



Indian Institute of Management Bangalore

Reva:
Driving Technology Adoption through Strategic Innovation

By

Prof. Rishiksha T. Krishnan
Corporate Strategy & Policy Area

Reva: Driving Technology Adoption through Strategic Innovation¹

With the commercial launch of the *Reva* in June 2001, Chetan Maini, Managing Director of the *Reva* Electric Car Company (RECC) fulfilled a seven-year old dream to bring an electric car to the Indian market. But by March 2002, it was clear that while the car was technologically sound, he still faced a number of challenges in making it a commercial success. The business model adopted for the *Reva* included keeping capital investments to a minimum through innovative product design and manufacturing strategy, and by outsourcing wherever possible. The latter made ramping up production volumes difficult. On the market side, the government had not come forth with subsidies as expected thereby preventing the company from using price effectively as a competitive weapon. The range and variety of cars available in the Indian market had also increased considerably since the market study was done making the competitive space much more crowded. Chetan also faced the long-term challenge of maintaining the technological leadership of his company in the face of the great physical distance between his headquarters in Bangalore, India, and the world's leading centres of new automobile technologies, the limited resources available, and the inadequacies of other constituents of the Indian innovation system.

Background

Chetan had an interest in cars right from his childhood – he built a radio-operated car at the age of 12. Later, he won a solar-powered car contest. Chetan focused on electric vehicles right from his college days. After obtaining degrees from the University of Michigan and Stanford University, Chetan joined Amerigon, an American company founded in 1991 by the senior management and technical staff of Technar, a major supplier of air crash bag sensors to the automotive market. Amerigon's mission is the efficient transfer of advanced technology concepts from aerospace, military and computer industries to the automotive market.² As a program manager at Amerigon, Chetan was involved with a variety of development projects financed by the American government and carmakers to establish the viability of electric vehicle technologies.

Though the first electric vehicle was developed in 1834, electric vehicles are even today not a mainstream commercial proposition in developed markets. Long distances, high speeds, low fuel costs, and high carrying capacities combined with the clout of the conventional vehicle lobby make electric cars uncompetitive in those markets. Yet, in Indian cities with dense traffic, scarcity of parking space, pollution problems, and high fuel costs, Chetan believed that there could be a market for a small, environment-friendly

¹ © 2002 Rishikesh T. Krishnan. This case has been written by Prof. Rishikesh T. Krishnan, Corporate Strategy & Policy Area, Indian Institute of Management, Bangalore, India. It is based on talks given by Mr. Chetan Maini and his colleagues at the *Reva* Electric Car Company to students of IIM Bangalore's Postgraduate program, and Executive education program participants in January 2002, and a subsequent interview with Mr. Maini. It is intended for classroom discussion and not to reflect effective or ineffective handling of managerial situations. Not to be reproduced in any form without the written permission of the author who can be reached at rishi@iimb.ernet.in

² Source: www.amerigon.com

car with low operating costs if designed to meet local needs. Luckily for him, his family's business interests in material handling equipment and automobile components provided the basic infrastructure to make the conception of such a project possible.

Chetan's dream would be considered to be unrealistic by many in a country that has, in general, been a technological laggard, and that has only recently (in 1998) seen the launch of the first indigenously developed, mass-produced car, the *Tata Indica*. The project cost of the *Indica* at Rs. 18000 million (about \$ 400 million) made it one of the largest development projects ever undertaken by an Indian company. Chetan's family runs the Maini group, that consists primarily of a precision component manufacturing company started in 1973 with customers including General Motors and Bosch, and a materials handling equipment manufacturing business started in 1983. The Maini group (Annual sales turnover of about Rs. 750 million; Number of employees: 1500; 11 manufacturing facilities spread in and around Bangalore) while reasonably successful, is tiny compared to the Tata conglomerate (Annual sales turnover of over Rs. 300 billion) which is among India's largest business houses.

The history of small, independent automobile manufacturers in India is another source of skepticism. Maruti, the small car company started by Sanjay Gandhi in the early 1970s, was a failure until the government rescued it after his death by entering into a joint venture with the Suzuki Motor Company of Japan. Another small car venture manufacturing a car called the *Dolphin* was also short-lived. A larger company, the Standard Motor Company of India that manufactured light motor vehicles and cars folded up after an investment in making larger cars based on the design of the Rover turned sour.

However, in manufacturing the *Reva*, Chetan could count on some strengths of the Maini group. Founded in 1973, the Maini group's flagship company, Maini Precision Products (MPP) exported components with a 2 micron tolerance to Bosch more than twenty years ago, at a time when such levels of precision were all but unknown among automobile component manufacturers in India. MPP was the first company in India to export components to General Motors and among the first to obtain QS9000 certification. The company exports about 90% of its turnover. The practices and people developed by MPP have been available to the *Reva* project and MPP also manufactures some components for the *Reva*. Another group company, Maini Materials Handling, makes small battery-powered forklifts and other equipment for material handling within a factory.

Reva was not the first electric vehicle to be manufactured in India. Bharat Heavy Electricals Ltd (BHEL), a government-owned company with a strong reputation in the manufacture of power generation and other electrical engineering equipment, started the development of a battery-powered minibus in the year 1978 and the development work was completed by 1982. This consisted of a minibus with a single moulded fibre reinforced plastic (FRP) body on a Mahindra & Mahindra chassis with a thyristor chopper taking power from a lead acid battery on-board. Nearly 300 battery-powered road vehicles with a seating capacity of 15 passengers have been sold by BHEL so far, mainly to tourist operators near and around the Taj Mahal in Agra and to some zoological

parks. High initial cost (Rs. 1.5 million for a minibus with 15 seats), high replacement cost for batteries (Rs. 300,000) and difficulties in creating a nation-wide service network have been some of the economic constraints to wider diffusion of this product. The technical constraint has been the high weight and low energy density of the lead-acid battery which limit the range of the vehicle on a single charge. Another public sector company, Scooters India Ltd. (SIL), has developed a battery-powered three wheeler, the Vikram EV, of which 750 vehicles have been sold, again mainly in locations such as Lucknow, Kathmandu and Agra where local regulations prevent diesel vehicles from operating for reasons of environmental protection.

The Reva Project

Chetan's interest in creating an electric car for the Indian market was kindled early in his stint with Amerigon. Based on a survey in ten cities of India in 1994, Chetan readied the design and concept for a "city mobility vehicle." He set up a small team in India, and a formal memorandum of understanding (MOU) between Amerigon and the Maini group was signed. Because of the developmental nature of the vehicle, the two companies entered into a broadbased MOU rather than a formal technology transfer agreement.

The first prototype for a 2-door hatchback that could accommodate two adults and two children was ready in 1995 and was brought to India for homologation and certification the following year. The Automobile Research Association of India (ARAI) certification of roadworthiness, a prerequisite for registration of the vehicle under the Indian Motor Vehicles Act, was obtained. However, the cost of manufacturing the vehicle was found to be prohibitive, and Chetan and his team realised that a higher degree of indigenisation would be required to make the car affordable to potential buyers in India. Market research revealed that the size of the car and its range would also have to increase to meet buyers' expectations. Chetan and his colleagues also took advantage of a study done by the consulting firm, A.T. Kearney, in 1997, on behalf of the International Finance Corporation (IFC). Based on a perceived gap between two wheelers and the smallest car available in the market, the 800cc Maruti, this study projected an annual demand for 18,000-40,000 small cars if priced appropriately. At the time that study was conducted, Maruti 800 and the Maruti Zen were the only small cars available in the Indian market.

By 1998, Amerigon had decided to focus on advanced technologies at the component level such as climate-controlled seats and radar sensor systems, and had decided to exit from the electric vehicle market because it did not develop as rapidly as anticipated³. Chetan realised that development had to move completely to India to accelerate the development process. Starting January 1999, people were hired, and the organisation started functioning like a typical start-up. Serious organisational challenges confronted the young company as the infrastructure and experience did not exist in India for the development of electric cars. At the same time, capital costs had to be kept low. A young team was recruited and their efforts were supplemented by consultants on different

³ From Amerigon Form 10K filings with the United States Securities and Exchanges Commission. Source: www.sec.gov

aspects. Special efforts were made to leverage the capabilities of different Maini group companies and their R&D centres.

Business Model

Early on, Chetan and his team realised that to keep investments at reasonable levels, and to be consistent with international automobile industry trends, it made best sense to concentrate on assembly and outsource as many components as possible. For proprietary components that could critically affect the vehicle's performance, the company tied up with other companies through special relationships (such as the motor controller developed by the Curtis Company). Certain other components were developed by other group companies.

Right from the beginning, an effort was made to formulate a manufacturing strategy to suit conditions in India. The lower cost of Indian labour and the high cost of Indian capital meant that the typical capital to labour ratio of the west did not make sense for manufacturing in India. The investment costs also had to reflect the projected peak volumes of 15,000-20,000 cars per year. Efforts were made to re-design the car to reduce capital costs for manufacturing. For instance, a new bumper was designed using a process used to manufacture overhead tanks in India, resulting in a tooling cost of approximately one-tenth of a similar product produced overseas. Similarly, for the body, dent-proof ABS panels mounted on a tubular steel frame were found cheaper and more suitable than stamped steel panels. Spending Rs. 7.5 million on the tooling for an instrument panel was avoided by identifying a vendor who could make minor modifications to an existing design being produced in large volumes. All this resulted in a low project cost of Rs. 800 million. With an operating break-even of about 150 cars per month and a payback period of about 3.5 years to recover all costs, RECC appears to have the right scale and level of investments to be a sustained player.

Raising finance for the project was one of the major hurdles. Financial institutions (FIs) were difficult to convince, particularly because of the failure of many electric vehicle manufacturers worldwide. The *Reva* team tried to learn from the failure of other companies so as to be able to improve their chances of success and to buttress their own case with the FIs. For instance, battery management was identified as one of the most critical areas. This led to a focus on the creation of an intelligent energy management system, in collaboration with an American company, AEVT (formed by spinning off Amerigon's electric vehicle business). This system monitors the power pack, helps maximise driving range, extends battery life, and gives feedback to the driver on charge levels. Today, the patented energy management system⁴ for which Chetan Maini is identified as one of the inventors is one of *Reva*'s key differentiators. This systematic approach helped the company get support from ICICI and the Indian government's Technology Development Board in the form of loans totaling about Rs. 122 million.

⁴ U.S. Patent No. 6,184,656 granted on February 6, 2001. Source: www.uspto.gov

Business Prospects

As a car specially designed for the Indian market, *Reva* foresees its prospects as good, but more as a niche product than a competitor to mainstream automobiles. In its favour are its energy efficiency (it even captures about 15% of the energy that would otherwise be dissipated as heat while braking), low operating cost (estimated at Rs. 0.40 per km), low maintenance cost, low centre of gravity (leading to high stability), and reasonable range (80 km on a single overnight charge that consumes 9 kWh). It has been tested for safety and reliability over about 1 million km before reaching the first customer. The absence of an engine, carburetor and gearbox make it easy to maintain. Designed in a modular form, it is expected to be upgradeable as different component technologies change. As the prices of regular cars rise as manufacturers make modifications to meet increasingly stringent emission norms, *Reva's* price proposition will improve. An additional factor in its favour will be that it is a non-polluting vehicle.

At its present price of Rs. 249,000, the *Reva* is comparable in price to the mass-market cars available in the Indian market such as the Maruti Suzuki 800 cc. car. (See Exhibit 1 for a comparison of prices). However, over the life cycle of the car, given the major saving in operating and maintenance costs, savings could be substantial. Getting this message across to customers is one of the challenges of the marketing strategy. The company hopes to be granted subsidies by the government (as are being given to some other energy-saving technologies) that will allow them to bring down the price for customers. Other marketing challenges include the lack of familiarity of the market with either the Maini group (as they do not have any other consumer products) or its collaborators (Amerigon/AEVT).

In designing the car, the *Reva* team had to make a trade-off between cost and convenience. While the daily range could have been increased beyond the current 80 km, this would have meant a substantial increase in the cost, and hence the price to customers. Research indicated that this would have, in turn, lowered the number of customers. Over time, the company hopes to give multiple options to customers such as offering a longer range at a higher price, and providing climate-controlled seats as a substitute for air-conditioning.

The *Reva* is positioned as an ideal city car (see Exhibit 2 for samples of *Reva* publicity material). With no clutch and gears, it is easy to drive. Small in size, it is easy to manoeuvre and park. Its non-dentable body is suited to Indian cities where most cars have multiple dents due to narrow roads and densely-packed traffic. It has been designed to allow people to get in and out without difficulty. It can withstand the flooding that is common during the Indian monsoon season with a special snorkel arrangement that protects the battery pack. It is specially equipped with a voltage regulator to take care of fluctuations in voltage during charging. And, its energy-absorbing bumpers make minor collisions less dangerous. The car can be conveniently charged overnight – the company does a free installation of the charging infrastructure (a socket outside the house or apartment that can be connected to the car).

Initial purchase patterns indicate that the buyers are often buying the *Reva* as their second car. 35% of the purchases are for use by housewives for daily errands, shopping and dropping and picking up children. 40% of users take it to work. About 10% of users are students. There are also some corporate purchasers as they can claim an accelerated rate of depreciation. Less than 10% of the customers are believed to be making a statement by their purchase of the car.

By the end of February 2002, RECC had sold about 200 cars. Production reached a level of 50 cars per month in January 2002. At the production rate of 50 cars per month, demand outstrips supply, and there is a waiting list. Early sales have been only in Bangalore so as to be able to get direct feedback from customers for improvements and minor design changes. Bangalore has, in many ways been an ideal city for launch of such a product – it is India's most technology-conscious city, is geographically compact, has short travel distances, and traffic moves at moderate speeds. There is pressure for an all-India launch with more than 3500 enquiries seeking dealerships for the product. Early launch is contemplated only in those markets that offer sales tax and road tax exemptions – without these, the price of the car will be exorbitant. The car will also be launched in Delhi to achieve greater visibility with policy-makers in the government.

With a limited budget at its disposal, the *Reva* team has used innovative methods to promote its sale. It has literally taken *Reva* to the doorsteps of Bangalore residents, by participating in all major local exhibitions and other events where large number of residents congregate. The car has also been showcased and demonstrated at most of the major technology companies and institutions in Bangalore. The team estimates that 60-70% of people in Bangalore have seen the car. The car has been used in some movies. Segment-specific telemarketing campaigns have been conducted. Journalists have been invited to the *Reva* factory and the car has got write-ups in all the major newspapers. The company has taken care to see that word-of-mouth reports are favourable – for each customer, it has a 7-day customer contact plan that involves talking to the customer everyday for the first week after purchase.

Future Challenges

RECC believes that its distinctive competence lies in its ability to optimise electric vehicle performance and produce small volumes very economically. The company believes that its prowess is proven by its successful implementation of features such as on-board computers to provide usage data, and its energy management system. The company is building up a comprehensive database on the performance of the vehicle as a whole, and of different subsystems, to aid future design optimisation as well as production testing. The core electric vehicle technology is now established in the market. However, a number of challenges remain.

Ramping up Production

The future performance of RECC depends on its ability to address competitive and technology-related issues. At this time, the key concern is ramping up production. The

outsourcing model, while offering flexibility and low investment, makes the company dependent on external suppliers to increase volumes. As a new entrant with small volumes, *Reva*'s bargaining power with large external suppliers is small. Though a few suppliers maintain separate lines for small batch production, this is more the exception than the rule. So far, RECC has tried to overcome the disadvantage of its small volumes by intense interaction with large suppliers so as to build strong relationships. At the same time, it is difficult to find small suppliers in India who can maintain the quality levels and delivery commitments required. Bringing production in-house is only a partial solution because this increases capital investment and also necessitates taking up contract manufacturing to ensure adequate capacity utilisation of the specialised assets so created. But RECC could lose sales if it is not able to meet customer demand as, in today's overcrowded market with powerful players and under-utilised plants, the customer has numerous options.

Change in Competitive Landscape

A challenge faced by RECC is the change in the competitive landscape since the time of the A.T. Kearney study. The lower end of the automobile market today has aggressive players such as Hyundai (*Santra*), Tata Engineering (*Indica*), and Daewoo (*Matiz*) apart from Maruti Suzuki that has launched new models (*Wagon R* and *Alto*, in addition to *Zen* and the *Maruti 800*). All these companies are offering discounts and incentives in an effort to boost volumes and improve market share and capacity utilisation. Though the total demand for cars in India is in excess of 500,000 vehicles per annum, RECC believes that this competitive scenario implies that the demand for the *Reva* will be lower than the numbers forecast by A.T. Kearney unless the company is able to offer lower prices with the help of lower taxes (see *Government Policy and Subsidies* below). The company is also looking at other options such as leasing the battery (current cost Rs. 35,000) so as to reduce the upfront price of the car. Indigenisation of the battery and other imported components may also reduce costs.

R&D and Technology Management

Reva sees itself as a system integrator, understanding technologies early, keeping ahead of changes, and integrating the best-in-class in its products. The company has already put in place a system for monitoring and keeping up with new and emerging technologies. Its R&D groups are evaluating technologies that will enter the market at different times in the next five years. The company is committed to spending about 7% of sales turnover on R&D against an average Indian R&D spend of less than 1%. About 50 of RECC's 180 employees work in R&D and testing. Thanks to his long experience in the international electric vehicle industry, Chetan Maini is well networked with the close-knit international EV community. This enables him to keep abreast of the latest developments and has also enabled him to access foreign nationals with the requisite experience to be part of the extended *Reva* team. One issue of concern is the retention of qualified R&D manpower. Competing for such people are two wheeler manufacturers in India that are in the process of strengthening their product development infrastructure and multinationals setting up

technology development centres. Working closely with his R&D team to keep them motivated is therefore an important demand on Chetan's time.

To protect key technologies, *Reva* has long-term contracts and non-disclosure agreements with suppliers of these products. Some proprietary technologies have been retained with group companies for enhanced protection. Intellectual property protection and enforcement will be important areas in the future.

Government Policy and Subsidies

In spite of RECC's efforts to bring down costs, the cost of the car (and hence its price) still remain constraints to wider diffusion. Though as an environment-friendly vehicle, the *Reva* has received support from some state governments in the form of sales tax and road tax exemption, RECC has so far been disappointed in its efforts to get a substantially lower rate of excise duty or concessional customs duty for imports. The company hopes that local governments will create special parking zones and power point access for electric vehicles.

According to a recent press report⁵, "In its technology and capabilities, the *Reva* is head-to-head with similar sub-compact electric cars recently developed by auto giants such as Ford, Fiat, Nissan and Suzuki. Unfortunately, the *Reva* has not yet got any of the fiscal and regulatory support that its rivals in other countries are getting." While *Reva* was originally designed based on a 5th generation electric vehicle developed by Amerigon (which was itself a recipient of substantial research and development funding in the United States), support from the Indian government will be necessary to help *Reva* become a global player in the emerging electric vehicle market and buck the trend of the Indian market being a recipient of outdated technologies.

Exports and Large Automobile Companies

Global demand for vehicles in the *Reva* class is estimated at about 45-50,000 vehicles per annum. In Europe alone, the demand is about 25,000 vehicles per year. Some countries have regulations that allow only environment-friendly vehicles to enter city centres; some cities give preferential parking to such vehicles. Electric vehicles in the developed world cost in the range of \$20,000-40,000 making the *Reva* quite cost competitive. It will, however, require design modifications for these markets. RECC believes that it can match the features and performance of the Ford *Think* that currently retails for \$20,000 through a modified version of the *Reva* that could be priced at about \$8500 (the current model of the *Reva* retails at about \$5000 in the Indian market). Given its modular design, Chetan and his team are confident that they can make the modifications required to enter different niche markets.

Small companies have been at the forefront of electric vehicle development worldwide, though companies like General Motors, Ford, Chrysler, Toyota and Nissan all have electric vehicle development programmes. However, if there is a substantial increase in

⁵ N.N. Sachitanand "Electric vehicles need Govt. support," *The Hindu*, 3rd December 2001, p. 16.

volumes, large manufacturers can be expected to enter the electric vehicle market. But this is unlikely to happen in the short or medium term unless there is a major change in fuel economics. A force that could change the pace of introduction of electric vehicles is environment-related legislation – the U.S. state of California has already mandated that some percentage of new vehicles will have to be “clean vehicles”; for the 2008 Beijing Olympics, at least 20% of the vehicles on the street will be clean and non-polluting. While a company like RECC is extremely cost-competitive for small volume production, the story is likely to be different if the volumes increase substantially.

Exhibit 1

Prices of Cars in India

	Price* Rs.
<i>Reva</i>	249,000
Maruti 800 (Euro 1)	236,250
Maruti Omni	261,292
Tata Indica (Diesel, non-AC)	351,000
Daewoo Matiz (non-AC)	330,442
Hyundai Santro LE (AC)	372,000

*“On-the-road” prices in Bangalore including all taxes, registration charges and insurance as of January 9, 2002 for the lowest price variant of each model. According to RECC sources, the *Reva* is comparable in price to the Maruti 800 meeting Euro 2 pollution norms, the minimum required in Indian cities.

Source: Dealers for respective vehicles

Exhibit 2

Extracts from Reva Publicity Material

REVA

INDIA'S FIRST ELECTRIC CAR

Plug in to the Electric Car revolution.

Introducing Reva – A whole new concept

in city mobility. A concept whose time

has come. Reva heralds a new era of

non-polluting, very affordable personal transportation

that will be a boon to city commuters. This elegant,

light yet rugged two-door hatch back offers safety

and convenience, along with the opportunity to contribute

towards protecting our environment.

Take a closer look at Reva's

"hassle free" features:

Exhibit 2

Extracts from Reva Publicity Material (continued)

REVA

A HASSLE FREE OWNERSHIP EXPERIENCE.

Hassle free driving:

With no gears, no clutch, Reva drives like an automatic – ideal for “stop and go” city driving. With a low running cost you do not have to worry about high commuting expenses.

Hassle free maintenance / repair:

With no engine, carburetor, gearbox, radiator or exhaust, Reva has minimal maintenance costs. Besides, Reva’s body panels are made of dent proof ABS.

Hassle free recharging:

Recharge anytime, anywhere – in the convenience of your home or at your workplace. No more queuing at petrol bunks. Just plug in, charge up and take off!

Hassle free parking:

Reva has the smallest turning radius in its class. Couple with its compact size, it needs the least space to park.

Think Reva. Think “hassle free” !

Exhibit 2

**Extracts from Reva Publicity Material
(continued)**

REVA TECHNOLOGY IN HARMONY WITH ECOLOGY!	
MOTOR Best-in-class acceleration.	REGENERATIVE BRAKES Provide 'power-assist' feel
ENERGY MANAGEMENT SYSTEM Maximises efficiency and performance	CHARGER 80% charge in under 3 hours
SMALLEST TURNING RADIUS Easy to manoeuvre and park!	POWER PACK 80 km to a single charge!
ZERO EMISSION, WHISPER QUIET DRIVE Totally eco-friendly!	SIDE IMPACT BEAMS STEEL SPACE FRAME DENT-PROOF BODY PANEL Security in the concrete jungle
Reva is safe and reliable	
Reva's two onboard computers, side impact beams, a specially developed steel frame, regenerative braking, a frontal crush zone and energy absorbing bumpers, all lead to a high level of safety and reliability.	