab at Francisco Motors in the Philippines. In an advanced industrial country it would be cut and formed through a single stroke of a heavy hydraulic press using an expensive set of dies. In the Philippines, the panel is first cut from hand-marked sheets by an operator using a set of rotary shears and then hammered to shape by two operators using a simple mechanical peening hammer. In this instance the pattern for the work piece is effectively carried in the workmen's minds rather than being embodied in the set of dies. The use of elementary metal-shearing techniques in several AUV panels leads to increased hand finishing work. Elsewhere in the same works mudguards are formed by simple hand hammering.

In India, many special-purpose machines have been developed by the motor-scooter and other automotive manufacturers, either from their own resources or in association with one of the major Indian machine-tool manufacturers–Hindustani Machine Tools and Tata Engineering and Locomotive Company (Telco). These machines could profitably be compared with machines in use in higher-income economies. For example, it is the policy of one Indian plant that if an investment expenditure that permits the firm to do without one worker is less than 50,000 rupees ($5,600) it will be made. If the necessary expenditure is more than 100,000 rupees ($11,200), it will not be made. Finally, if it falls between these limits, the possibility will be examined in depth. The annual cost per worker in the plant (in 1976) is about 10,000 rupees ($1,100). Obviously, the same scheme implies a judgement as to the trade-off between labour savings and the cost of capital (in this case the labour savings amount to 20 and 10 per cent, respectively, of the capital cost limits stated above).

The rate of return being sought on capital is thus not dissimilar to what is sought in a higher-income economy. The difference is that lower wages make smaller and less complex physical investments attractive. The effect of introducing a higher wage rate would be to alter the performance characteristics sought from particular machines. A detailed engineering examination of the types of modifications in production processes that have resulted from systematic investment appraisal under low-wage conditions could be useful.

Over the years a few countries have been able to make a significant more into automotive manufacture by acquiring used plant and equipment from an established automotive firm. This transfer may take place within a transnational firm, with the subsidiary company acquiring used machinery from its parent, or it can occur as outright purchase by an independent company.

India, for example, has frequently acquired second-hand special-purpose machines and toolings for models previously produced in another country, which has been important in the development of motor, van, scooter and the associated three-wheeler programmes. Special plant and tooling that have reached the end of their economic life in the country of origin because of changing market conditions or have become obsolete as a result of new competitive models may still have a useful, productive life in a market where, because of import and licensing restrictions and because of a different standard of living, similar competitive pressures do not exist. While there are obvious dangers in buying second-hand machines and disadvantages in buying older models of vehicles, the Indian experience has been that such plant can often be acquired very cheaply and provide quite satisfactory service. It is important to note that because India's machine-tool industry is well developed, machines that prove unsatisfactory in use can be replaced or upgraded. The risk associated with extensive second-hand purchase is thereby much reduced.

The redesign and simplification of vehicles may lower production costs because of the reduced need for special toolings. This reduction in costs has been most obvious in the development of the AUV, where the main emphasis has been on avoiding extensive special tooling and high-capacity production machines. The main areas of saving have been in basic chassis and body design. The engines for all Philippine AUVs are currently imported. Some will be manufactured locally, but in plants designed to cater for a wider market and thus able to secure reasonable economies of scale. The chassis and the body are the main indigenous parts and are designed down to local, low-volume production. The longitudinal chassis members are made from simple channel sections rather than complex pressings. For example, the required step between the engine mounting and body section of the chassis is secured either by simple bending or by welding of overlapped sections. The member is then strengthened by welding of inset plates or sections. The body panels constitute the most visible change from conventional car manufacture. The panels are almost all flat; and, where possible, shape changes are limited to simple bending such as can be achieved either by use of press brakes or manual bending against fixed forms. Corrugations are produced by repeated pressings.

In a parallel way the economic attractiveness of the motor scooter and its derivatives as developed in India is partly explained by the lower capital requirement associated with scooter manufacture. The use of aluminium die castings for major engine components, the smaller size of forgings required, the smaller and less complex panels—all entail lower capital costs per vehicle. The most significant element in this change is in engine manufacture. In terms of capital, space and economic volume, the requirements for making simple two-stroke engines are all only a fraction of those for manufacturing conventional four-cylinder engines. The technical requirements, although still exacting, are also much lower.

The extremely rudimentary nature of the assembly lines being used in the production of low-cost vehicles must be emphasized. These bear little resemblance to the popular image of a highly mechanized assembly line with extreme division of labour. In Philippine AUV production programmes, with daily production rates ranging from only 1-2 to 20-30 units, there is obviously little scope for a sophisticated assembly line. Chassis construction starts on the floor, and body construction is carried out alongside in locally designed and manufactured jigs. Apart from these jigs, equipment other than lifting and welding gear is scarcely needed. The AUV bay is situated alongside the conventional assembly area and can thus make use of established facilities such as the paint shop. A small team of workmen carry out a wide variety of jobs, with little specialization among them. For one model of the AUV, the total development cost, including the cost of all special jigs and tools, was estimated to be no more than $100,000.

In Indian three-wheeler programmes, a not dissimilar situation exists. Three-wheeler production is essentially secondary to the main work of the plants, which is generally motor-scooter production; in some cases the assembly lines for the scooter are extensively conveyorized. For the three-wheeler, however, they are not.

It should be emphasized that, with only minor exceptions, low-cost vehicle programmes have been carried out alongside other, and usually pre-existing, assembly operations. This arrangement permits the programmes to enjoy access to facilities such as spray booths and welding equipment, no doubt with economies as a result. They have also been able to draw on existing management expertise. These are important advantages that quite likely helped to hold down costs at least in the early stages of development. It does not mean that economic production facilities cannot be designed exclusively around low-cost vehicles. If demand is sufficient, considerable economies may be realized through a more systematic design of production facilities and methods. Gains from this redesigning will probably far outweigh the short-term gains from the initial production—using established facilities.

In promoting manufacture of automotive vehicles, both conventional and low-cost, governments of many developing countries have sought to achieve some rationalization in parts manufacture. The buying in of parts is, of course, a common feature of automotive production everywhere and has enabled final manufacturers to avoid committing the capital necessary to support production of the full range of parts and components. The capital charges for some of these parts are thus spread among the

various manufacturers who draw on a particular supplier. In developing countries, parts manufacture has to be established at the same time as final assembly, and the opportunity has been taken to limit the number of parts producers so as to avoid duplication. In vehicle design, emphasis has been placed on drawing components from the existing array rather than calling for new components.

An important economic test of efficiency and success in adapting production patterns to local conditions is provided by the comparative cost of local manufacture. Such comparisons are not easy because the types of vehicles being discussed are not being produced in the advanced industrial economies. However, information provided by two Indian scooter manufacturers, one of whom is a principal manufacturer of three-wheeled vehicles, suggests that the cost of manufacture in India is about 15-20 per cent higher than the cost of manufacturing the comparable vehicle in Italy, and a price comparison with Japan would show a greater disadvantage. However that may be, the price disadvantage is small–all things considered. The Indian volume of production is about one third that of the Italian equivalent, and local content is 100 per cent. The price difference is very much less than that typically associated with conventional automotive manufacture, often at lower levels of domestic content.

Indian manufacturers have paid much attention to improving production processes, with consequent reduction of production times and costs. One scooter manufacturer has reduced the required time per vehicle by more than a third over the last six years. More generally, in the 1960s the relative price index for motor scooters fell by a quarter relative to the movement of the wholesale price index.

One Indian manufacturer of a light four-wheeled van asserted that he produced more cheaply than his European equivalent. As for the Philippine AUVs, although no direct comparison with vehicles in the industrial economy is possible, the ex-works price range of $2,000-$3,000 suggests reasonable economic performance.

In a background paper prepared for the Expert Group Meeting at Melbourne, UNIDO suggested that to achieve substantial market penetration, the ex-works prices of low-cost vehicles should not exceed $150 for mopeds, $250 for motor cycles, $400-$1,000 for three-wheelers and $2,000 for four-wheelers (ID/WG.224/1). The prevailing prices reported earlier in this study tend to be rather higher than these. They are nevertheless of an order that suggests a fair economic performance, particularly when one considers the very high levels of protection in many developing countries.

At the same time, it is important to recognize the paramount importance of price in determining the extent of market penetration. At present, effective demand, as measured by sales of low-cost vehicles, is limited. It is appropriate at this point to examine prevailing market conditions in more detail.

IV. The pattern of demand

A statistical relationship between income levels and vehicle ownership has been established. Data quoted earlier for 1970 showed that the United States, with its *per capita* income of $4,289, had a car population of 430 per 1,000 persons, whereas in India, with a *per capita* income of $93, there was one car per 1,000 persons. As the above figures show, in the United States every second person owns a car, but in India only one in a thousand can afford to do so. In the affluent countries the automobile provides the normal means of transport, but in the less developed countries it remains a rarity, a fact that can be obscured by the noise and bustle of the major cities of the developing world.

Regardless of income levels, transport remains an essential function at almost all levels of economic development. A wide range of work performed by automotive means in an advanced industrial country is performed by animal or manual power in a less developed economy. The search for more basic forms of automotive transport is in essence a search for cheaper substitutes for animal and human power than are attainable through the use of the conventional automobile.

India provides a convenient opportunity to consider the place of the automobile in the transport system and to see how its cheaper forms compete both with the more advanced automotive forms and with animal and human power. The streets of Indian cities (beyond the heart of major cities such as New Delhi or Bombay) present an almost complete spectrum of transport modes—simple manual carriages, manual two-wheeled carts, manual four-wheeled carts, bullock carts, bullock trains, horse-drawn carts, motor scooters, three-wheeled vehicles for both goods and passengers, light trucks, motor cars, heavy trucks and buses. Long-distance goods and passenger transport is the preserve of rail, truck and bus. The Indian array of low-cost vehicles is unsuited to long-distance or country operation because of low speed, small capacity and low road clearance. The smaller the vehicle, the greater are these disabilities.

In the face of competition from automotive and rail transport, the distance over which animal transport is used has dropped in recent years. Bullock carts now rarely operate beyond a maximum range of 10 kilometres. Nevertheless, India's estimated 13 million bullock carts still play a major transport role, including the carriage of some heavy and bulky loads.

Indian low-cost vehicles operate essentially in urban areas, where road conditions are adequate and where distances are sufficiently limited. Most vehicles are used for passenger transport, either as personal transport, as in the case of motor scooters, or as taxis.

Motor-scooter and motor-cycle ownership is almost exclusively the preserve of the middle and upper classes. At the higher level, the motor scooter competes with the private car, while at the lower level it competes with bicycles (including powered units) and public and pedestrian transport.

Table 6 gives information on patterns of ownership of transport durables in 1967/68.

The table shows that car ownership is significant only in urban households with incomes of more than Rs 15,000. In a survey made in 1971, NCAER found that the average income of car owners was around Rs 20,000 (or $2,750 at current exchange rates), about the same price as a car. They noted that whereas in India the average household income was about one tenth the price of a car, in the United States the median income was about three times that of a car.

TABLE 6. VEHICLE OWNERSHIP IN INDIA ACCORDING TO HOUSEHOLD, 1967/68

Annual disposable income (Rupees)	*Number of households (million)*	*Percentage of households owning*			*Number of vehicles (thousand)*		
		Motor cars	*Motor cycles and scooters*	*Bicycles*	*Motor cars*	*Motor cycles and scooters*	*Bicycles*
Urban							
Below 3 000	12.1	–	–	25.1	1	–	3 048
3 000-4 999	3.8	–	0.1	58.8	-	24	2 219
5 000-9 999	2.2	0.4	3.2	48.2	10	72	1 082
10 000-14 999	0.6	5.9	12.9	68.1	36	78	410
15 000 and above	0.4	38.6	22.9	51.2	155	92	206
Total	19.1	1.1	1.4	36.4	202	266	6 965

TABLE 6 *(continued)*

Annual disposable income (Rupees)	*Number of households (million)*	*Percentage of households owning*			*Number of vehicles (thousand)*		
		Motor cars	*Motor cycles and scooters*	*Bicycles*	*Motor cars*	*Motor cycles and scooters*	*Bicycles*
Rural							
Below 3 000	54.5	–	–	12.4	–	4	6 740
3 000-4 999	9.7	–	–	41.8	–	–	4 044
5 000-9 999	7.1	–	0.5	62.9	–	37	4 446
10 000-14 999	1.4	0.8	2.0	73.4	11	29	1 055
15 000 and above	0.5	5.7	11.5	75.8	27	54	351
Total	73.2	0.1	0.2	22.7	38	124	16 636

Source: Based on *All-India Household Survey of Income, Saving and Consumer Expenditure* (New Delhi, National Council of Applied Economic Research, 1972).

Notes: 1. In 1967/68, Rs 7.6 = $1.

2. The middle classes are conventionally seen as falling in the Rs 5,000-15,000 range. In 1967/68, some 13 per cent of households had incomes of over Rs 5,000.

Motor-cycle and motor-scooter ownership extends into lower-income groups and, accepting the Rs 5,000-15,000 boundaries, most such vehicles are owned by middle-class rather than upper-class families. For motor-scooter owners NCAER has estimated an average annual income of Rs 9,750 ($1,300) in 1970.

The bicycle is the nearest thing to a mass vehicle, with one being owned by approximately one in four of the close to 100 million Indian households. The $24-$35 cost of a standard cycle is, needless to say, still substantial in an economy where the *per capita* annual income is only about $100. In proportion to that income, the bicycle appears in approximately the same relationship as a conventional car does to incomes in the United States or in some Western European countries.

In terms of public passenger carriage, the only Indian low-cost vehicle is the three-wheeler taxi, the fare for which is half that of the conventional taxi. The average operating speed is lower by about the same proportion. The fare for the three-wheeler taxi is about five times that for a bus.

The Indian low-cost vehicles play a minor role in freight carriage. Freight applications are known to constitute only a small proportion of the 55,000 registered three-wheeled vehicles, while there are no fewer than 415,000 trucks and, as already noted, 13 million bullock carts in the country. Nevertheless, demand for three-wheeled freight-carrying vehicles has been steady, and with the exception of the Tempo, for which production has been cut back severely, the manufacturers expect to continue selling at current levels.

The carrying capacity of the various low-cost vehicles is significantly less than that of conventional vehicles. They also operate at lower speeds. Despite these differences, the sharply lower capital cost means that the low-cost vehicles offer a similar performance as measured in ton-kilometres per hour per unit of capital expenditure, as table 7 shows. The figures for operating speeds are estimates only and have been set well below rates claimed in company literature. Even so the speeds are possibly high for much urban movement under typical operating conditions.

TABLE 7. COMPARATIVE COST AND PERFORMANCE OF LOW-COST VEHICLES

Vehicle	*Rating (cc)*	*Capacity (kg)*	*Operating speed (km/h)*	*Performance (ton-km/h)*	*On road capital cost (dollars)*	*Capital cost per ton-km/h (dollars)*
Powered tricycle	35	150	12	1.8	300	160
Scooter three-wheeler	150	500	35	17.5	1 400	80
Larger three-wheeler	400	750	35	26.3	2 000	76
Four-wheeler		1 600	50	80.0	6 000	75

Insufficient data are available on actual operating costs to compare them properly, but it can reasonably be assumed that fuel and maintenance costs will be significantly lower per ton kilometre of capacity as vehicle size increases.

To a large extent, however, the three-wheelers do not effectively compete with the larger vehicles. They perform a subsidiary role in local short-distance, small-lot carriage of goods and in this they effectively compete with animal- and hand-cart carriage of goods. The economic rationality of the small vehicle arises not from any competitive advantage against the four-cylinder family of vehicles but from the possibility of offering small units of automotive power at correspondingly low levels of capital cost. In a low-wage economy it is economically sensible to combine smaller blocks of capital with labour. Furthermore, the low-income structure means low levels of investment. The boundary between the light truck and the hand or animal cart is in effect the boundary between the modern industrial sector and the traditional sector. To cross it is to experience a change in income and capital levels as dramatic as many of the more obvious visual contrasts between the lot of the common man and the standards of an industrial society. For example, whereas the owner operator of a truck (about two thirds of the trucks are owner-operated) may earn about Rs 1,000 ($110) per month, the hand-cart operator can expect to earn about Rs 300 ($34). If the objective is to replace animal and hand carts, it is necessary to deliver automotive units with capital costs low enough to be within reach of the operators of such vehicles.

In this respect it is of interest to consider the case of an urban bullock cart, which, for both bullocks and cart, will cost over Rs 3,000, or about $350. This vehicle has a normal capacity of about 500 kg (capacity varies considerably and some strengthened carts can carry well over one ton) and operates at about 3 km/h. This suggests a capacity of 1.5 ton kilometre-per-hour and a capital cost per ton kilometre of capacity of about $200. Although this figure must be regarded as approximate, it does suggest that the low-cost vehicles are competitive in terms of capital cost per unit of capacity. The larger three-wheelers require several times the capital outlay, however, and thus raise important problems of financing.

The Indian Government has in recent years actively encouraged lending for the purchase of commercial vehicles. Banks may lend some 60-70 per cent on the security of the vehicle and may lend up to 100 per cent, with any balance being secured by personal loans. Repayment instalments are scheduled weekly and in some cases even daily.

The picture of demand in the Philippines is significantly different from that in India. A higher *per capita* income, a significantly broader ownership of vehicles, a better road system, a very much more regulated system of road access, vehicle segregation and higher speed standards mean that there is little or no scope for lower-speed, lower-cost vehicles of the type developed in India. Instead, the AUV is designed to operate at speeds comparable to those of the standard automobile. Clearly, this imposes severe limits on the extent to which the automobile can be designed down in performance. The combination of high operating speed and medium load-handling capacity dictates the adoption of a four-cylinder rather than a two-stroke engine. Quite apart from the consequent effect upon economies of scale in manufacture, the shift in emphasis places the AUV in direct competition with conventional vehicles under operating conditions that have evolved around the performance characteristics of the more expensive and economically efficient four-or-more cylinder engines.

Nevertheless, the AUV has captured a significant proportion of the Philippine commercial-vehicle market (certainly a far higher proportion than attained by the three-wheeler in India), and its success suggests that it is economically attractive. The main reasons for this are probably:

(a) Since the main limitation on more widespread adoption of automotive power in developing countries is the initial cost, any reduction in the cost at which a person can buy a vehicle is likely to have a significant effect upon demand;

(b) Despite the technical difficulties of providing performance characteristics similar to those of larger and more powerful vehicles, the income and development levels of the Philippine economy confer some natural advantage on the smaller vehicle. Load lots tend to be smaller and thus more economically handled by smaller vehicles and operators. In passenger movement the Jeepney again offers a small-load capacity making it economic to use in areas where larger buses cannot compete;

(c) Finally, as has been noted previously, the lower wage structure prevailing in a situation where the capital cost of access to particular units of automotive capacity is much the same as in developed economies, implies that it will be sensible to operate very much lower units of automotive capacity per person. Designing down the size of the vehicle is one way of doing this. The process also works from the other end of the scale, as is evident from the widespread use of drivers' assistants on buses and trucks, whose main role is to reduce the time the vehicle is standing.

The motor cycle and side-car obviously shares these characteristics with the AUV. Two additional points need to be made, however. First, in urban areas these vehicles operate under restricted licence conditions. They are permitted to operate only in their registered zone and not on the major highways This system of restriction enables them to perform

their prime function of transporting small lots of goods and a restricted number of persons at low speed and for short distances, while keeping clear of vehicles operating at high speeds.

Secondly, the motor cycle and side-car has proved a versatile vehicle in rural areas because of its higher clearance and power and its basic two-track characteristic (as opposed to the three-track pattern of the Indian three-wheeler). The vehicle can cope with all but the roughest of rural roads and tracks. Its small capacity is also appropriate for rural conditions. Some distributors maintain that the typical rural transport operator would, when expanding capacity, think first in terms of buying an additional three-wheeler rather than moving up to a four-wheeled vehicle. Needless to say, this assertion may or may not prove well founded in the emerging market situation.

V. Policy issues

The preceding survey of conditions in several Asian economies indicates extensive and diverse patterns of development of low-cost vehicles. It shows that manufacturing technology for these vehicles is now well developed both in terms of vehicle design and engineering and in terms of production engineering, and that the vehicles are capable of meeting significant demand in developing countries.

Although the production of low-cost vehicles to date has scarcely begun to meet the potential demand for these vehicles, progress has been made. Much has been learned about manufacturing, considerable development costs have been expended and significant productive capacity has been established. Many types of vehicles have now been operated under market conditions for a long period. The automotive industries in several developing countries are now in a good position to take advantage of new developments in both manufacturing processes and products.

The policy issues relating to use of low-cost vehicles as a component of the transport system of a developing country need to be fully examined. However, this study is limited in the sense that these vehicles are viewed as complementary and in certain cases substitutes for motor vehicles of a more conventional design. The essential point in introducing low-cost vehicles is to widen the array of options available. These vehicles are unlikely to divert traffic from conventional high-performance vehicles but can be of use where it would be uneconomic to operate more expensive conventional vehicles, e.g. transporting small lots which account for a substantial proportion of the total traffic. The exact segment of the market will depend upon the type of vehicle and will differ, for example, between the Indian three-wheeler and the AUV. Obviously, it will also depend upon the particular circumstances of the country.

Low-cost vehicles are likely to be competitive primarily in terms of vehicles operated by animal and human power. Indeed, it is the extent that low-cost vehicles replace the more primitive means of transport that will effectively measure their success.

National policy

The automotive sector—a key sector—is directly affected by many aspects of government policy. In most developing countries the existence of assembly operations derives from direct government intervention through licensing or tariff policy as does the degree of local content achieved. The volume of sales is likely to be affected by taxes imposed to give protection and to yield revenue. The volume of production may well be regulated through the rationing of foreign exchange. Finally, the conditions under which a country's vehicle fleet operates are greatly influenced by road policy and traffic regulation.

Government policies thus determine significantly the shape of the automotive sector and should be considered as a whole. Frequently, however, they are only loosely co-ordinated and in some areas may conflict. Better co-ordination is clearly desirable and may be achieved through careful planning.

Examining all aspects of policy together is of particular importance in that the major commercial decisions on whether to undertake or extend production are taken by private companies, most commonly in association with one of the international and developing country automotive firms. Successful commercial decision making depends upon a reasonably accurate assessment of the environment in which the enterprise will operate. Such an assessment will be possible only when a government has in fact arrived at some defined policy.

The broad shape of an automotive policy will be much influenced by the basic characteristics of the economy, including particularly its size, its income level, the stage of technical development, the stage of development of supporting industries such as the steel industry, the existing pattern of the transport sector and the country's road system. These and other factors together determine both the pattern of demand and the country's short and mid-term possibilities in automotive production. Key decisions that have to be taken are:

- Whether to enter the automotive industry at all
- The types and numbers of vehicles to be produced
- The extent of local content
- How many firms are to be encouraged
- Policies on private as opposed to public, and foreign as opposed to local, equity
- Arrangements for the transfer of technology
- The modes by which the industry is to be fostered, e.g. tariffs or licensing

In deciding upon the emphasis to be given to the production of low-cost vehicles, several factors are relevant. The potential demand for low-cost vehicles will be higher in countries with lower incomes. It will also depend greatly on whether roads are adequate and will be influenced by the priorities accorded to the various types of vehicles in designing roads and regulating traffic.

The development of low-cost vehicles raises some major issues in road- and traffic-engineering policy. These vehicles occupy a position intermediate in performance between pedestrian and animal traffic on the one hand and conventional automotive traffic on the other. In a world where high-performance vehicles did not exist, the required road structure and system of traffic regulations would be considerably different from that of either an industrial or pre-industrial economy.

The modern motor vehicle is, however, a feature of life in all developing countries. The potential market for low-cost vehicles, particularly in the lower performance ranges, will be much influenced by the extent to which road design and standards for regulating traffic are determined by the requirements of conventional vehicles. On the one hand, the confusion of a totally unregulated traffic flow clearly inhibits the efficient operation of all modes: it is an open question which suffers the greatest disadvantage. On the other hand, rigorous traffic separation reinforces the advantages of the more powerful vehicles. For example, the banning of low-performance vehicles from a major road network almost inevitably restricts their operating range severely because the major road creates a boundary that cannot easily be crossed.

Related issues are raised by considerations of the objectives of the national transport. For example, early Indian transport policy placed the main emphasis on public transport, with the bicycle as the main form of personal transport. The market for cars was correctly seen as limited, but it was only later that the potential for motor scooters and related vehicles was recognized in investment planning. Again, objectives in terms of rural-road design and maintenance standards will exert a powerful influence on the performance potential of different types of vehicle. The degree to which particular countries may wish to control investment patterns in this area is, of course, a matter for those countries to determine, as are the patterns sought. The important point is that decisions on whether and how to intervene do need to be made, and these can be expected to exert influence on the direction of automotive manufacturing programmes. Persons interested in the manufacture of low-cost vehicles need to have a clear picture of these policies.

The relative price structure of low-cost and conventional vehicles helps determine the effective demand for vehicles of each type The cheaper the low-cost vehicle is in relation to conventional vehicles, the greater the demand for it is likely to be. Such comparisons will be substantially affected by the incidence of government taxes. Tariffs and sales taxes frequently account for a significant part of the price paid by the final buyer.

Taxes, by raising the price of the vehicle affected, reduce demand. While such discouragement is usually thought appropriate in the case of private cars, policy makers in many countries impose lesser taxes on vehicles intended for productive use. Similarly, countries intending to encourage the use of low-cost vehicles should adopt appropriate tax and related promotional policies.

There is some possibility of conflict between the twin objectives of promoting production and encouraging sales. Policies designed to encourage local manufacture will usually permit charging a higher price for the vehicle than the price of a similar vehicle imported from an established producer. If so, the higher price will tend to reduce the level of effective demand, which may not matter to a country faced with foreign-exchange constraints. A country wishing to promote both production and sales of low-cost vehicles is thus faced with a real problem. While the solution is not simple, and will vary from country to country, the general lines of the approach are fairly clear.

First, as has been seen, the cost excess associated with production at any particular volume is less for some processes than it is for others. In the manufacture of low-cost vehicles, because of simpler production technologies, this excess is smaller than for conventional vehicles. By encouraging a staged entry into the industry, the excess costs associated with a too precipitate entry can be reduced or avoided. By choosing an appropriate level of local content, the policy maker can aim for a particular level of cost excess. The first step then is to choose a level of national content appropriate to the expected volume of sales and the country's stage of industrial development, and for which the resulting cost excess, if any, is consistent with the country's protective policies.

This decision has to be made regardless of the means of regulation, although the means chosen will affect the details of implementation. When regulation is by tariff, a level of protection has to be set that balances the desire for local production with that for high market penetration. Under a licensing system, continuing attention must be paid to the cost of local manufacture, particularly when expansion in capacity is being planned. The same situation exists where a public monopoly is created.

A second decision is to ensure that the protective mechanism shall be designed so that there is no unnecessary tax loading in the final cost of the vehicle. Again, these decisions must be made within the framework of wider policy: many countries have provided for concessional entry of parts imported by assemblers who meet stated guidelines as to the level

of local content. The common feature of these schemes is that the reduction or forgoing of duty on imported parts reduces the cost to the final buyer. At the same time the concession can provide a strong incentive for assemblers to meet local-content requirements.

Depending on the priority accorded to development of low-cost vehicle manufacture, countries may also find it useful to adjust income-tax policies, for example, by increasing initial depreciation allowances or by permitting investment allowance deductions. Again these are matters that have to be decided within a wider context.

Finally, and in some ways most important, sales taxes, frequently imposed on low-cost vehicles, may be reduced or removed. In most countries sales taxes are varied to reflect various priorities and, in respect of motor cars, rates have often been scaled according to the size of the engine, without particular attention being paid to the utilization of the vehicle. It should be noted that a reduction in sales tax, while encouraging sales through lower prices, offers no disincentive to production. A change of this type can thus be made without encountering the problem referred to earlier.

When a package of tariff, licensing and taxation policies is designed, the most important point is to articulate clearly the objectives, both in production and marketing.

An essential and often neglected aspect of policies concerned with automotive development is the provision of adequate finance. The need for finance arises at three main stages: when investing in land, buildings and plant; when building up working capital; and when marketing the vehicles.

The financing of physical facilities is of major interest to the three main parties to the investment decision: the foreign automotive company, which may wish to or be encouraged to provide capital to support the venture; the local company (which may or may not be a subsidiary); and the government, the extent of whose interest is likely to depend upon the extent of national investment planning. Here is not the place to discuss the requirements of these parties, but it is appropriate to note that in this area a lack of clarity in national objectives can easily lead to frustrating delays in negotiating the details of particular investments. While the determination of policies and priorities is clearly the prerogative of governments, those policies and priorities should be defined clearly and openly so that the commercial partners can plan accordingly. It is relevant to note that the provision of capital by the foreign automotive company not only eases the foreign-exchange constraint, but also provides some assurance that interest in the project will not cease. However, such reliance on foreign capital implies continuing remittances and some loss of national control over the running of the enterprise, disadvantages that must be weighed against the advantages.

The provision of adequate inventories and supplies of imported components demands the commitment of a sizeable amount of working capital and a continuing flow of foreign funds, which has clear implications for national credit and foreign-exchange policies. Again, planning is necessary, and there is an advantage in having clearly stated policies.

In most countries a considerable proportion of the sales of commercial and private vehicles is financed on credit. Hence, the volume of sales is much affected by the state of institutional development in the credit field and by government intervention in financial markets for macroeconomic reasons. Even though low-cost vehicles are far cheaper to buy than conventional vehicles, their purchase may be a relatively heavier burden for those with low incomes than the purchase of a conventional vehicle is for those with higher incomes. Furthermore, the large population in some markets means that the aggregate demand for retail finance can be very large. Consequently, governments need to pay close attention to the institutional structure of the finance market to see that the available capital is put to the best use; governments must also ensure that the aggregate flow of finance to this sector shall accord with national economic policies.

These are not simple matters. Most lending institutions lend for a wide range of purposes and must, by the nature of their business, pay close attention to factors such as the credit-worthiness of the borrower and the security he can offer. Because the major part of the funds that could be used to enable the purchase of vehicles could also be used in other ways, there are limits to what a government can do by working through existing institutions. This is not to deny that changes in general credit policy can have an important influence on the supply of funds for purchasing vehicles. The essential point, however, is that the complexity of the finance sector frequently makes it difficult for governments to influence the short-run flow of funds with precision.

Because it is a capital good, the motor vehicle can itself be offered as security for a loan. Because of the relatively short asset life of a vehicle and because of the risk of accidental damage, the commonest form of lending against the security of a vehicle is hire purchase. Typically, a large initial cash payment is required, and repayments are scheduled over a relatively short period. The government may set conditions for the financing of hire-purchase agreements and variations of these can have important short-term effects on the sale of vehicles.

The machinery for extending credit for the purchase of low-cost vehicles should reflect an awareness of the small-scale nature of such transactions. An obvious starting point is to encourage lending through the established manufacturing and distribution networks. Because of their greater size, relative to that of the final purchaser, the manufacturer and distributor are able to offer greater

security to a major lender and are in a better position to spread the risk. The distributor is also in direct contact with the purchaser and is thus well placed to handle administrative details of the transaction. It would thus be sensible for governments to examine the existing flow of credit through distributor systems and to consider possible ways of expanding it.

Similarly, there is a need to review the operation of arrangements for the financing of vehicle purchase through the major financial institutions, including banks, finance houses and independent financiers.

Most developing countries have set up development banks to promote lending for particular purposes. Some of these have special responsibility for encouraging small business. It would be useful if the objectives and operations of such institutions could be reviewed to ensure that they provide adequately for the needs of transport operators and an adequate level of support for the purchase of low-cost vehicles.

Credit unions and related co-operative systems have also proved useful in assisting small enterprises. The short loan period associated with vehicle purchase means that a fund established for such purchase can be expected to turn over fairly rapidly and thus demonstrate to members and potential members of such schemes the benefits of co-operative saving. It is certainly easier to persuade persons of the potential benefits of membership than it is to persuade an institution geared to longer-term investments such as those in housing.

Beyond these institutional matters, governments interested in more actively promoting vehicle sales should see that the commercial law relating to such transactions is appropriate. The law is frequently slow to change; legislative codes established to govern financial transactions should be reviewed periodically so that they will be sufficiently flexible to enable a volume of transactions consistent with wider objectives to be carried out.

These are difficult and important matters that need to be considered in detail when automotive-development policies are formulated.

Summary of discussions of the Expert Group Meeting at Melbourne

The Expert Group Meeting on Manufacture of Low-cost Vehicles in Developing Countries, held at Melbourne in February 1976, considered ways in which the international community could assist in promoting the manufacture of low-cost vehicles in developing countries It was noted that at present information on the range of possibilities was limited in many countries and that it would therefore be useful for the international community to promote the flow of literature on the subject, in view of the urgent need to disseminate information on particular types of low-cost vehicles so that governments could more readily appraise the range of options open to them. It was also felt that detailed comparisons of the operating cost of these vehicles in different situations should be prepared so that governments could better assess the potential in their countries for particular types of vehicles.

These recommendations reflected a common concern that policies in many countries were being made with only a limited appreciation of the options available. It was felt that in determining the mix of vehicles to be made, accidents of history and the particular institutional and commercial circumstances of a country could predispose it simply to adopt standard automobiles. In deciding whether to break from this pattern by introducing complementary low-cost vehicles, the developing country should have a clear understanding of the potential and limitations of the various types of low-cost vehicle. Because some low-cost vehicles had been developed in developing countries by firms with little experience in and few resources for promoting their products internationally, a more concerted approach should be adopted.

It was considered probable that some of the more important innovations, in terms of market potential, would prove to have arisen in economies that mirrored the technical and market conditions of other emerging countries, but such innovations would be made by enterprises poorly placed to compete with the promotional experience and expertise of the major automotive companies. Thus the international community could usefully promote a flow of information in terms of both literature and personnel comparable to that currently offered by the major automotive companies.

Although the present array of low-cost vehicles offered a wide choice, it was felt that there was possibly room for further development of vehicle types.

Low-cost vehicles currently in use were derived essentially from vehicles originally designed for operation in considerably more developed economies. This was true of the Indian three-wheelers, which, despite some modification, were still essentially the same as their Italian predecessors, particularly in their inability to operate off sealed or at least well-formed roads. It was also true of the AUV, which was a downstream derivative of basic four-wheeled, four-cylinder utility vehicles and designed to public-highway performance standards. These adaptations had obviously been useful and had a major role to play, but the fact of limited adaptation suggested that introducing more radical designs might be contemplated.

The desirability for such an approach was also suggested by participants at the Expert Group Meeting who noted that significant segments of market requirements were not effectively met by vehicles available at present. Emphasis was placed on

the need for vehicles better able to cope with rural conditions. The need to promote motorization of vehicles operating on water, important in many developing countries and of major importance in some, was mentioned.

The possibility of designing a motorized competitor for the rural bullock cart was discussed.

The cart survived as an urban vehicle, particularly for loads of rural origin, but it was clearly under competitive pressure. In rural reas where roads were rudimentary and where the bullock performed as draught animal, the cart remained the prime short-distance mover. Where road conditions permitted, trucks provided competition, particularly for longer distances. The farm tractor, which directly replaced draught power, was also sometimes used as a subsidiary short-distance form of transport; a trailer was added and some passenger seating was even fitted to the sides of the tractor itself. Motor cycles also provided road transport.

The problems in designing a vehicle that could provide better and cheaper transport than the bullock cart and tractor yet would provide some draught power were obviously considerable and possibly intractable. Alternatives that could prove more attractive could be the pursuit of more limited goals, such as extending tractor gearing, the design of appropriate trailers and the design of a low horsepower, high-torque diesel engine that could be adapted to several uses.

The Expert Group did not make any recommendations on the development of particular types of vehicles, but it was suggested that some kind of common effort was needed. Because the problems being considered affected primarily the poorest countries, it was felt that some international funding of research and development was necessary. The initiatives that had been taken in establishing automotive industry centres for technology in some developing countries were favourably noted, and it was suggested that UNIDO set up an expert group from within the region of Asia and the Pacific to promote vehicle development.

The Expert Group was of the opinion that the exchange of automotive expertise between developing countries should be promoted; the different paths that had been followed in terms of production patterns and techniques had created opportunities for a useful exchange of experience. For example, the Indian authorities could explore the possible role for four-wheeled vehicles along the lines of the AUV to complement their existing range of vehicles. A relevant consideration was India's ability to manufacture such a vehicle at close to 100 per cent local content. At the same time, the types of low-cost vehicles already produced in India were likely to prove useful in many other low-income economies and could be widely studied.

One of the more effective ways of transmitting knowledge and of exploring possibilities would be through an increased international exchange of experts in the various branches of automotive production because there was a world of difference between the relevance of information transmitted by printed booklets and manuals and that carried by the experienced man who was able to respond immediately to the questions put by a person responsible for action.

It was pointed out that an exchange of expertise should not be limited to aspects of vehicle design; producers in developing countries had been designing process and special-purpose machinery in forms appropriate to local conditions. In particular, low labour costs had led to the redesign of processes to a more labour-intensive basis. The Group felt that the innovations that had occurred were sufficiently important to warrant further study and an increased exchange of experience among developing countries in which automobiles were manufactured.

The Expert Group noted that to date, the main source of overseas experience in production was what senior automotive engineering personnel had learned in the automotive industries of developed countries. Although the value of this experience should be given its due, it was inevitably experience with manufacture under economic and technical conditions remote from those of the current workplace. In the opinion of the Group these engineers had proved innovative in adapting that experience to their own conditions, but some of their innovations in production techniques were probably as diverse as some of the vehicles developed. It would therefore be useful to promote an increased exchange of personnel among the countries concerned.

The Expert Group considered the wider question of transferring production capacity to less developed economies. The point had now been reached where some of the developing countries were themselves initiating technology transfer to other developing countries. It could be expected that the normal process for this transfer would be not unlike the original transfer from the developed countries, with the important difference that the technology being transferred had been modified to make it more relevant to developing countries. The first stage was the simple assembly of the vehicle in the export market, possibly following a period of completely build-up (CBU) imports to test the market. Although this implied a high exchange cost to the importing country (the equation looked pleasanter to the exporting country), a low initial level of local content was sensible while the market was being tested, distributorships built up, and the basic assembly skills firmly learned. At the same time, the undertaking of an assembly operation guaranteed the host economy some commitment by the exporting country and provided a focal point for receipt of market feedback, which facilitated product modification.

Once assembly was firmly established, the host country would normally wish to proceed beyond the

incorporation of elementary hang-on parts to the installation of production equipment and increased local procurement, which would lead ultimately to effective 100 per cent local content. The ability to achieve this goal depended upon the stage of development in related industrial areas.

In this process, the developing country automotive industries had some natural advantages but would be moving into international competition, both among themselves and with the established industrial economies. Their advantages were obvious. Experience with vehicles and production processes designed to the circumstances of one developing country could be valuable elsewhere. Nevertheless, the automotive industries in most developing countries were highly protected, and only time would determine how effectively any particular automotive industry would compete internationally. For example, should the existence of a large market potential for particular vehicles be demonstrated, one or other of the developed country automotive industries could well become actively interested in producing them.

The successful design of vehicles less subject to economies of scale than the conventional car did not mean that those vehicles could not be more economically produced in larger volumes. Evidence of a large market could encourage active competition. Nevertheless, firms in several countries in a region might profitably develop low-cost vehicles co-operatively.

The Expert Group saw a need for UNIDO to play a positive role in promoting technology transfer. Individual countries might find it necessary to seek advice on matters ranging from the design of appropriate tariff structures to the appraisal of particular investment packages. It was felt that UNIDO and the regional development banks had an obvious role to play in assisting in the selection and appraisal of particular development proposals. The Group noted with interest that the United Nations General Assembly by its resolution 3507 (XXX) had requested the UNIDO Executive Director to take "all necessary measures to establish an industrial technological information bank as a component of an over-all technological information exchange network".

Emphasis was laid on the importance of enhancing the relevant technical skills among developing country nationals. The situation varied markedly between countries, and in some cases there was no serious problem. In others there was a dearth of all but the most rudimentary skills. The Expert Group noted the role played by UNIDO in organizing training programmes such as those on diesel engine maintenance and the repair of mechanical equipment, and in providing fellowships. Continuing assistance along these lines in relation to low-cost vehicles would increase the supply of workers with the necessary skills.

Finally, the group examined the possibilities of greater regional co-operation in planning production. The existence of significant economies of scale in production and the small size of most national markets meant that cost reduction might be achieved through regional co-ordination. Internationally, significant initiatives to reduce costs in this way had been taken by groups of countries, as for example, the countries of the Andean Group, and by associated companies of international automotive corporations. The objective of these schemes had been to promote specialization in parts manufacture between units, with careful attention paid to the need to maintain balanced trade between the countries concerned. Experience had shown that the promotion of regional co-operation in automotive production was far from simple. The complexities inherent in national industrial planning were compounded by the difficulties in matching the different and sometimes conflicting interests of the countries involved. Nevertheless, the potential gains were great so that the possibilities certainly deserved consideration.

Similarly, benefits could be expected to flow from greater standardization of parts and components, which would lead to increased trade and to production economies.

VI. Conclusions

The development of low-cost two-, three- and four-wheeled vehicles in a number of countries and experience in marketing them suggests that these vehicles have a major part to play in economic development. Moreover, the simpler production technologies involved mean that manufacture can be more readily undertaken at lower volumes of production in countries at an early stage of industrial development. This feature can reduce the foreign-exchange cost of providing an adequate transport system and contribute directly to the enhancement of productive abilities and technical skills.

To secure these developments, the flow of information on vehicle types and productive techniques should be promoted as a matter of urgency. Governments of developing countries should pay attention to the possible role of low-cost vehicles in their economies and to frame development policies accordingly. There is need for continuing support from the international community, including UNIDO and the United Nations regional agencies, in providing information, training and advice on policy and investments.

Annex I

LOW-COST TWO-WHEELERS

Name and address of manufacturer	*Types of vehicles and main characteristics*	*Stage of development*	*Ex-works prices*	*Countries where produced*	*Mode of transfer of technology*
1. STEYER-DAIMLER-PUCH AG Werke Graz Postfach 423 A-8011 Graz Austria	Moped, type Maxi S Engine: Puch, 1 cylinder, 2 stroke Cooling: air Max. output: 2.2 kW at 5,500 rpm Displacement: 38.8 cc Dry weight: 44 kg	Full-scale production	n.a.	Austria (ca 160,000 pieces/annum) assembly in other countries from SKD kits	n.a.
2. JAWA n.p. Strasnice V Korytach 12 10085 Prague 10 Czechoslovakia	Motorcycle, Jawa 350 type 634 Engine: 2 cylinder, 2 stroke Cooling: air Max. output: 23.7 kW at 5,250 rpm Weight: 155 kg	Full-scale production ca 80,000 pieces/annum	Retail price in United Kingdom (as of Oct. 1976) £395	Czechoslovakia	Delivery of full-scale assembly, documentation, technical assistance for start-up operation, supply of know-how and spare parts
3. PIAGGIO and Co. Via Antonio Cecchi 6 Genoa Italy	*(a)* Scooter, type Vespa 90 Engine: 1 cylinder, 2 stroke Max. output: n.a. Displacement: 88.5 cc Weight: 75 kg	Full-scale production	$355 f.o.b. Genoa (as of June 1976)	Brazil, Cameroon, Indonesia, Italy, Malaysia, Nigeria, Pakistan, Singapore, Spain, Syrian Arab Republic	Know-how, plant layout and technical assistance etc.
	(b) Moped, type Boxer 2 Engine: 1 cylinder, 2 stroke Max. output: n.a. Displacement: 49.77 cc Weight: 49/51 kg	Full-scale production	$225 f.o.b. Genoa		
	(c) Motorcycle, GILERA 50 Touring Engine: 1 cylinder, 2 stroke Max. output: 6.25 hp DIN at 7,500 rpm Displacement: 49.8 cc Weight: 70 kg	Full-scale production	$443 f.o.b. Genoa (as of June 1976)	Italy	As *(a)* and *(b)*
4. MOTOBECANE 16, rue Lesault 93502 Pantin France	*(a)* Moped, type CADY M3T Engine: 2 stroke Max. output: 1.5 hp at 4,500 rpm	Full-scale production	F 693 ex-works (as of June 1976)	France and Brazil, Colombia, Greece, Italy, Mali,	Licence agreement accompanied by engineering contract

	Displacement: 49.9 cc Weight: 35 kg			Mauritius, Morocco, Spain, Tunisia, Turkey, Upper Volta, Uruguay, Zaire	and supply of machinery and components
	(b) Motorcycle, Motobecane D-55 Engine: 1 cylinder, 2 stroke Max. output: n.a. Displacement: 49.9 cc Weight: 59 kg	Full-scale production	F 2,115 ex-works (as of June 1976)	France	
	(c) Moped, Velosolex 3800 Engine: 1 cylinder, 2 stroke Max. output: n.a. Displacement: 49 cc Weight: 28.5 kg	Full-scale production	F 460 ex-works (as of June 1976)	France and countries under *(a)* above	
5. AKUABUG International Inc. 100 Merrick Road Rockville Center New York 11570 U.S.A.	Bicycle engine, Bikebug Engine: 2 stroke, aircooled Displacement: 22 cc Max. output: 0.8-1.2 hp at 6,000-7,000 rpm Weight: 5.5 kg	Full-scale production	$110 f.o.b. New York (as of December 1976)	United States of America	n.a.
6. BAJAJ Auto Ltd. Poona India	*(a)* Scooter VIJAY DELUXE Engine: 2 stroke Max. output: 9.4 bhp Displacement: 150 cc Weight: n.a.	Full-scale production	Rs 3,000/3,400	India	n.a.
	(b) Moped VICHY Engine: 2 stroke Max. output: 2.5 bhp Displacement: 49 cc Weight: n.a.	Full-scale production	Rs 1,675	India	n.a.
	(c) Motorcycle YEZDI Engine: 2 stroke Max. output: 12 bhp Displacement: 250 cc Weight: n.a.	Full-scale production	Rs 3,800/4,300	India	n.a.
7. KINETIC Engineering Ltd. D1 Block, Plot No. 18/1, Chinchwad 411019 India	Moped LUNA Engine: 2 stroke Max. output: 1.2 hp Displacement: 50 cc Weight: n.a.	Full-scale production 12,000 pieces/ annum	ca $180	India	Technical assistance for engine, gear-box assembly; supply of spare parts; training and start-up of the plant

Figure I. Motobecane Velosolex 4600

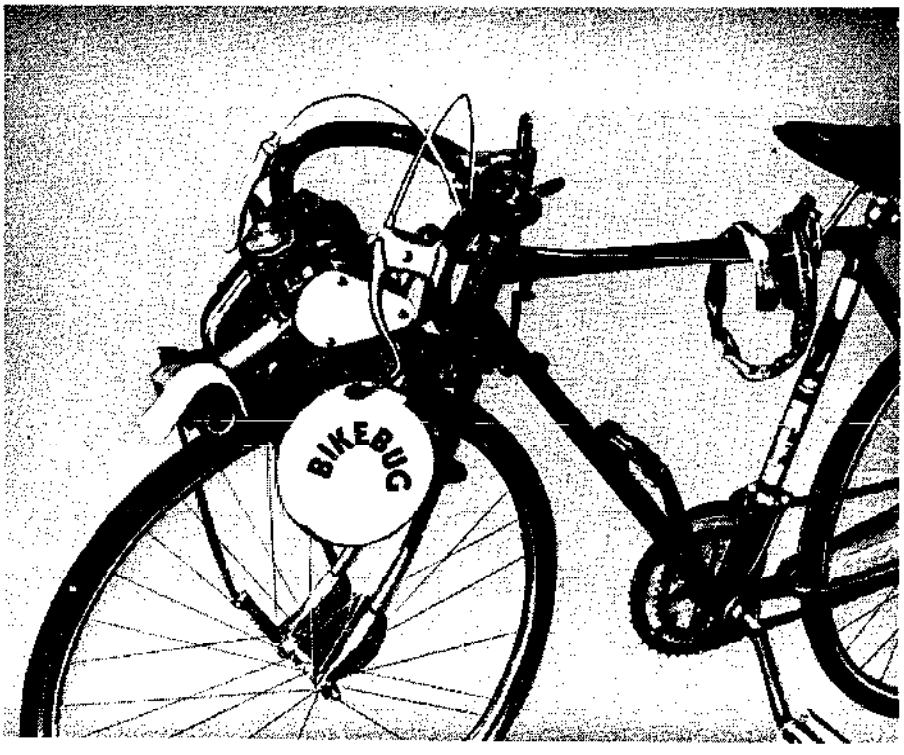

Figure II. Aquabug assembled Bikebug

Annex II

LOW-COST THREE-WHEELERS

Name and address of manufacturer	*Types of vehicles and main characteristics*	*Stage of development*	*Ex-works prices*	*Countries where produced*	*Mode of transfer of technology*
1. BAJAJ Auto Ltd. Poona India	*(a)* Bajaj Commercial Engine: 2 stroke Max. output: 6 bhp Displacement: 150 cc Weight: n.a.	Full-scale production	Rs 6,200 ($700) Retail price Rs 8,000	India	n.a.
	(b) Lambretta Engine: 2 stroke Max. output: 7 bhp Displacement: 175 cc Weight: n.a.	Full-scale production	Rs 6,200-12,700	India	
2. PIAGGIO and Co. Via Antonia Cecei 6 Genoa Italy	*(a)* APE CAR Engine: 2 stroke Max. output: 10.35 hp Displacement: 217.9 cc Weight: 376/437 kg	Full-scale production	$1,544 f.o.b. Genoa	Italy	Co-operation agreement including supply of know-how, technical assistance in designing and supply of equipment
	(b) VESPA Commercial 50 hp Engine: 2 stroke Max. output: n.a. Displacement: 187 cc Weight: n.a.	Full-scale production	$1,118 f.o.b. Genoa	Italy, Pakistan	As above
3. The RELIANT MOTOR Company Ltd. Tanworth Staffordshire B77 1HN, England	*(a)* ROBIN VAN Engine: Reliant, 4 cylinder Max. output: 32 bhp Displacement: 748 cc Weight: 793.8 kg	Full-scale production ca 12,000 pieces/annum	n.a.	United Kingdom, Greece, Indonesia	Manufacturing and know-how agreement
	(b) ROBIN 850 VAN Engine: Reliant Max. output: n.a. Displacement: 850 cc Weight: n.a.	Full-scale production	£1,112	United Kingdom	As above

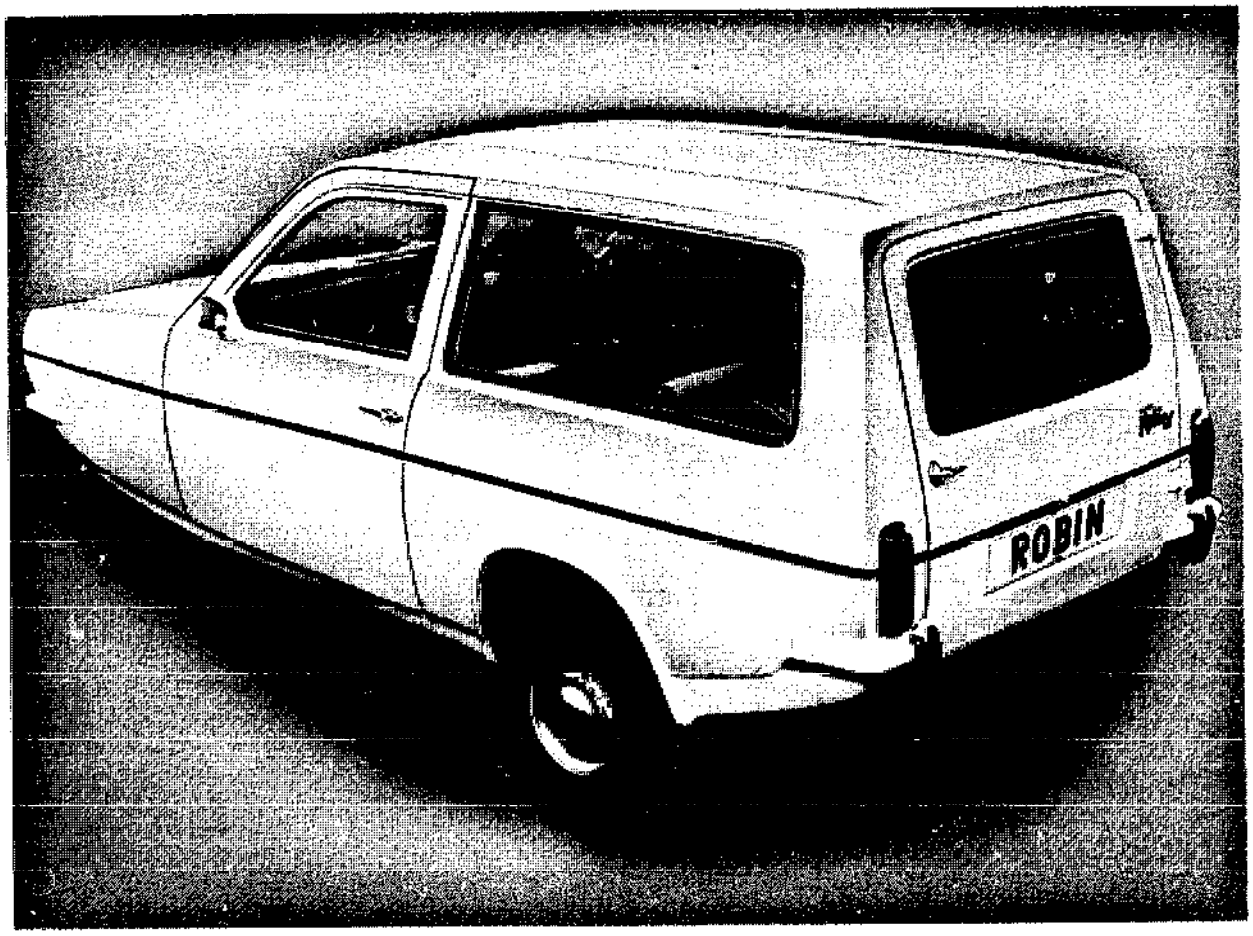

Figure III. Reliant three-wheeler Robin

Annex III

LOW-COST FOUR-WHEELERS

Name and address of manufacturer	*Types of vehicles and main characteristics*	*Stage of development*	*Ex-works price*	*Countries where produced*	*Mode of transfer technology*
1. The RELIANT MOTOR Company Ltd. Tanworth Staffordshire B77 1HN, England	Kitten Saloon Engine: Reliant 4 cylinder Max. output: 40 bhp Displacement: 848 cc Weight: 504 kg	Full-scale production, 1,500 pieces/annum	Basic £1,360	United Kingdom	Manufacturing and know-how agreements
2. INTERPLAN Willbachstrasse 6252 Diez Federal Republic of Germany	MT 1 Engine: 4 stroke Max. output: 12 DIN hp Displacement: 491 cc Weight: 450 kg	Prototype	Estimated at $400		Engineering data, handbooks, models etc.; licensing agreements
3. Volkswagenwerke AG Postfach 3180 Wolfsburg 1 Federal Republic of Germany	PICK-UP VW, type 1 Engine: 4 cylinder, 4 stroke Max. output: 45 hp/DIN Displacement: 1,584 cc Weight: 1,000 kg	Full-scale production	n.a.	Ghana, Indonesia, Pakistan, Philippines, Senegal	Assembling plants, know-how, licence agreements, engineering assistance, plant lay-out, supply of parts
4. FORD-ASIA PACIFIC INC. 33 Albert Rd. Melbourne, Victoria Australia	FORD FIERA (Standard) Engine: 4 cylinder Max. output: 44 hp/DIN Displacement: 1,097 cc Weight: 3,000 lb	Full-scale production	Philipp. pesos 18,421 Thailand baht 47,900	Philippines, Thailand	Assembly and engineering agreement and know-how; supply of spare parts and technical assistance as well as trade-mark agreements
5. FIAT Sp. A Corso 6 Marcon 10/20 10125 Turin Italy	FIAT "22" (126 Cavalletta) Engine: 2 cylinder, 4 stroke Max. output: 21.5 hp DIN Displacement: 600 cc Weight: 490 kg	Prototype	n.a.	–	
6. VAUXHALL Motors Ltd. Kimton Road Luton, Beds United Kingdom (Division of General Motors)	BTV Engine: 4 cylinder Max. output: 54 hp Displacement: 1,250 cc Weight: 1,321 kg	Full-scale production	n.a.	Bangladesh, Costa Rica, Ecuador, El Salvador, Ghana, Guatemala, Honduras, Indonesia, Kenya, Malawi, Malaysia, Nicaragua, Nigeria, Paraguay, Philippines, Portugal, Thailand	Complete assembly line, engineering, know-how agreement, testing, supply of technical assistance, and spare parts
7. CHRYSLER Philippines Corp. P.O. Box 4592 Manila Philippines	CIMARRON	Full-scale production	n.a.	n.a.	n.a.

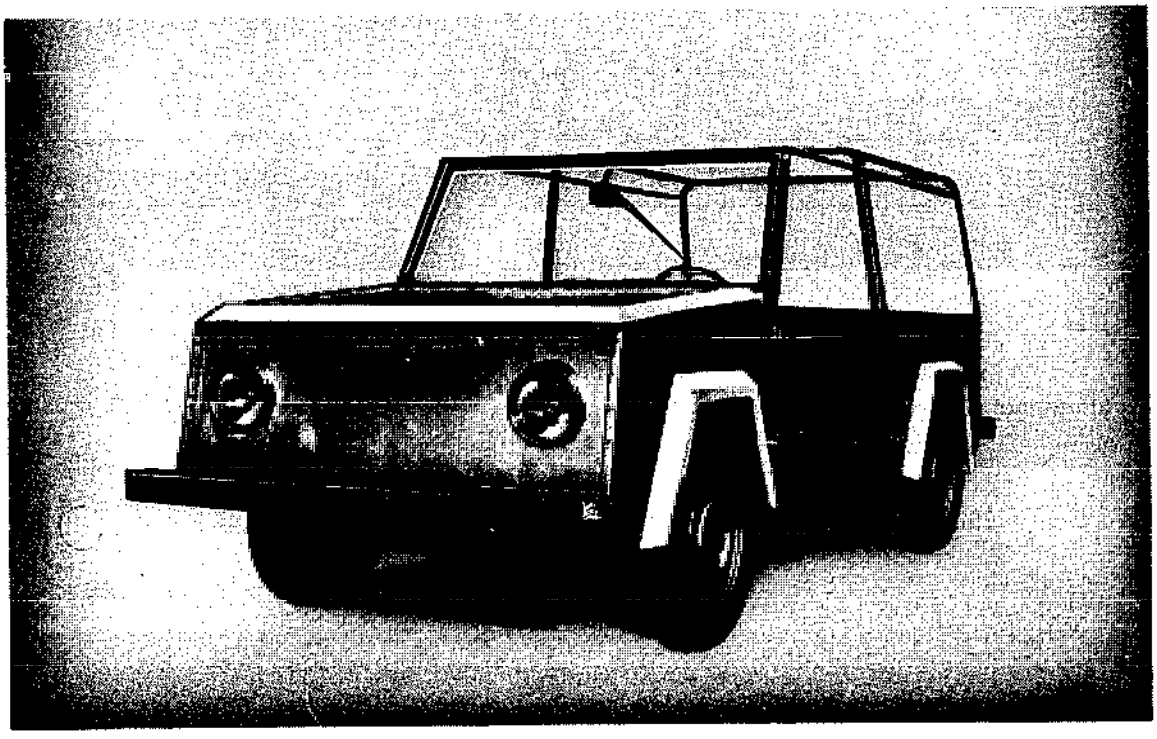

Figure IV. Four-wheeler prototype MT 1 by INTERPLAN

Figure V. Reliant four-wheeler type Kitten DL Saloon

Figure VI. Fiat prototype Cavalletta 22

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