DEVELOPMENT, DEMONSTRATION AND PERFORMANCE EVALUATION OF BATTERY OPERATED CYCLE RICKSHAW

Final Project Report

Submitted to
Ministry of Non-conventional Energy Sources (MNES),
Government of India, New Delhi

(Ref. No. 6/6/1/2000-NT)

By

NARI

Nimbkar Agricultural Research Institute,
P.O. Box 44, PHALTAN-415 523,
Maharashtra, India

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Executive Summary

1. Introduction :

At present there are about 31 million petrol-powered two wheelers and about 2.6 million petrol and diesel-powered three wheelers in India. In addition to the foreign exchange, which the country has to spend in buying the fuel for running these vehicles, these vehicles produce high levels of both air and sound pollution.

On the other hand in many towns and cities of India nearly 2 million cycle rickshaws carry about 6-8 billion passengers-kms/year. These environmentally friendly vehicles have hardly changed in last 60-65 years and partly due to many drawbacks in their design, are being slowly phased out at many of the locations.

Therefore our Institute NARI designed an improved pedal cycle rickshaw (IMPRA). IMPRA has 3-speed gears, reduced length of long chain drive, back wheel braking, better suspension and less aerodynamic drag than the existing rickshaws. Unlike the existing rickshaws, IMPRA enables a rickshaw puller to take 2 passengers on a 6-10% slope quite easily and without getting down from his seat. IMPRA is about 10 kg lighter than the existing rickshaw and is expected to last at least 7-10 years due to its sturdy construction. However, with an IMPRA a rickshaw puller cannot go uphill with ease nor can be carry heavy loads to very long distances.

Consequently, a motor-assisted pedal rickshaw (MAPRA) was designed. This is basically a modified IMPRA with a small, geared electric motor, batteries and an electric switch. Twenty MAPRAs were fabricated and efforts were made to commercialize them.

2. Objectives of the project :

i) To make 20 numbers battery-operated cycle rickshaws.

ii) To make efforts for commercialization in smaller towns.

3. Design methodology for MAPRA :

The major components of MAPRA design were as follows :

a) **Acquisition of PMDC motor of adequate size :** After taking into consideration all the forces acting on IMPRA, motor wattage calculations were carried out. The motor chosen was 1500 rpm 375 W four-pole permanent magnet DC one. These motors are being purchased from a manufacturer in Pune.

b) **Gear box design :** A gearbox was designed with a ratio of 7:1. Thus with the PMDC output of 1500 rpm the output rpm of gearbox was ~ 215. This allowed the MAPRAs to go at 10-15 km/hr. The gearbox had a hollow input for the motor shaft and the motor was foot mounted on the gearbox. These gear boxes are being purchased from a manufacturer in Hyderabad.

c) **Design of drive gear train :** The chain drives from both the pedal and the motor have been put on the main drive shaft. The sprocket/chain design was done in such a manner that both the motor and the pedal drive can work in tandem. Especially hardened sprockets had to be designed for the chain drive.

d) **Battery selection :** With the aim of at least doubling the income of rickshaw pullers we arrived at the distance of 40-50 kms which they would be required to traverse every day. For this two 40 amp-hr batteries of 12 V each would be required. Thus deep discharge 6EL-40 Exide batteries were used.

e) **Design of high current switches :** As the microprocessor-based soft-start units are very expensive and have to be imported from abroad, a switch unit was designed in our laboratory. It contains i) a thumb-controlled on-off switch at the handle, which allows the rickshaw puller to start the motor the moment he feels an increased load. This switch was linked to the brake lever. ii) on/off high current switch near the motor and iii) a 20 A limiting switch with cut off key.

f) **Development of battery charger :** A simple and cost effective battery charger was designed and fabricated which could charge 2 number 40 amp-hr batteries in 10 hours.

The final MAPRA specifications are given in Table 1 (pg 16) and Fig. 5 (Page 15) shows the photograph of MAPRA.

4. Results and discussions :

The performance of MAPRA was tested both on highway (continuous running mode) and in city conditions (start/stop mode). It was found that MAPRA can go to 45-50 km in one battery charge in continuous running mode and 50-60 km in city conditions. The details are given in section III-2 (Pg 18). Till today MAPRAs have logged more than 5000 km in trial runs.

The economic analysis of MAPRA as a taxi showed that a MAPRA owner can get an average net profit of about Rs. 25,500/year. This is when he charges Rs. 3/km as taxi fare. The detailed assumptions and calculations are given in section III-3 (pg 23). Thus owning and running a MAPRA is an economically feasible proposition.

Twenty MAPRAs have been fabricated and MOUs have been signed with Pune University campus and a charitable trust in Hampi, Karnataka to run these rickshaws. The Pune University has been using these MAPRAs for more than 3 months and the results are very encouraging. Hampi experiment will start in August. Attempts were made to commercialize these vehicles in Lucknow, Nagpur, Agra and Kanpur with mixed success.

5. Conclusions :

Based upon the present work, the following conclusions can be drawn :

1. A motor assisted pedal cycle rickshaw, christened as MAPRA has been completely designed, fabricated and test run in various locations.

2. The MAPRA has a 375 W, 4 pole PMDC motor, two 40 amp-hr deep discharge lead-acid batteries and a 7:1 ratio planetary gear box. A stand alone battery charger is provided to charge the batteries overnight.
3. MAPRA can also take two passengers to 45-50 km in one battery charge on highway (continuous running mode) and can take them to 50-60 km in city driving conditions (stop/start mode).
4. MAPRA can also take 2 passengers on a 10-15% slope at 10-12 km/hr.
5. Complete data on battery discharge, power used in running MAPRA under different driving conditions and life of various components have been developed.
6. Twenty MAPRAs have been fabricated and tested.
7. In developing MAPRA quite a number of vendors were identified in Satara, Pune and Hyderabad who designed the motor, battery charger and gear box according to our specifications. This is one of the major achievements of the project.
8. MAPRA till todate has logged more than 5000 kms in trial runs.
9. Five MAPRAs have been successfully introduced in Pune University campus where they have logged more than 2000 kms in trial run since February 2002. There has been a very positive response to this experiment. Hence authorities at Baroda University, I.I.T. Kanpur and Nirma Institute of Technology, Ahmedabad want to introduce MAPRAs on their campuses.
10. There have been some problems in introducing MAPRAs in western Maharashtra. There is no tradition of using cycle rickshaw in this part of the country. Hence it is very difficult to get rickshaw pullers to drive these rickshaws. Efforts are however on to introduce these rickshaws in small towns.
11. An MOU has been signed with a charitable trust in Hampi, Karnataka to introduce 5 MAPRAs as tourist vehicles in the Hampi ruins.
12. The cost of MAPRA has been estimated to be Rs. 20,500/-. This includes the cost of battery and charger. The selling price of MAPRA is estimated to be Rs. 27,000/-.
13. Economic analysis of running MAPRA as a taxi shows that it is possible for the rickshaw puller/owner to earn a good profit from it.

14. Vendors in Pune have been identified to manufacture various parts of MAPRA so that it can be fabricated rapidly.

6. Recommendations :

Based upon this work the following recommendations can be made :

A) Technological issues :

i) The design of MAPRA is very robust and simple. However further changes can be made in the design by making MAPRA frame out of lightweight tubular material.

ii) There is a scope for reducing the weight of gear box. This will help bring down the weight of MAPRA further.

iii) There is a need to develop a very low cost controller, which can sense the load and start the motor. This will help bypass the tendency of a rickshaw puller to always put the motor on while driving MAPRA.

iv) The technology of MAPRA is available and ready for large scale commercialization.

B) Policy issues :

i) There is a great need to make available to a rickshaw puller a bank loan so that he can own a MAPRA. This can only be done by setting up rickshaw pullers' cooperative societies in different cities. These societies or self-help groups can then take loans from the banks to buy MAPRAs. This is necessary as no existing rickshaw owner is ready to purchase MAPRA.

ii) IREDA can also provide soft loans to such cooperative societies/self-help groups. This will help to put MAPRAs on the road all over the country.

iii) MNES can take a lead in this venture. To our mind this is the only electric vehicle effort in India, which helps the poor labourer by giving him employment, and at the same time allows transport of passengers in a humane and eco-friendly manner. This effort should be supported and moved forward as a part of various Rojgar Yojanas of Government of India.

iv) Introduction of MAPRAs in University Campuses, zoos and at heritage sites should be encouraged.

7. Achievements of the project :

a) A motor assisted pedal cycle rickshaw (MAPRA) has been designed, developed and tested.

b) Various vendors in Pune, Satara and Hyderabad have been identified to manufacture various parts of MAPRA.

c) Twenty MAPRAs have been fabricated and partially commercialized.

d) MAPRA has been shown to be a commercially viable transport system.

e) Various policy issues to move this concept forward have been identified.

CHAPTER 1

1. INTRODUCTION

Most of the cities and towns in developing countries are highly polluted. The main reason is the air and noise pollution caused by transport vehicles, especially petrol and diesel-powered two and three-wheelers. For example, data for 1998 show that in India there are close to 18 million petrol-powered two wheelers and about 1.5 million petrol and diesel-powered three-wheelers and their population is growing at a healthy rate of about 15% per annum. Besides being a major hazard to people's health, these machines are guzzling huge amounts of petrol and diesel for which the country has to pay dearly in foreign exchange outflow. It is a common sight in developing countries that during traffic jams in congested areas of cities these vehicles produce tremendous pollution [1].

An electric cycle rickshaw can provide a non-polluting and a very silent transport system for urban and rural areas of India. Besides it is a very energy efficient and cost effective vehicle. Work done at our Institute has shown that improved cycle rickshaw powered by an electric motor and batteries has a potential to provide an attractive alternative to petrol and diesel-powered three-wheelers. Besides they can also provide large-scale employment and extra income to the rickshaw puller.

2. EXISTING CYCLE RICKSHAWS

There are guesstimates that close to 2 million cycle rickshaws ply on the Indian roads carrying about 6-8 billion passenger-kms/year. In some cities they are the major means of transport. They provide employment to more than 2 million rickshaw pullers, are very maneuverable and are completely non-polluting and hence environmentally friendly means of transport. It is however very unfortunate that deliberate policies in most of the urban towns of developing countries have been made by the concerned authorities to phase out these rickshaws. These non-polluting vehicles are being replaced by polluting (both air and noisewise) petrol and diesel-powered three wheelers. Our data for example show that three wheeler diesel tempos in Lucknow city (capital of Uttar Pradesh) produce close to 70-80 decibel noise at a distance of 1-2 m, besides belching out huge amounts of particulates into the air. Similar data exist in almost all major towns where diesel/petrol three wheelers are being

introduced. Even in rural areas in taluka/tehsil towns the spread of diesel/petrol three wheelers has started affecting air quality [1].

However, the existing rickshaws are so poorly designed that running them takes a heavy toll on the health of a rickshaw puller. The existing cycle rickshaw has hardly changed since it was introduced in India in early 1930's and 40's. The gearing and the mechanical advantage of the pedal is very poor. Hence the rickshaw puller has to work very hard while climbing even a slight slope. A common sight is of the rickshaw puller getting down and pulling on foot the rickshaw with passengers. The braking system is also very poor with only front brakes on the rickshaw. Thus when going downhill at high speeds sudden braking produces a catapult effect. Similarly the seating arrangement is very uncomfortable and the aerodynamic drag of the system is very high. It is therefore humanly degrading to pull the existing inefficient cycle rickshaw. Yet because of poverty, migrant labourers do become rickshaw pullers and suffer adverse consequences to their health. The rickshaw manufacturing presently is a footpath industry with no quality control and there are as many rickshaw designs as cities in which they ply. These rickshaws are so poorly made that they have to be replaced completely in a couple of years. Thus there is a need to improve the existing rickshaw and bring quality control in its manufacture.

Our Institute has therefore designed and developed two types of cycle rickshaws :

A) Improved pedal cycle rickshaw (IMPRA).

B) Motor-assisted pedal cycle rickshaw (MAPRA).

A) *Improved pedal cycle rickshaw (IMPRA)* : The new design of pedal cycle rickshaw has 3-speed gears, reduced length of long chain drives (which are in existing rickshaws), back wheel braking, better suspension and less aerodynamic drag than the existing ones. Fig. 1 shows the IMPRA. Tests done at our Institute have also shown that it enables a rickshaw puller to take 2 passengers on a 6-10% slope quite easily and without getting down from his seat. This rickshaw is made of mild steel angles and is light in weight and sturdy. The weight of the rickshaw is 85 kg as compared to 90-95 kg of the existing rickshaws. Its life is estimated to be between 7-10 years [1].

Fig. 1. Improved pedal cycle rickshaw (IMPRA)

Our data (from interviews with more than 300 rickshaw pullers and owners) from urban towns of India has also shown that a large number of rickshaw pullers are migrant labourers from villages and sometimes have the rickshaw as their sole possession. Hence at night when they sleep, they sometimes do so on the cramped seat of the rickshaw for the fear of it being stolen. Our new design allows the seats to be arranged in such a way that a long bed results which allows a rickshaw puller to sleep properly and without the fear of his rickshaw being stolen at night. The cost of this rickshaw is estimated to be Rs. 7,000/- in mass production and compares very well with Rs. 4000-6000/- which is the cost of existing cycle rickshaws.

B) *Motor-assisted pedal rickshaw (MAPRA)* : Our data (from discussions with rickshaw pullers) also revealed that with a small battery-driven motor (permanent magnet D.C. motor) attached to the IMPRA, it may be possible for the rickshaw puller to go uphill with ease. Similarly he can also carry a heavier load to longer distances than what the IMPRA can at 10-15 kms/hr speed.

Consequently a motor-assisted pedal rickshaw (MAPRA) was designed and is described in this project. This is a modified IMPRA with a small geared electric motor, batteries and an electrical switch.

3. OBJECTIVES OF THE PROJECT

i) To make 20 numbers battery-operated cycle rickshaws.

ii) To make efforts for commercialization in smaller towns.

4. OUTLINE OF THE REPORT

The report is divided into the following chapters :

a) Design methodology for MAPRA (Chapter II)

b) Results and discussion (Chapter III)

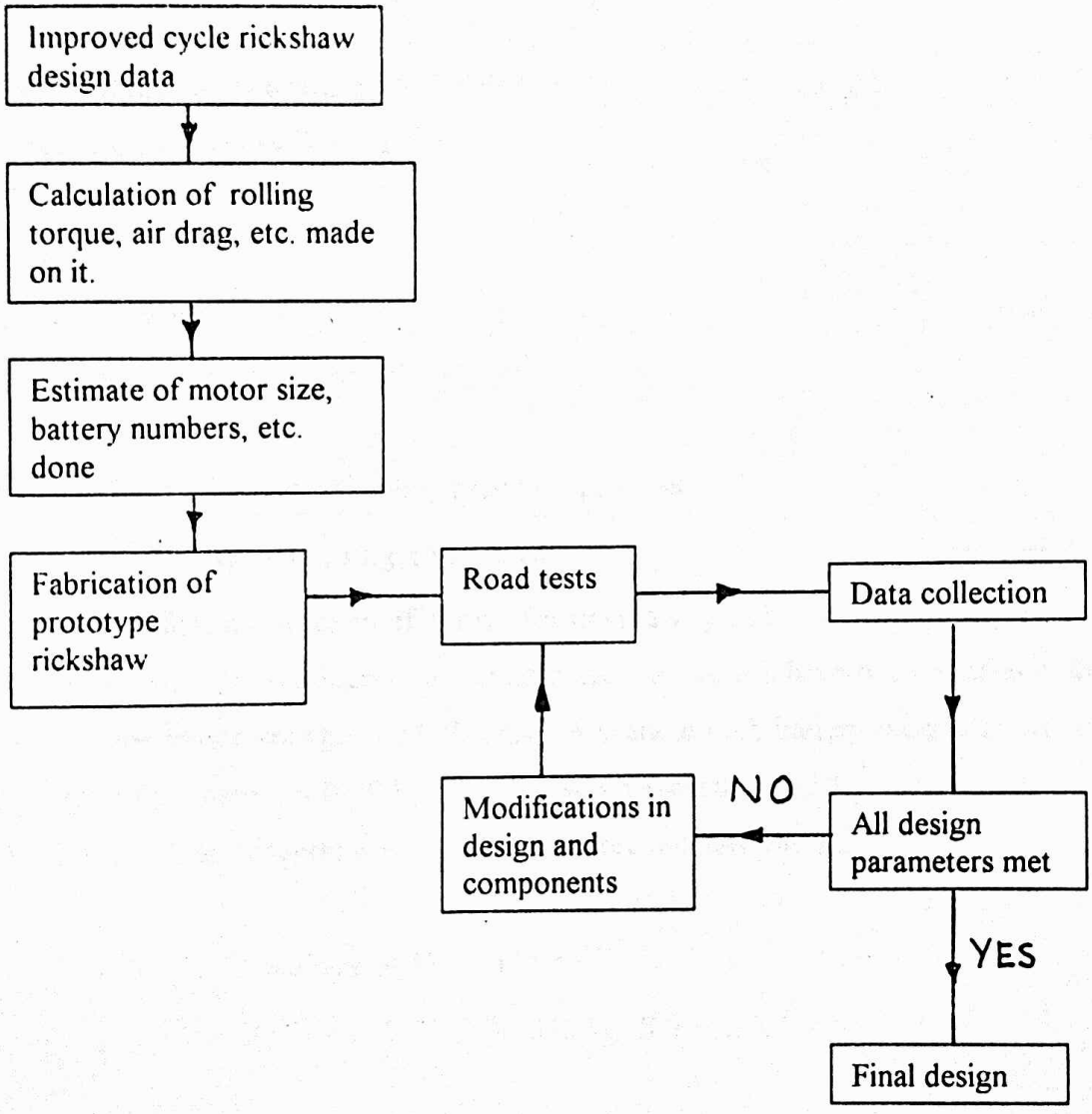
c) Conclusions and recommendations (Chapter IV)

d) Appendix.

CHAPTER II

DESIGN METHODOLOGY FOR MAPRA

As discussed in Chapter I, NARI has designed an improved cycle rickshaw (IMPRA) and then converted it to motor-assisted pedal rickshaw (MAPRA), which is the subject of this report. The design methodology used for developing MAPRA was as follows :



The major components of design were :

a) Acquisition of PMDC motor of adequate size.

b) Development of small gear box.

c) Design and development of gear train.

d) Selection of proper deep discharge batteries.

e) Development of high current switches.

f) Development of a battery charger.

Designing was done for each of these components and the calculation details are given below:

II-1. Motor wattage calculations :

The forces acting on a rickshaw are : [2]

a) Rolling friction

b) Aerodynamic drag

c) Acceleration of vehicle

d) Inertial resistance of moving parts

A) **Rolling friction :** The force of rolling friction is given as

$$R_r = C_r . M.g \text{ (Newtons)} \quad \text{---------- (1)}$$

Where C_r is the coefficient of friction of tyres (for rickshaw tyres it is 0.007/tyre [3]) and M is the mass of rickshaw with passengers. It was assumed that we will have two batteries in the rickshaw so that the motor voltage is 24 V. On an average each battery weighs 20 kg, so combined weight of the batteries is 40 kg. The MAPRA weight is 115 kg. The weight of 3 persons (1 driver and 2 passengers) was taken to be approximately 180 kg.

$$\therefore \text{ Total mass} = 180 + 115 + 40 = 335 \text{ kg}$$

$$\therefore R_r = 0.007 \times 3 \times 335 \text{ kg} \times 9.8 \text{ m/s}^2 \cong 68.94 \text{ N}$$

B) **Aerodynamic drag :** The forces acting on rickshaw because of aerodynamic drag are given by Darcy equation :

$$R_d = C_D \, A.\rho. V^2 / 2 \text{ (Newtons)} \quad \text{--------- (2)}$$

Where C_D = drag coefficient, A = frontal area of rickshaw, m^2, ρ = density of air, 1.2 kg/m^3 and V = the velocity of vehicle, m/s. As the vehicle was expected to go at varying speeds, the maximum value for drag was used in motor calculations. C_D was taken to be ~ 1 (for the maximum resistance) whereas A = 1.5 m^2. For MAPRA the maximum speed will be that of pedal rickshaw which is about 15 km/hr. It will vary between 10-15 km/hr. Hence an average of 12 km/hr has been used in our design calculation.

Thus,

$$R_d = 1 \text{ X } 1.5 \text{ m}^2 \text{ X } 1.2 \text{ Kg/m}^3 \text{ X } (3.33)^2 / 2 = 9.98 \text{ N}$$

C) **Acceleration of vehicle :** It was assumed that the vehicle will reach 12 km/hr from rest in 1 minute. This acceleration rate is comfortable at velocities involved.

$$\therefore a = V / t, \quad \text{where } t = \text{time}$$

$$\text{and } R_a = M \cdot a \text{ (Newtons)} \qquad \text{---------- (3)}$$

$$\therefore R_a = 335 [12000 / (3600 \text{ X } 60)] = 18.61 \text{ N}$$

D) **Inertial resistance of moving parts :** The inertial resistances of parts are negligible as compared to the above forces and were neglected [2].

$$\therefore \text{ Total resistive force } R_T = R_r + R_d + R_a \text{ (Newtons)} \qquad \text{---------- (4)}$$

$$\text{and Total power} = R_T \cdot V \text{ (Watts)}$$

$$= (68.94 + 9.98 + 18.61) \text{ X } 3.33 \text{ (N.m/s)}$$

$$= 324.77 \text{ W}$$

Thus the motor chosen was 1500 rpm 375 W permanent magnet DC one. It should be pointed out that since this rickshaw is motor-assisted pedal rickshaw, the human power will reduce the power requirement for electric motor and hence the motor capacity chosen is more than adequate. This is what has been observed in the actual experiments.

Getting a motor of right size proved to be a difficult proposition. Based upon our design a Pune party was identified to make the motor. This party delivered 5 motors but then stopped their business because of internal problems. Therefore a search was mounted to identify other manufacturers. Two manufacturers were identified, one in Baroda and the other in Pune. Both manufacturers' motors were tested and the one from Pune party was found satisfactory.

However the motor did not give the requisite torque. The Pune party then did extensive R&D and produced the motor which gave very satisfactory results. Four motors from this Pune party were tried and tested before the final design was optimized. Subsequently all motors have been purchased from this party.

II-2. Gear box design :

The strategy applied in the present design is that the rickshaw puller will continuously keep on pedalling and the motor will be switched on to help him pull the rickshaw under increased loading and on uphill climb. Hence a gear box had to be designed so that the ratio would be 7:1. With the PMDC output of 1500 rpm the output rpm of gear box was ~ 215. This allowed the rickshaw to go at 10-15 km/hr.

In the initial design phase a very simple gear train of pulleys and a belt was fabricated with a ratio of 7:1. The rickshaw was tested for about 200 km. The problem with his gear train were:

a) it was very bulky
b) slippage of belt took place thereby increasing the loss of power and hence increased battery drainage took place.
c) the alignment of pulleys had to be very precise and it could not be maintained properly in a small space.

Hence a small gear box with worm/gear arrangement was designed for the above ratio. A Pune party was identified and it fabricated this gear box. The gear box was compact and the worm design was done in such a manner that it could rotate forward and backward. This was done so that the MAPRA could go both forward and in reverse direction. This required a worm angle which was quite steep. This gear box was tested for about 500 km and was found to function satisfactorily. However the worm (made of brass) got worn out in this distance. Thus it was felt that a very sturdy gear box of planetary nature will be an ideal choice. However the Pune party did not have the expertise of making the planetary gear. Therefore a search was mounted for gear manufacturers.

Two manufacturing parties (one from Satara and the other from Hyderabad) were identified and the planetary gear boxes based on our design were fabricated. The gear box had hollow input for the motor shaft and the motor was foot mounted on gear box. The gear boxes from both the parties were found to be satisfactory. Ultimately the cost considerations made us select the Hyderabad party for the final delivery. Hence all the gear boxes have been purchased from them. Till today these gear boxes have logged more than 5000 kms in run and are functioning properly.

II-3. Design of drive gear train :

The chain drives from both the pedal and the motor have been put on the main drive shaft as shown in Fig. 2. The sprocket/chain design was done in such a manner that both the motor and the pedal drive can work in tandem and hence the chains are mounted on free wheel sprockets on the main drive shaft. Quite a number of permutations/combinations were tried before we ultimately arrived at the right drive ratio for comfortable driving by the rickshaw puller. This required the designing of especially hardened sprockets for chain drive. A party in Pune has been identified to manufacture these sprockets for us.

II-4. Battery selection :

Once the wattage of the motor was decided, the next design step was to decide its voltage. In the design of PMDC motors the weight and volume of the motor is inversely proportional to its voltage. Hence a higher voltage would be useful but that would entail a large number of batteries of 12 V each. Thus a compromise of 24 V motor was reached.

Our information collected from discussions with rickshaw pullers revealed that they normally travel a distance of 20-25 kms/day [1]. Hence it was decided that with MAPRA their earnings should at least double and therefore they should be able to travel 40-50 kms in one day. Design calculations showed that they can go to this distance with 40 amp-hr battery capacity. Hence two 40 amp-hr batteries of 12 V each were used in all MAPRAs. Fortunately Exide batteries (manufactured by Chloride Industries Ltd.) has recently introduced deep discharge batteries in the market in this range and hence 6EL-40 batteries were used.

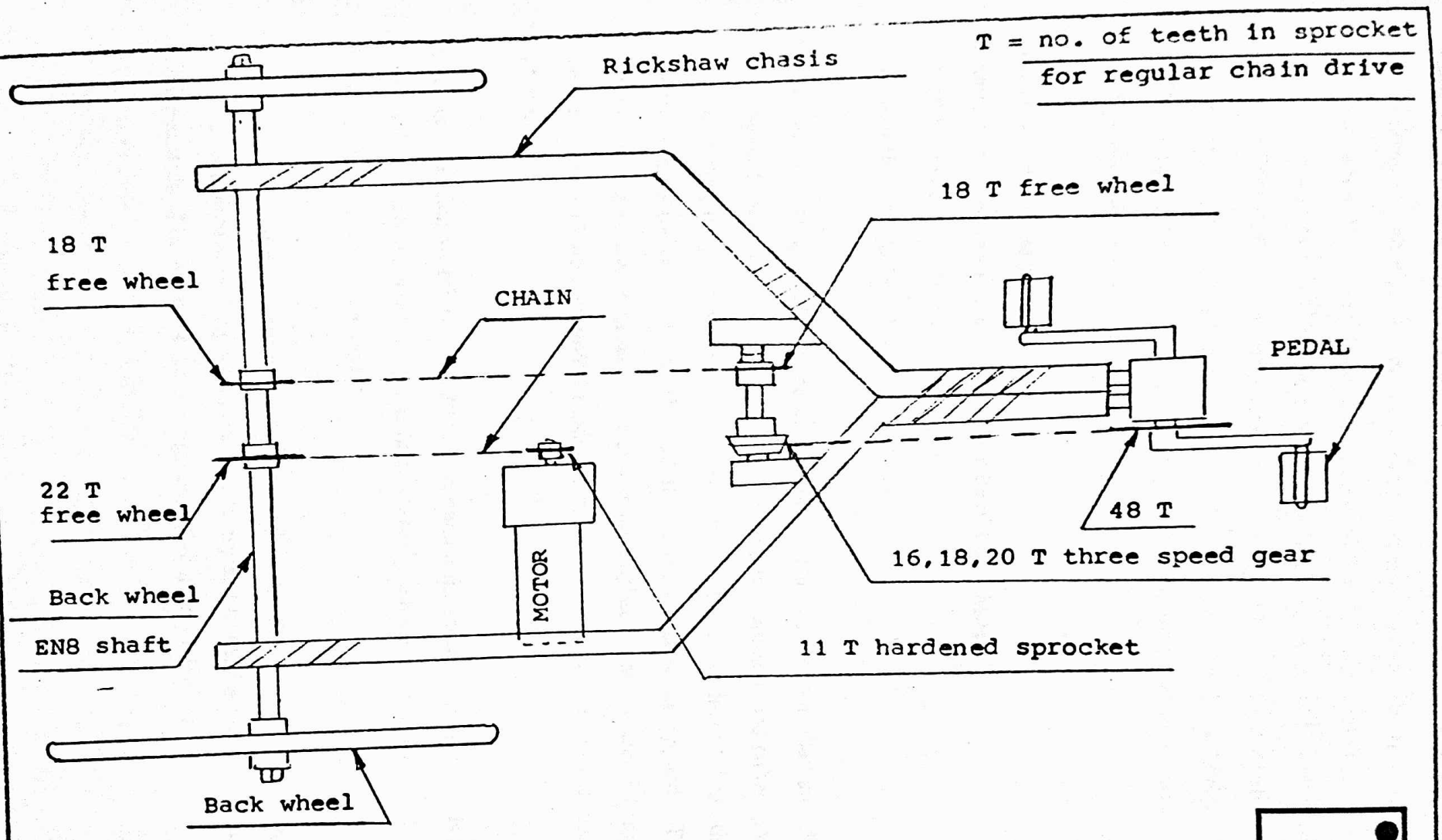


Fig. 2. Schematic diagram of drive gear train

II-5. Design of high current switches :

Normally in designing an electric vehicle a microprocessor-based soft-start unit is deployed. These units are not available in India and are imported from abroad. Also they are very costly (for example for our design the unit from Curtis Instruments of U.S. will cost anywhere between Rs. 10,000-12,000). Hence a very simple strategy of the rickshaw puller using an on-off switch to start the motor whenever he needed it was deployed in MAPRA. Subsequent observations suggest that this strategy works quite satisfactorily and as a result, the cost of MAPRA was substantially reduced.

The switch unit has three parts

a) Thumb controlled on-off switch at the handle of the rickshaw
b) On-off high current switch near the motor
c) A 20 ampere limiting switch with cut-off key

The block diagram (Fig. 3) shows the arrangement. The thumb controlled switch allows the rickshaw puller to start the motor the moment he feels an increased load either going uphill or at any time during his journey. This switch is linked to the brake lever. Thus the design of this switch allows the motor to be shut off the moment brakes are applied. This helps in preventing the motor overload when the brakes are applied. Thus in city driving conditions where the motor will work in on/off mode the present strategy can lead to an increase in the life of motor.

The current limiting switch is set at 20 amperes and if the motor current exceeds this limit for 2 minutes the switch shuts off and it has to be manually put on. This is a safety feature for the rickshaw and also protects the motor.

The high current switch is a spring-loaded one and made of materials to withstand 50 ampere current. This switch was designed in our laboratory and to the best of our knowledge is not available outside. Fig. 4 shows the photographs of all the switch parts.

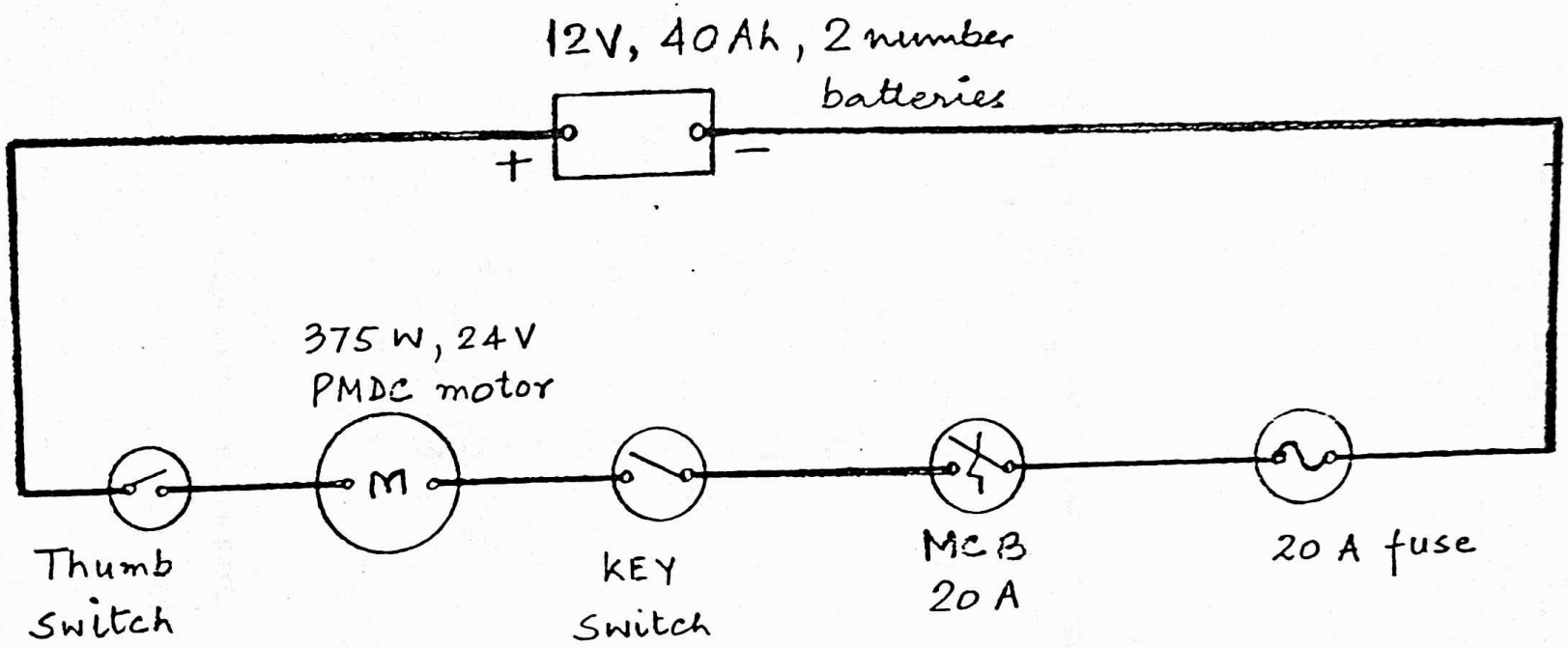


Fig. 3. SWITCHING CIRCUIT FOR MAPRA

NARI

Fig 4. Photographs of all switch parts

II-6. Battery charger design :

Two types of battery charger were designed to charge two 40 amp-hr batteries overnight. One was based upon SMPS design and the other was a regular one. The SMPS charger was small, light in weight and sturdy but very costly (~ Rs. 4000 per piece). The regular charger was slightly bigger and weighed about 5 kg but it was half the price of the SMPS-based charger. Since the batteries had to be charged at night, the charger had to be a stand alone unit. Thus the cost considerations far outweighed the weight considerations. Consequently low cost regular charger was used in all the MAPRAs. The battery charger was made by a party in Pune.

II-7. Other design considerations :

The other design criteria considered in MAPRA were

a) Lightweight chassis, seating and hood arrangement.

b) Provision for rickshaw puller to sleep on the rickshaw.

c) Ample baggage space.

d) Issue of differential on the back wheels.

A) The chassis was same as that in IMPRA and was made of mild steel angle iron. The leg rest and luggage compartment were made out of 14 gage wire mesh. Besides giving an aesthetically pleasing appearance, the open design allows good aerodynamics and hence reduces the air drag on rickshaw. A hood arrangement has been made in such a manner that both the passengers and the rickshaw puller are protected against the sun. Fig. 5 shows the final MAPRA design.

B) Our survey of rickshaw pullers showed that majority of them are migrant labourers and for quite a number of them rickshaw is their only possession. They sleep in a very uncomfortable manner on the rickshaw itself for fear of it being stolen. The MAPRA has been designed in such a way that the backrest can be taken off and attached to the seat so that a long bed results and the rickshaw puller can sleep comfortably.

C) There is an ample luggage space under the seat and in front. Provision has also been made for a small attachment at the back for extra luggage.

D) The existing rickshaws have only one back wheel drive. This design has evolved so as to keep the design very simple. However with this design the rickshaw tends to be pulled to one side. Since the speeds of the cycle rickshaws are between 10-15 km/hr only this issue

is not very critical and in a very short time the rickshaw puller learns to control the rickshaw properly.

In MAPRA we have continued using one back wheel drive strategy since the speeds are again in the range of 10-15 km/hr. For high speed vehicle the issue of back wheel differential gear mechanism becomes very important. Also by introducing back wheel differential in MAPRA the cost would have again gone up substantially. Besides we would have had to design it and get it fabricated specially for us since no small differential systems are available in the market.

With all these design considerations, the final MAPRA looks like as shown in Fig. 5. Shown in Fig. 6 is the photograph of MAPRAs fabricated and ready for dispatch. The weight of each MAPRA is 153 Kg and the specifications are shown in Table 1. To the best of our knowledge MAPRA development has been pioneered at NARI. Based upon our work there is now a worldwide interest in this type of rickshaw. Recently a U.S. party which is the producer and supplier of pedicabs for both U.S. and Europe has expressed willingness to import our MAPRAs into the U.S. Negotiations are on for their export to them.

Fig. 5. Final MAPRA design

Fig. 6. Fabricated MAPRAs

Table 1 : Specifications of MAPRA

1.	Pay load	: 180 kg (2 passengers + 1 driver) to 15% grade
2.	Vehicle weight	: 153 kg (including batteries)
3.	Range	: 45-50 km on highway (80% battery discharge)
		: 50-60 km in city conditions (-do-).
4.	Top speed	: 15 km/hr. Average 10-12 km/hr.
5.	Battery type	: 12 V 6EL-40 Exide-make deep discharge with 40 amp-hr capacity .
6.	Battery weight	: 19 kg each. (Total of 38 kg)
7.	Battery charger	: 24 V; 10 A DC; stand alone charger
8.	Charging time	: 10-12 hours
9.	Motor	: 375 W, PMDC, 4 pole, high torque
10.	Gear box	: Planetary type, 7:1 ratio; hollow input
11.	Transmission gear train	: Chain/sprocket driving backwheel
12.	Frame/body type	: M.S. angle iron construction
13.	Size specifications	: 2.5 m (L) X 1.05 m (W) X 1.93 m (H)
14.	Ground clearance	: 23 cm.
15.	Brakes	: Back wheel shaft braking

CHAPTER III

RESULTS AND DISCUSSION

This chapter gives the details of results. The topics covered are :

1. Number of MAPRAs fabricated and total distance traveled by them.
2. Performance of MAPRAs on highway (continuous run) and in city conditions (stop/start mode).
3. Economic analysis of running a MAPRA.
4. Issues regarding commercialization of MAPRA.

III-1. Number of MAPRAs fabricated and total distance traveled. As per the objective of the project, total of 20 number MAPRAs have been fabricated. Seven of these are running continuously whereas the rest 13 still have to be deployed. The MAPRAs have accumulated a total of more than 5000 kms in trial run.

III-2. **Performance of MAPRAs :**

A) ***Performance under highway conditions (continuous run)*** **:** A large number of trial runs were carried out to test various components of MAPRA and its overall performance. Thus tests were conducted under heavy loading to see whether the gears, sprockets and the mechanical components can pass the durability tests. Data have also been collected on the voltage of batteries, current used by the motor and the specific gravity of batteries to find out the percentage of discharge. Fig. 7 shows the typical run data where the power of motor is plotted against speed. Fig. 8 shows the specific gravity of battery vs. distance traveled. It can be seen that the MAPRA can travel 45-55 km in one battery charge. The average speed was 10-15 km/hr. It should be pointed out that the power vs. speed curve is valid for level road running. Similar graph under city driving conditions (stop/start mode) yielded a different curve.

Tests conducted on 15% slope showed that MAPRA could easily take 2 passengers up this slope at a speed of 8-10 km/hr. However if MAPRA is started from standstill condition on this slope then the 375 W motor power was not sufficient to climb up with 2 people and driver. Only one passenger could be carried under this condition.

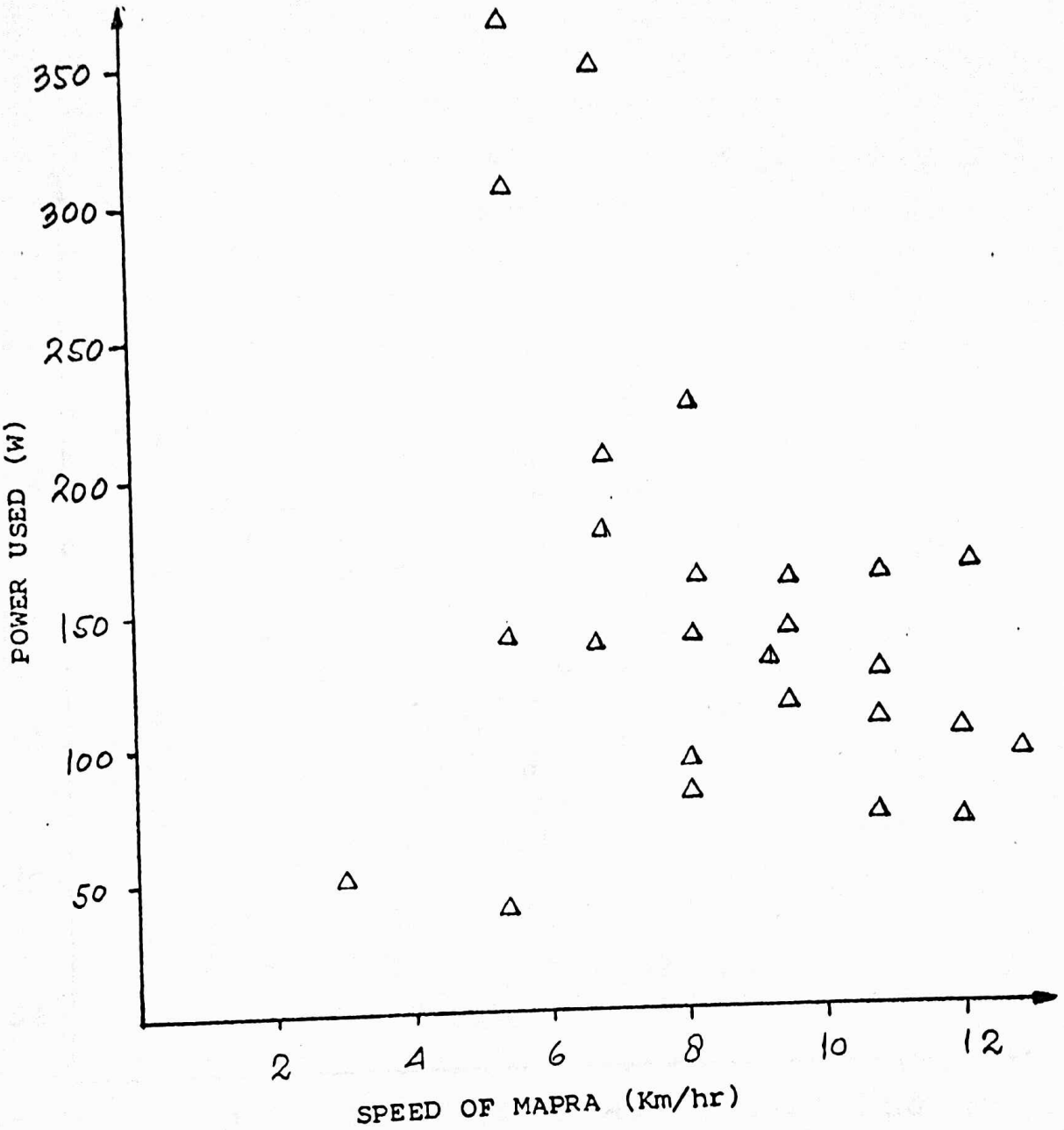


Fig. 7. Power used vs speed on level road running conditions

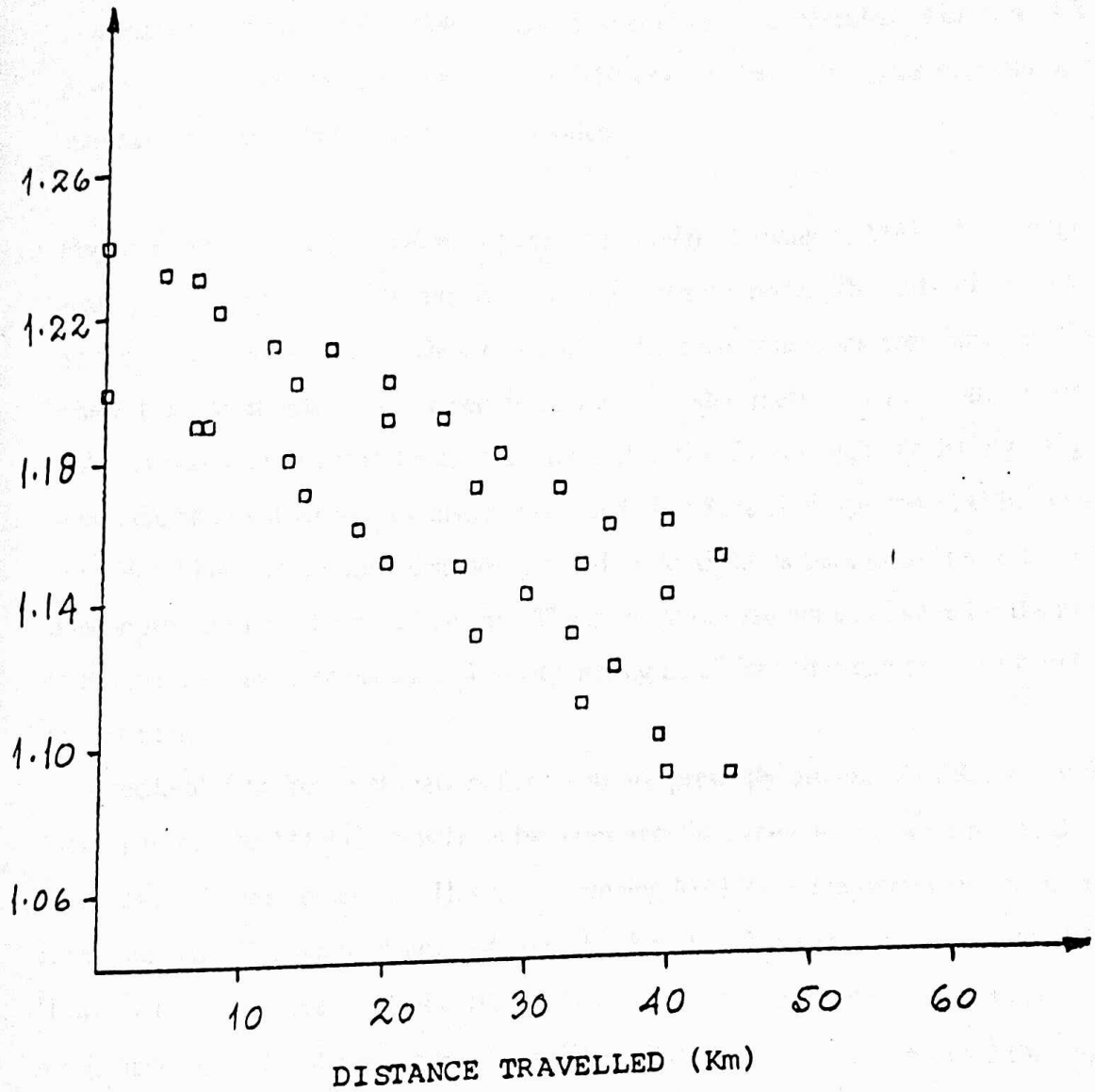


Fig. 8. Specific gravity of battery vs distance travelled on level road

The strengths of different mechanical parts were tested for almost one and half years under different conditions and a large number of permutations/combinations were tried to arrive at the right combination of sprockets, free wheel, shaft dimensions etc. The quality of cycle rickshaw parts available in the market leaves much to be desired. Hence some of the components were specially fabricated to withstand the rigors of rickshaw plying. It should be pointed out that the present rickshaw parts are so poorly machined and fabricated that in a year or two the whole rickshaw has to be completely overhauled. For MAPRA our design strategy was for it to last at least 7-10 years. Hence the focus on good quality materials and attention to design, was provided.

3) ***Performance under city conditions (start/stop mode)*** : Driving of MAPRA in congested areas of cities requires it to be mostly run in the start/stop mode. This puts a heavy burden on the motor and batteries. Data collected under such conditions are shown in Fig. 9 where the power output vs. speed is plotted. Under these conditions the speed of MAPRA was 9-11 km/hr and was much lower than that for the highway driving. Fig. 10 shows the battery discharge vs. distance traveled. For 80% discharge the MAPRA can go upto 50-60 km. This longer distance traveled by MAPRA is because of more pedalling done in stop/start conditions of the city. These conditions are not conducive for the motor to run the rickshaw continuously. The city driving conditions thus can be more beneficial to the battery.

Anecdotal data from rickshaw pullers who are presently driving MAPRA show that they try to run the MAPRA mostly on batteries and since they do not want to pedal they try to take only one passenger. This makes running MAPRA quite unremunerative. This is an outcome of human tendency and could be thought of as a shortcoming of MAPRA. However the alternative was a Rs. 10,000-12,000 microprocessor based controller which would have made the MAPRA very costly. This controller would have allowed the motor to be turned on when the load increased. It should however be pointed out that these data have been generated by testing MAPRA in locations (Pune and Phaltan) where cycle rickshaws are not used. The rickshaw pullers here are not used to driving such rickshaws. In cities and towns where cycle rickshaws are presently in use, driving of MAPRA by rickshaw pullers is expected to be in both pedal and motor mode. Consequently the earnings of rickshaw pullers will be much higher when driving a MAPRA.

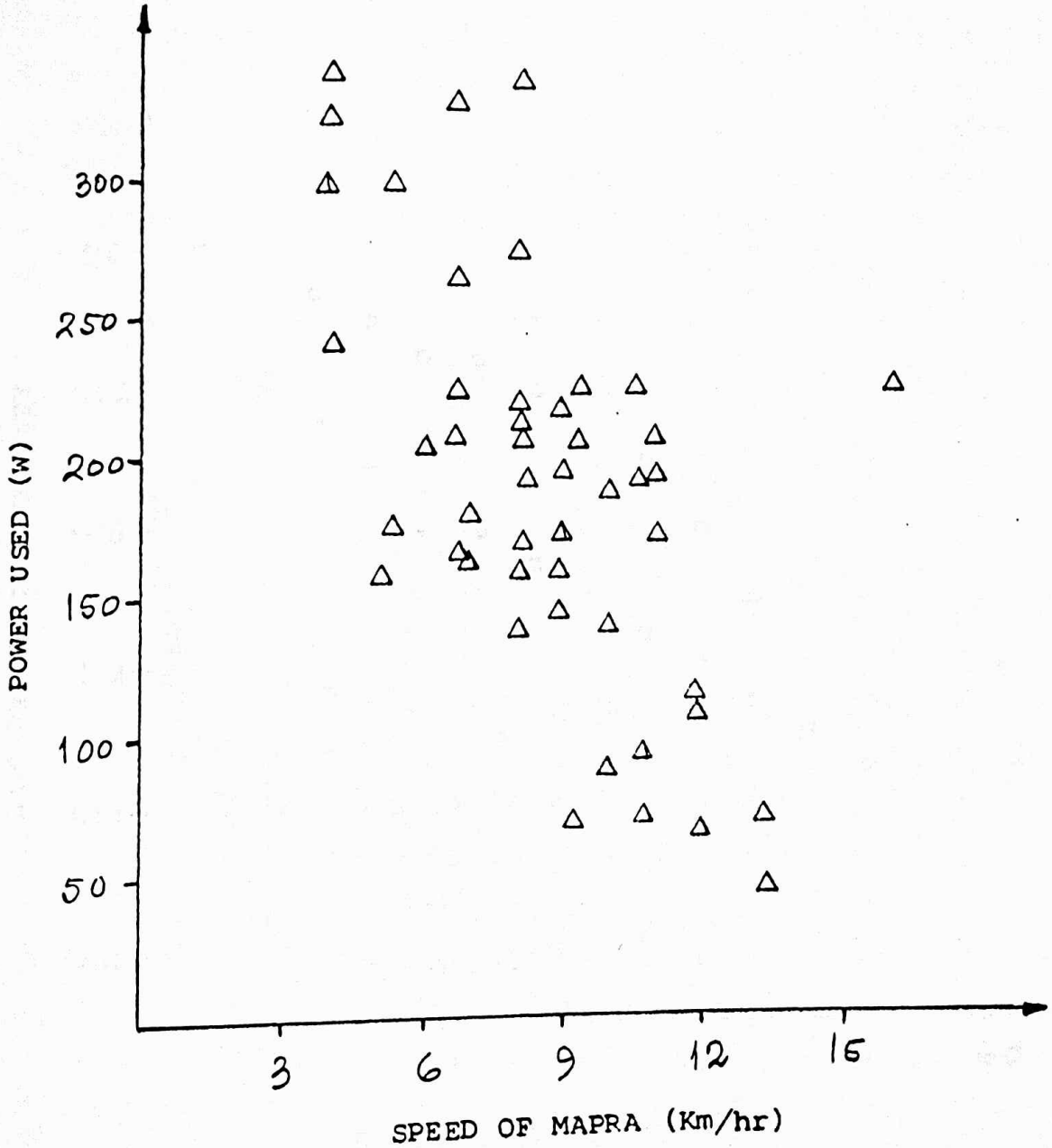


Fig. 9. Power used vs speed for city run conditions

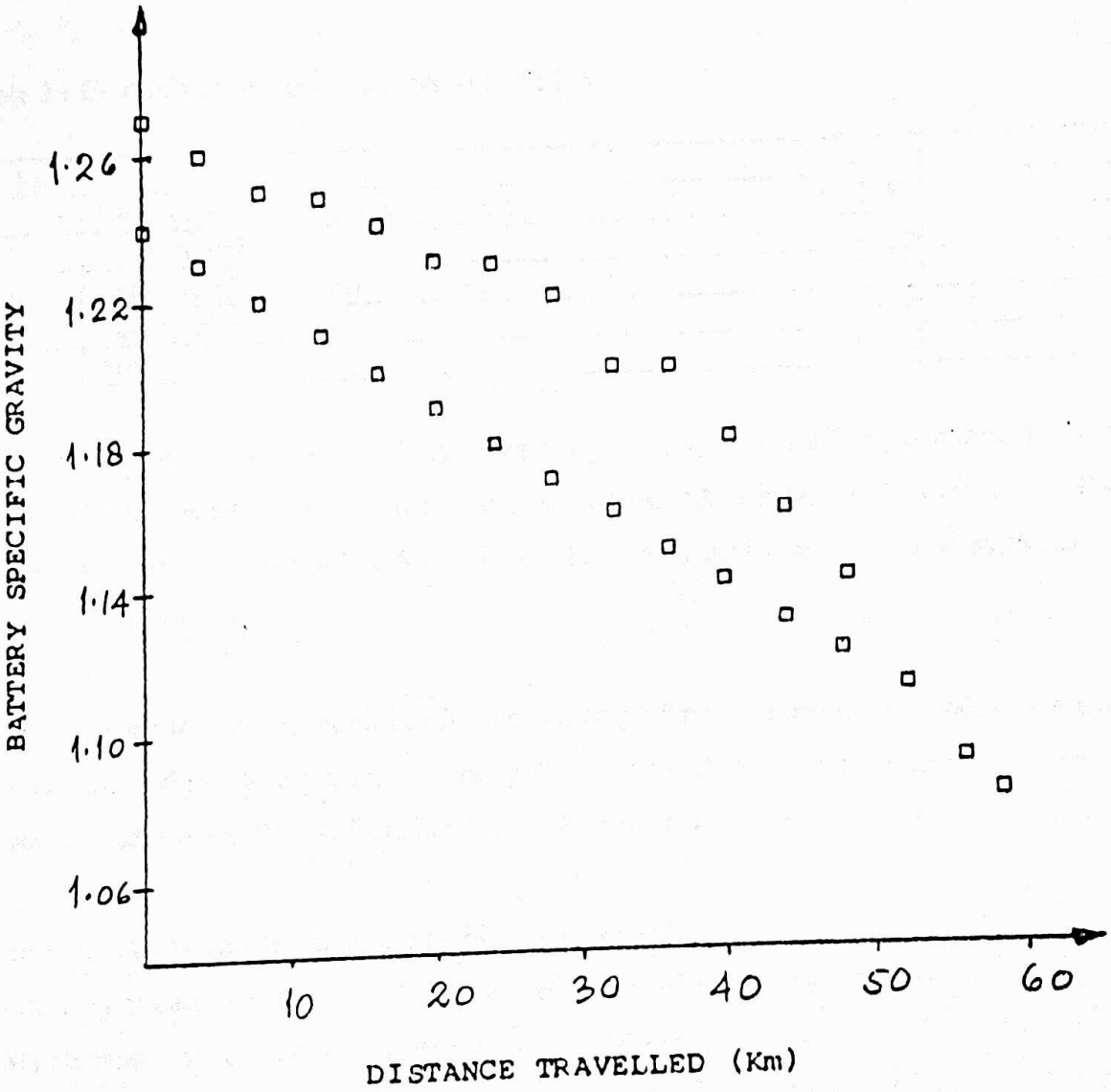


Fig. 10. Battery discharge vs distance travelled for city run conditions

III-3. Economic analysis of running MAPRA :

It is also instructive to do a simple economic analysis of running MAPRA as a taxi. This will show its economic feasibility vis-à-vis a cycle rickshaw.

Based upon our data of fabricating MAPRA in NARI's workshop and those of subcontracting it outside, the following costs are expected to result for mass production (volume of 100-200/batch).

Table 2 : Cost of various components of MAPRA

Sr. No.	Components	Cost Rs.
1.	Chasis/tyres/seating arrangement etc.	7,000
2.	Motor/gearbox	5,500
3.	Batteries (2 numbers)	7,000
4.	Battery charger	1,000
	Total	20,500

Generally any industry works on a 30% profit margin and as a first effect economic analysis we will take this number. Hence the final cost of MAPRA will be Rs. 26,650 or say Rs. 27,000/-. We can also treat MAPRA as a renewable energy device and hence no sales tax or excise will be levied on it.

Since electric cycle rickshaw comes under the category of renewable energy devices, we can make an assumption that a rickshaw owner/puller or a rickshaw pullers' cooperative society can get soft loans from IREDA @ 12% p.a. interest payable in 10 years.

Hence assumptions used for running MAPRA as a taxi are :

1. Charging of battery will require 1.5 kWhr/day. Electricity cost is Rs. 5/kWhr.
2. Maintenance cost of MAPRA is taken as Rs. 1,000/year.
3. Loan for buying MAPRA will be at an interest of 12% p.a. payable in 10 years.
4. MAPRA will charge Rs. 3/km as taxi fare. This is the same amount that cycle rickshaws charge in different cities. However our data suggest that in some cities rickshaw pullers charge upto Rs. 5/km.
5. Batteries will be replaced every alternative year. This is based on the performance of existing Exide batteries.

6. MAPRA will run 40 kms/day and on an average for 300 days/year. This is much less distance than MAPRA can go and reflects the distance that the rickshaw puller will ply MAPRA to when a large number of these vehicles come on the road.
7. No yearly escalation in taxi charges or material cost has been taken.

It should be pointed out that in case the rickshaw puller is also the owner he will try to minimize the use of batteries as much as possible and in that case the potential exists of this rickshaw going to 50-60 kms/day.

Table 3 : Cost Benefit calculation for MAPRA as a taxi

Expenditure

Rupees

Sr. No.	Item	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1.	Loan repayment	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	-
2.	Interest payment	3240	2916	2592	2268	1944	1620	1296	972	648	324	-
3.	Running cost	3250	3250	3250	3250	3250	3250	3250	3250	3250	3250	3250
4.	Battery	-	7000	-	7000	-	7000	-	7000	-	7000	-
	Total cost Rs.	9190	15866	8542	15218	7894	14570	7246	13922	6598	13274	3250

After 10th year all the loan will be repaid and the running cost will be Rs. 3250/yr and every alternative year it will be Rs. 10,250/yr (battery replacement years).

Earnings/Profits

Rupees

Sr. No.	Item	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1.	Earnings @ Rs. 3/Km	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000	36000
2.	Running cost	9190	15866	8542	15218	7894	14570	7246	13922	6598	13274	3250
	Profit @ Rs. 3/km	26810	20134	27458	20782	28106	21430	28754	22078	29402	22726	32750
	Profit @ Rs. 2/km	14810	8134	15458	8782	16106	9430	16754	10078	17402	10726	20750

Or at Rs. 3/km charge the rickshaw puller will earn a net profit of Rs. 25,000 per year as an average for 11 years or ~ Rs. 85/day. If he gives this rickshaw to a rickshaw driver then he needs to get Rs. 35/day as his average daily earning to repay the loan. The profits for fare of Rs. 2/km are also given as an example. At this tariff rate, running of MAPRA is unremunerative.

We feel that in order to increase the remuneration's, the following strategy can be applied :

a) For self-owned MAPRA the city driving conditions (less speed) allow the MAPRA to go to 50-60 kms in one charge. This can substantially increase the income earned.

b) For MAPRA given on hire to a rickshaw puller it is possible to have it run in 2 shifts and charge the batteries during the second shift. This will effectively increase the remuneration/day. However the cost of an extra set of batteries will have to be taken into account for cost calculations.

III-4. Commercialization of MAPRA :

This part of the project proved to be the most difficult one. In fact we feel that the objectives of the project were very ambitious. Designing, developing and fabricating 20 MAPRAs itself was a challenge and could be barely finished in the stipulated time of one and half years. Commercializing it in small towns was even more ambitious. In any case we have been partially successful in this venture and a beginning has been made. We feel that with the initial success it may be possible to move forward the commercialization of MAPRA. Listed below are the events in this direction.

A) Introduction of MAPRAs in Pune University Campus :

Most of the University campuses in the country are sprawling and cover huge areas. Some of these campuses also have lots of green areas and hence it was thought prudent to install environmentally friendly MAPRAs in them so that pollution by the existing vehicles could be reduced. Thus 5 MAPRAs were installed in Pune University on an experimental basis to ferry passengers from the main gate of the University to various buildings inside the campus. The University has given a contract to run these rickshaws to an outside contractor. Since there is no tradition of running cycle rickshaws in Pune, the rickshaw pullers sometimes get lazy in pedalling them. This lacuna is being addressed by discussions with the contractor.

An MOU was signed with the University to introduce these rickshaws. It took University of Pune almost 5 months to sign it. Thus the MAPRAs were inaugurated in February 2002. This project created quite a stir in Pune and our efforts received tremendous publicity. Appendix lists the media reports on this project. The effort seemed to have been successful since University wants 5 more MAPRAs and it seems that officials of other Indian universities who

visit Pune University and have seen MAPRAs also want to put these on their campuses. Thus discussions are on with Baroda University, Nirma Institute of Technology, Ahmedabad and I.I.T. Kanpur. All MAPRAs have a nameplate acknowledging MNES funding.

B) MOU signing for introduction of MAPRAs in Hampi, Karnataka :

The Vijayanagar Empire ruins in Hampi have been declared a World Heritage site by UNESCO. Millions of tourists from all over the world come to Hampi every year. Recently because of heavy tourist traffic, a large number of polluting petrol and diesel 3 wheelers have been introduced in Hampi. This is creating adverse conditions for the monuments. Various government organizations and NGOs are trying to reduce this pollution. Consequently a local NGO called The Kishkinda Trust (TKT) approached NARI for the possible use of MAPRA in Hampi. Consequently an MOU has been signed with TKT to introduce 5 MAPRAs in Hampi and during off-season (May-August) to use them in Anegundi (small rural town in Hospet Taluka). The MAPRAs will be introduced in August.

We feel that lots of tourist places in the country might take up MAPRAs. The sensibilities of tourists are also not hurt since the human effort in pulling MAPRA is augmented by the electric motor. Preliminary inquiries in this regard have come from zoos and other heritage sites in the country.

C) Other efforts in commercialization :

Before the above successful efforts there were quite a number of other efforts mounted by us for commercialization of MAPRAs which unfortunately were not successful. They were :

i) Introduction in Lucknow :

An MOU was signed with a party in Lucknow to manufacture and introduce MAPRA. However this party was more interested in getting the grant money from the minorities commissioner of U.P. for these MAPRAs. Since they did not succeed in getting it, they lost interest. Nearly 6 months were wasted in this effort. We sent our technical staff to Lucknow two times with a full model of MAPRA and the party's technicians were also trained. However the efforts were not fruitful.

ii) **Introduction in Nagpur :**

Detailed discussions were held with the manufacturers and rickshaw owners in Nagpur. They seemed to be enthusiastic about MAPRA but were not interested in taking it up till all the technology was given free of cost to them. We tried to set up a rickshaw pullers' cooperative society in Nagpur but could not find a worthwhile NGO to take this up. Around 2 months were wasted in this effort.

iii) **Introduction in Agra near Taj Mahal :**

Detailed discussions took place with the Commissioner, Agra and the Director,U.P. Tourist dept. They both promised to take at least 10 MAPRAs for putting them near the Taj Mahal. However they failed to make good their promise despite many letters and phone calls.

iv) **Introduction in Baba Amte's Ashram in Anandwan :**

Discussions took place with Shri. Vikas Amte, the Secretary of Anandwan. He wanted free MAPRAs and was not prepared to give an undertaking that Anandwan will fabricate these rickshaws in their workshop and introduce them in Nagpur. We got the feeling that because of the large donations received by the Ashram, they are not serious in undertaking any activity which is commercial in nature.

v) We participated in November 2001 in an International renewable energy vehicle exhibition in I.I.T. Kanpur where our rickshaws were exhibited. There was a tremendous interest shown by the visitors and the local rickshaw pullers were very much interested in MAPRA. Consequently the discussions have been initiated with I.I.T. Kanpur authorities to introduce MAPRAs on their campus. I.I.T. Kanpur's feedback is still awaited.

In all these endeavors it became quite clear that most of the people showed initial interest in MAPRA but backed out later because of its high initial cost. For the rickshaw owners the difficult conditions faced by rickshaw pullers driving a poorly designed existing rickshaw are of no concern. They want a cheap vehicle and want to earn whatever they can from the daily hiring charges collected from the rickshaw puller. For rickshaw pullers, MAPRA is a first real attempt at making a friendly human powered rickshaw which can make a difference in their life. Thus there is a dichotomy in the approaches of rickshaw pullers and rickshaw owners.

This problem can be solved to a large extent by making rickshaw pullers into rickshaw owners. Thus there is a need to get loans to rickshaw pullers from the banks so that they can be provided MAPRA on a large scale.

D) Manufacturing of MAPRA :

The major input in commercialization of any vehicle is its manufacturing. Hence efforts were mounted to fabricate these rickshaws. Consequently 3 parties were identified in Pune to make different parts of MAPRA. Thus one party did all the angle iron fabrication while the second party did all the machining of various parts. The party which made the motor also purchased the gear boxes and fabricated the complete motor-gear box assembly. All these parts were then assembled in NARI workshop and testing was done. Also the fabrication of seating arrangement and hood was done in NARI. This allowed the MAPRAs to be assembled quite rapidly.

E) Issue of licence from Regional Transport Office :

When MAPRAs were introduced in Pune University the local RTO raised objections regarding its use and said that a licence is required. However he had to be convinced that such vehicles will be useful for reducing environmental pollution and since this is a pedal-driven vehicle, it does not need any licence. Permission has therefore been given by him to run these vehicles inside the Pune University campus. Similar permissions may have to be obtained from local RTOs for introducing MAPRAs in various towns.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

IV-1. Conclusions :

Based upon the present work, the following conclusions can be drawn :

1. A motor assisted pedal cycle rickshaw, christened as MAPRA has been completely designed, fabricated and test run in various locations.
2. The MAPRA has a 375 W, 4 pole PMDC motor, two 40 amp-hr deep discharge lead-acid batteries and a 7:1 ratio planetary gear box. A stand alone battery charger is provided to charge the batteries overnight.
3. MAPRA can also take two passengers to 45-50 km in one battery charge on highway (continuous running mode) and can take them to 50-60 km in city driving conditions (stop/start mode).
4. MAPRA can also take 2 passengers on a 10-15% slope at 10-12 km/hr.
5. Complete data on battery discharge, power used in running MAPRA under different driving conditions and life of various components have been developed.
6. Twenty MAPRAs have been fabricated and tested.
7. In developing MAPRA quite a number of vendors were identified in Satara, Pune and Hyderabad who designed the motor, battery charger and gear box according to our specifications. This is one of the major achievements of the project.
8. MAPRA till todate has logged more than 5000 kms in trial runs.
9. Five MAPRAs have been successfully introduced in Pune University campus where they have logged more than 2000 kms in trial run since February 2002. There has been a very positive response to this experiment. Hence authorities at Baroda University, I.I.T. Kanpur and Nirma Institute of Technology, Ahmedabad want to introduce MAPRAs on their campuses.
10. There have been some problems in introducing MAPRAs in western Maharashtra. There is no tradition of using cycle rickshaw in this part of the country. Hence it is very difficult to get rickshaw pullers to drive these rickshaws. Efforts are however on to introduce these rickshaws in small towns.

11. An MOU has been signed with a charitable trust in Hampi, Karnataka to introduce 5 MAPRAs as tourist vehicles in the Hampi ruins.
12. The cost of MAPRA has been estimated to be Rs. 20,500/-. This includes the cost of battery and charger. The selling price of MAPRA is estimated to be Rs. 27,000/-.
13. Economic analysis of running MAPRA as a taxi shows that it is possible for the rickshaw puller/owner to earn a good profit from it.
14. Vendors in Pune have been identified to manufacture various parts of MAPRA so that it can be fabricated rapidly.

IV-2. **Recommendations** : The following recommendations can be made :

B) Technological issues :

i) The design of MAPRA is very robust and simple. However further changes can be made in the design by making MAPRA frame out of lightweight tubular material.

ii) There is a scope for reducing the weight of gear box. This will help bring down the weight of MAPRA further.

iii) There is a need to develop a very low cost controller which can sense the load and start the motor. This will help bypass the tendency of rickshaw puller to always put the motor on while driving MAPRA.

iv) The technology of MAPRA is available and ready for large scale commercialization.

B) **Policy issues :**

1. There is a great need to make available to a rickshaw puller a bank loan so that he can own a MAPRA. This can only be done by setting up rickshaw pullers' cooperative societies in different cities. These societies or self-help groups can then take loans from the banks to buy MAPRAs. Without this process no existing rickshaw owner is ready to purchase MAPRA.
2. IREDA can also provide soft loans to such cooperative societies/self-help groups. This will help MAPRAs to be put on the road all over the country.
3. MNES can take a lead in this venture. To our mind this is the only electric vehicle effort in India which helps the poor labourer by giving him employment and at the same time allows transport of passengers in a humane and eco-friendly manner. This effort should be supported and moved forward as a part of various Rojgar Yojanas of Government of India. Introduction of MAPRAs in University Campuses, zoos and at heritage sites should also be encouraged.

never fear to negotiate.
— John Fitzgerald Kennedy

ESTABLISHED 1838

THE TIMES OF

Pune, Wednesday, January 2, 2002 Bennett, Coleman & Co., Ltd.

CITY WEATHER

The city on Tuesday recorded a maximum temperature of 27.2 degrees Celsius and a minimum temperature of 10.7 degrees Celsius. Humidity was 68 per cent.
Today's forecast: Clear sky (min. temp. 10 degrees C).
Sunrise: 7.08 a.m.
Sunset: 6.09 p.m.

ENVIRONMENT-FRIENDLY PEDAL-POWERED 'RIKKIES' WILL FERRY CAMPUS RESIDENTS

Varsity set to foot out pollution

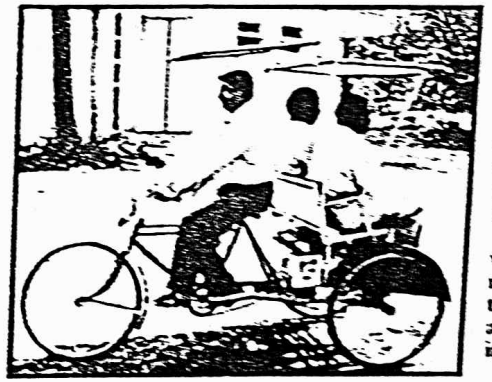
By Siddhartha D. Kashyap
Times News Network

PUNE: Anyone who has trudged through the verdant but sprawling university campus on their tired feet will shower silent blessings on the head of Anil K. Rajvanshi. The Phaltan-based innovator has devised an environmentally sound, motor-assisted pedal rickshaw, which the university has decided to put into use on campus.

On January 23, the day of its 95th annual convocation, Andhra Pradesh governor C. Rangarajan, chief guest, will ceremoniously introduce five such "rikkies", thus doubtless earning the gratitude of many a foot-sore student and professor. Vice-chancellor Ashok Kolaskar says the one-year trial project is being launched in the hope that the number of vehicles plying on campus will be reduced, and with it, air pollution levels.

"When there is an alternative available to us so easily, why not make use of it and set an example for others to follow?" he queries. The improvised cycle rickshaw was developed by Jamnalal Bajaj Foundation award winner Rajvanshi at the Nimbalkar Agricultural Research Institute in Phaltan, Satara. It had made headlines recently when several of them were imported by the United Kingdom by an English entrepreneur.

Rajvanshi, incidentally, also designed the 'Noore' multi-fuel lantern, which, when marketed over the Internet, found buyers in California! Preliminary tests carried out by the university found that the rickshaws were easy to manoeuvre and are both non-polluting and silent, besides being energy-efficient and cost-effective.



But will students leave their scooters and bikes behind and be tempted to ride in the rickshaws? Kolaskar admits he is somewhat apprehensive about the reaction on campus, but is determined to give it a shot. "When everyone is crying about the high pollution levels, why can't we set an example?" he said.

The enthusiastic inventor, whose idea failed to attract Indian buyers on a large scale, says the rickshaws, which costs Rs 20,000 each, have been given free of cost to the university. "The aim is to popularise the concept," Rajvanshi says. The Indian Institute of Technology, Kanpur is also a customer. "It has already banned the plying of autorickshaws inside the campus as a result of which 100 cycle-rickshaws are transporting people there."

The 'rikkie' has 3-speed gears and a small battery-driven motor which enables the driver to tackle uphill slopes with ease. A key feature of the 124-kg rickshaw is that the gears are arranged in such a manner that the pedal and the motor work in tandem to ease the load on the rickshawman.

A current overload switch cuts off the circuit when the motor draws more than the predetermined current. "However, the driver has to continuously keep on pedalling," Rajvanshi says, adding that the rickshaw can easily cover 40 km in one battery charge.

The motorised rickshaws were originally designed to ease the strain and suffering of rickshaw pullers, but they seemed uninterested in changing their ways. It is hoped that the university population will be more receptive and pay more than just lip service to environment-friendly technology.

APPENDIX

Verdant campus finally gets its green rickshaws

Times News Service

PUNE: If you suddenly see an old fashioned cycle rickshaw coming towards you in the University of Pune campus, don't fall over in disbelief. With a little help from modern technology, this clean and green form of transport is all set to convey students up and down the extensive campus.

The motor-assisted cycle rickshaws were inaugurated at the university by Madhur Bajaj vice-chairman of Bajaj Auto Limited on the foundation day of the university on Sunday. Designed by Jamnalal Bajaj Award winner Dr Anil K. Rajvanshi, director of the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Satara district, they will run on a trial basis for one year. A contractor will maintain the rickshaws and ferry passengers from the university entrance to the main building for Rs 2 per person. "The idea is to cut down on the number of vehicles plying within the campus, and consequently lower the level of air pollution," said vice chancellor Dr Ashok Kolaskar.

(From left) Industrialist Madhur Bajaj, inventor Anil Rajvanshi and Ashok Kolaskar hop on-board the first eco-friendly rickshaw.

Earlier in the day, the university gave away excellence awards announced on Friday. Pune-based Nowrosjee Wadia College of Arts and Science won the first prize for the best college (urban) and its lecturer in physics, Dr Farad Surve won the innovative teaching award. P V P College of Arts, Science and Commerce at Pravaranagar in Ahmadnagar district won the best college prize in the rural catgory and its reader in botany Dr Subhas M. Karande got the best teacher award. Dr Meera Kulkarni, lecturer at the Institute of Management Studies, Career, Development and Research, Ahmednagar won the second prize in the innovation in teaching category.

Dr Kolaskar announced that the Bank of Maharashtra has sanctioned a one-time grant of Rs 25 lakh to the university to establish an independent energy study centre at its school of energy studies. The centre will be dedicated to study various aspects of non-conventional energy.

SPECIAL REPORT

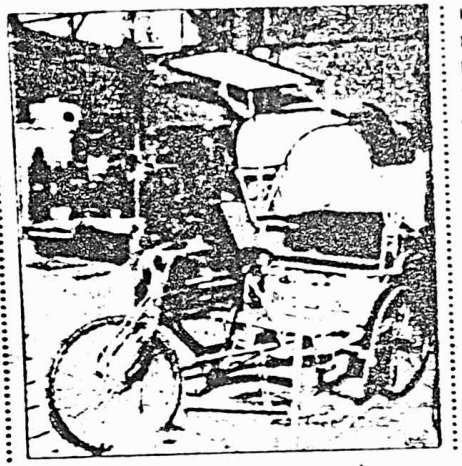
Battery-run cycle rickshaws provide cheap, easy transport from university gate to main building

Eco-friendly carriers run high on popularity at UoP

PREETI RAGHUNATH
MARCH 18

SHALAKA Joshi never understood Keats better. An endless wait for the bus to the English department or a nasty haggle with the *autowallah* hardly left her with any enthusiasm for the nuances of poetry once she reached class. Today, she simply hails a cycle rickshaw at the gates of the Pune University and enjoys the ride with lines by Keats.

Barely two months into the launch of the motor-assisted pedal rickshaws (MAPRA) service on the Pune University campus, the response has been tremendous. Plying from the main gate to the university Main Building, the



users of this service are mainly students. Donated and developed by Nimbkar Agricultural Research Institute (NARI) at Phaltan, the five cycle rickshaws can run up to 50 km once the battery is charged. From 7.30 am to 7.30 pm, these rickshaws seat two passengers and charge Rs. 2 per person.

The facility has brought about the much-needed difference for visitors and students alike. Says Mansi Deodhar: "No more do I have to wait for buses, the frequency of which is quite bad. Now, every 15 minutes I get a cycle rickshaw."

The rickshaw seems to suit every student's pocket. For Rajesh Jadhav "the bus costs Rs 2.50 but these cycle rickshaws charge only Rs 2. It's just a matter of 0.50 paise, but I'm not financially well off and it's a real boon."

Tired of being harassed by unscrupulous autorickshaw drivers, the cycle rickshaw comes as a welcome change. "I'm travelling by these cycle rickshaws for the first time, I think it is great and more should be introduced," says a parent. M R Deshmukh. Anwant Jadhav, a cycle rickshaw driver says, "Getting passengers is no problem, in fact, they are always saying how thankful they are for this service."

House manager of Pune University Bhuke Pude says, "The best thing about these cycle rickshaws are that they are environment friendly since they run on battery."

Now, students could well start their day with an airy trip before settling down to Calculus.

The Indian Express - Pune Newsline, Thursday, March 14, 2002

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