Chapter I

Introduction

1.1 HISTORY OF THE AUTOMOBILE INDUSTRY: AN OVERVIEW

From a humble origin as a 'horseless carriage' manufacturing industry dating back to 1890s, the global automobile industry of today has come a long way emerging as the market leader in manufacturing activity, providing employment to one in seven people, either directly or indirectly (Karmokolias 1994: 46). The automobile industry has undergone significant changes since Henry Ford first introduced the assembly line technique for the mass production of cars. Production concepts, processes and the associated technologies have changed dramatically since the first cars were built.1 Some 70 years ago, car assembly was primarily manual work. Today, the process of car assembly is almost fully automated.

The evolution of the automotive industry has been influenced by series of innovations in fuels, vehicle components, societal infrastructure, and manufacturing practices, as well as by the changes in markets, suppliers and business structures (David 1993: 441-450). Engine was developed as a result of discovering new energy carrying mediums, such as steam in the 1700s, and new fuels, such as gas and gasoline in the 1800s. Shortly after the invention of the 4-stroke internal combustion gasoline-fueled engine in 1876, the development of the first
motor vehicles and establishment of first automotive firms in Europe and America occurred.²

During the 1890s and early 1900s, developments of other technologies, such as the steering wheel and floor-mounted accelerator, speed up the development of the automotive industry by making vehicles easier to use.³ Famous vehicle models such as Ford’s Model T were developed during these times and, by 1906, car designs began abandoning the carriage look and taking a more "motorage" appearance (Kirchhoff 1994: 56-59).

During the 1910s, the development of technologies and societal infrastructure continued in addition to new manufacturing practices and business strategies. Henry Ford’s famous assembly line was launched in 1913, which allowed vehicles to be mass produced and thus achieved economies of scale. Ford also introduced the concept of using interchangeable and standard parts to further enable the mass production process (Reynolds 1995: 389-407). Automakers started merging with other companies (e.g., GM acquired Chevrolet) and expanding in other markets outside the national territories (e.g., GM in Canada).

In the 1920s, the development of infrastructure, adoption of new manufacturing practices, and the merging of companies continued (e.g., Benz and Daimler, Chrysler and Dodge, Ford and Lincoln). In manufacturing, mass production methods became better established, which led to the availability of a wide range of satisfactory cars to the public. While Ford had focused on a single model, GM adopted a new
production strategy for providing greater product variety (Levinthal & Cohen 1990: 128-152).

During the 1930s, several new vehicle brands were developed (e.g., Ford Mercury, Lincoln Continental, Volkswagen) and with that the differentiation between the American and the European markets in terms of the trends of vehicle consumer preferences became wider (Baldwin 2000: 45-50). Competition among the automobile manufacturer also was growing intense. For instance, GM's product variety strategy continued to give them a competitive advantage over Ford, allowing GM to continually increase their market share over Ford Motors.

During 1940s, World War II (WWII), automotive factories were used to make military vehicles and weapons, thus halting civilian vehicle production. After WWII, the economies of most European and some Asian-Pacific countries, such as Japan, were decimated; this required the development of new production and business strategies such as those of Toyota, which began to develop what is now known as Just in Time (JIT) manufacturing. Most of the first models produced were similar to the pre-war designs since it took some time for the plants to revamp their operations to make new designs and models (Narayanan 2001: 66-69).

In the 1950s and 1960s, more technological innovations, such as fiberglass bodies and higher compression ratio fuels, allowed vehicle developers to appease the growing consumer interest for vehicle comfort, look, and feel. Car designs were highly influenced by emerging safety and environmental regulations. Vehicle speed limits
and front seat belts became standard, in addition to other features such as heating and ventilation equipment.

The 1970s were marked by stricter environmental regulations and the oil embargo of the early 70s, which led to the development of low emission vehicle technologies, such as catalytic converters, and a 55-mph nationwide speed limit in the U.S. Foreign cars like the Japanese Honda Civic started appearing in the U.S. market. The Civic was marketed as a fuel efficient and low-emissions vehicle, which, given the high oil prices and strict environmental regulations, made it well-received (Rao 1993: 36-44).

In the 1980s, the U.S. automotive industry began losing its market share to the higher quality, affordable, and fuel efficient cars from Japanese automakers (Reddy 1997: 1821-1837). In response to this market share loss, U.S. automakers began focusing on improving quality by adopting different Japanese manufacturing management philosophies, such as JIT.

Another significant paradigm of the 1980s was the global nature of vehicle manufacturing. Automakers started assembling vehicles around the world. This trend was accelerated in the 1990s with the construction of overseas facilities and mergers between multinational automakers. This global expansion gave automakers a greater capacity to infiltrate new markets quickly and at lower costs. The increased product offerings in many markets led to consumers having a greater variety of vehicles from which to choose. To this new vehicle buffet was coupled the explosion of the internet, which made vehicle-related information readily accessible to consumers. Internet-informed and
empowered consumers now wanted a vehicle that was “personalizable,” inexpensive, reliable, and quickly obtainable (Siddharthan 1998: 97-109). Consumers desired vehicles that were less harmful to the environment, which led to the introduction of hybrid vehicles by Japanese automakers in the late 1990s.

Spurred by the spectacular record of economic growth in many developing countries in Asia and other parts of the world, the automobile industry’s global output touched 69.5 million vehicles in 2008. The major challenge faced by automobile manufacturers today is to control production costs while manufacturing a growing range of models for catering to the heterogeneous consumer preferences. A constraint to raising platform capacity and reaping higher scale economics is that the industry does not lend itself to globalization of products and consumers. This is because each country has its own unique driving habits, lifestyle and topography that determine the nature of vehicles demanded. Americans prefer big vehicles, particularly trucks and SUVs, and have little concern about the fuel economy. Europeans, on the other hand, traditionally prefer small, good-handling cars that have high fuel economy (petrol costs around twice as much in Europe as in the US). Asians demand small cars that can navigate narrow streets and parking spaces, with small engines to avoid high taxes based on engine displacement (Chenoy 2008: 5).

1.2 TECHNOLOGY AS THE DRIVER OF AUTOMOBILE INDUSTRY’S GROWTH

Technology throughout has been the main driver of automotive industry’s growth. The ceaseless technological innovations in the automobile sector often had far reaching implications. Vehicle
manufacturers were moving into completely new materials and technologies—guided partly by market and partly by environmental legislations—to design and develop radically different products. Some of the new technology devices could be bolted on to an existing vehicle with relatively few implications for the rest of the vehicle, covering most telematic applications. Others were much more fundamental, and had a profound impact throughout the supply chain. Prominent examples here include battery, electric or hybrid power trains, and alternatives to all-steel body (Almus 1999: 141-154).

The introduction of technological innovations in the automobile industry follows a familiar pattern. Manufacturers typically introduce innovations at the top of their product lines (in premium vehicles) and then gradually take them down the pyramid to mass-market vehicles. (Fuel injection, anti-lock brakes, dynamic suspension systems, and car phones all begun as expensive options in luxury vehicles.) This approach allows car manufacturers to recover the cost of developing innovations from customers willing to pay a higher price for them. The competition among the existing automobile manufacturers has resulted in many innovations that are being widely adopted. A few of these include antilock braking systems (ABS), traction-control systems (TCS), four wheel steering, four wheel drive (4WD) and all wheel drive (AWD), electronically-controlled and active suspension systems; supplemental restraint systems (air bags), electronic automatic transaxles and transmissions, electronic engine control and management, distributor-less ignition systems, sequential port fuel injection, supercharging and turbo-charging, variable engine valve
timing and lift, onboard diagnostics and a host of other innovations (David 1995: 441-454).

Indeed, the role played by technological changes has been well documented in literature (see in this connection, Kydland and Prescott 1982: 1345-1370). Technology has become a central element for firms in order to get competitive advantage, in particular for those located in industries, which demand constant improvements from their products/processes. It has assumed even greater importance in the context of globalization when competition for a market share is becoming increasingly severe. Technology has a great influence on individuals, business, society and nature (Khalil 2000 : 54-57).

Firms require technological capability to develop and design new products and processes and upgrade knowledge about the physical world in unique ways, thus transforming this knowledge into designs and instructions for the creation of desired outcomes. So they not only have the mastery of technological capabilities, but also have the capabilities to deploy and expand the full implications of core competencies, and combine various streams of technologies, and mobilize technological resources effectively across firms (Kumiko, 1994; McGrath et al., 1997; Torkkeli and Tuominen, 2002; Walsh and Linton, 2002; Afuah, 2002; Wang and Lo, 2004). More concretely, technological capability is a set of pieces of knowledge that includes both practical and theoretical know-how, methods, procedures, experience and physical devices and equipment. It also represents the superior and heterogeneous technical assets of a firm and is closely related to
product technologies, design technologies, process technologies and information technologies.

Furthermore, technological capability requires a deep understanding of scientific principles, as well as the ability to generate new knowledge, while being different from science in that they are usually implicit in experiences and skills (Wheelwright and Clark, 1992; Hayes et al., 1985; Kumiko, 1994; Torkkeli and Tuominen, 2002; Fowler et al., 2000; Afuah, 2002). Technological capability, in particular, represents an important potential source of competitive advantage and superior performance in technologically competitive markets (Nelson and Winter, 1982; Tyler, 2001). In addition, technological capability helps to increase a firm’s ability to recognize and apply new external knowledge to continue the competence development, which may result in superior performance. Besides, superior technological capability usually enable firms to create and deliver innovative products or service in innovative ways that customers may value, and thus determine both the overall and new product development performance of a firm.

Technological innovations in motor vehicles resulted from the ever-growing requirements and demands of end customers, manufacturers and component suppliers. Yet the pace of innovation was also influenced by legislation, the environmental lobby and societal trends (Gemnden 2004: 548-546).

1.3 STATEMENT OF THE PROBLEM

Of all the challenges faced today at the level of individual firms, the management of technological change is the most demanding one.
Where firms can effectively cope with technological change, they create both value and profit for themselves, develop sustainable competitiveness, and remain vibrant as growing organizations. On the other hand, if they get it wrong, firms can face serious, perhaps terminal, problems by way of losing money, workers, and reputation. In the vast majority of business sectors, if firms do not innovate, their competitors will, and they will be put out of business in any case (Burns & Stalker 1994: 651-658).

Firms are induced to change their technology when product and factor market conditions do not meet their expectations and irreversible choices make adjustments expensive. Technological change consists both of the introduction of original ‘never-seen’ before technologies and the adoption of technologies that had been already put in place elsewhere. A firm’s survival and growth is basically decided by its success in coping with ‘change’, technological change in particular (Richard 1987: 666-678).

Innovation and technology management is an inevitable issue in the high end technological and innovative organizations. Today, most of the innovations are limited with developed countries like USA, Japan and Europe while developing countries are still behind in the field of innovation and management of technology (Ali & Khan 2006: 1-6).

At micro level, whenever people think of innovation, they envision developed world companies. For instance, U.S.A’s IBM and Apple Inc. (computer hardware and software), Japan’s Sony (consumer electronics and entertainment), Finland’s Nokia (Telecommunication and mobiles), Switzerland’s Novartis (Pharmaceuticals) and South Korea’s Samsung
(Conglomerate Electronics, Construction and Engineering) are technology leaders, and they have stayed at the cutting edge of dynamic industries. These companies also hold many important patents. They have established state-of-the-art research and development (R&D) labs and are heavily investing in new ideas. The world’s top most 50 innovative companies belong to developed countries. Among these, 72%, 16%, and 10% companies belong to North America, Europe, and Asia respectively. There is not even a single company which belongs to developing countries like China, India and Brazil.

Of late, some companies in the developing countries such as China’s Haier (Home Appliances), Mexican’s CEMEX (Cement maker) and Brazil’s Natura (Cosmetics) are growing rapidly in the innovation and technology management (Donald 2004: 6-8). None of these companies of course are ranked very highly when it comes to innovations in technology. Innovation and technology management climates in the companies of the developing world are by nature, problematic, characterized by poor business models, political instability and governance conditions, low education level and lack of world-class research universities, underdeveloped and mediocre physical infrastructure, and lack of solid technology based on trained human resources (Jaffe 1986: 984-1001). The problems at the strategic levels in developing countries often restrict the possibilities of innovation and technology development. The low intensities of applied technologies in developing countries in turn constrain dynamic investment and industrial development in these countries. Inadequate skills, limited
access to technical information, ineffective institutional and regulatory frameworks, as well as organizational rigidities impede technical change and innovation.

Industrialized countries generate practically all the world’s technologies and, while in developing countries the prime concern has been around acquiring the technology and adapting these to their own needs and situations (Basant 1997: 1683-1700). Yet, for most developing country firms, many new technologies were simply not accessible. These technologies were also many a times either unaffordable, or inappropriate in certain forms. And in many instances, the firm in developing country was either not familiar with a new technology or did not have the necessary capabilities to adapt this technology to its own needs and situation (Perez 1988: 77-87).

The corporate response in developing countries was essentially of defensive nature. The corporate management in most cases was trying to bridge the technology - gap by arranging acquisition of the said technology through routes of foreign collaboration or outright purchase. The adverse effects of such easy options on the country’s long term growth have been documented by scholars in detail (Bagchi & Banerjee 1981; Subrahmanian and Pillai 1979). For one thing, such wholesale dependence on imported technology in the absence of matching in-house R & D capabilities created conditions for perpetuation of dependence leading often to repetitive import of technology and also of parts, components and subassemblies from the same foreign-technology suppliers. This meant in turn heavy foreign exchange outgo.
More importantly, it severely jeopardized the firm's long term market prospects, as the technology that was often being procured from the foreign collaborators had by the time of acquisition reached their maturation stage or was on the decline path which hardly did empower the acquiring company or firm with any amount of competitive edge (Sullivan & Steven 2003: 471). Therefore, for the developing country firm, making a foray into the global market on the strength of imported technology often remained out of question.

Researchers of late have been focusing on the role played by R & D in bridging the technology gap. Historically, R&D has been playing two strategically critical roles in relation to technological change: (1) in implementation of internal innovation strategies (Chesbrough & Crowther 2006: 229-236), and (2) in providing a firm with the capability to absorb technology from external sources (Cohen, L. and D. Levinthal 1989: 34-56).

Research and development efforts, to be meaningful, call for the involvement of both the state-run universities and R&D institutes and also of the giant corporations. Whereas the magnitude and scale of Government involvement in R&D have often been prompted by broader socio-economic and political considerations, for individual companies the compulsions to invest in R&D grows out of the specific dictates of the market (Fu & Perkins 1995: 907-920).

Viewed from the above angles, the situation in the developing countries has been far from ideal.
Firstly, many of the developing countries, India in particular, initially adopted an inward looking growth strategy with heavy emphasis on import substitution and protection. In such situations, naturally the market compulsions were weak.

Secondly, while successful R & D in industrial sector calls for investment on a massive scale, it was often beyond the capability of companies in most developing countries to think of undertaking R & D initiatives of the required scale.

Thirdly, in the public policy domain also there was no clear announcement from the Government that could have forced the developing countries companies to give due weightage to R & D efforts.

Given that R & D initiatives for producing meaningful outcome have to be based upon a minimum threshold level of investment and that such investments are often beyond the reach or capacity of an average firm in a developing country, control over technology remains highly skewed in favor of firms of the developed countries. The few developed country (DC) based giant automotive firms have naturally been the sources of most of the recent technological innovations in the industry.

A vicious circle of dominance and subordination thus perpetuates itself within the global automotive industry-structure. The DC based automotive firms with global operations and gigantic turnover invest huge sums in R & D that enable these firms to make technological breakthroughs; the technological mileage that so accrues to these firms
is then profitably utilized by them for gaining competitive edge and hence for further consolidating their grip over the global market of automobiles. Within this core-periphery framework, the developing country firms are often left with no alternative other than to become at best the ‘trusted’ collaborators (with clearly demarcated sales territories) or, worse still, the local assembling and selling agents of the DC-based firms.

Before any patient observer of the automotive industry scenario, the context as narrated above naturally poses a number of questions:

- Can a firm based in a developing country, given its limited turnover and financial capability, ever come out of this vicious cycle of its dominance and continued subordination by developed country firms?

- To put it differently, can a firm in a developing country, which gains a foothold in the market by initially posing as a collaborator, build up in due course adequate strength so as to be able to effectively and independently cope with industry-level technological changes? To make such transformation possible, what technology-strategy should a developing country-based firm ideally follow?

- Whether a firm’s strategic focus on technological self-reliance, particularly in the context of a developing country, would have any adverse bearing on its bottom line or corporate growth?
The above research questions were taken as the starting point of the present enquiry.

1.4 SELECTION OF THE CASE OF TATA MOTORS (INDIA) LTD.

Given the complexity of the issues involved, for seeking an answer to the above questions at least three preconditions were to be duly fulfilled:

i. First, it was necessary to identify a firm in a developing country setting (preferably in India) which commanded a respectable height not only in terms of its record of growth and present market share but also in terms of its strategic location vis-à-vis the questions raised (informed choice of critical case).

ii. Second, the case was to be intensively studied over time to see how changes were being introduced in automotive industry periodically by technological break-throughs and how the firm in question was responding to these technological changes at different points of time (longitudinal study).

iii. Third, both qualitative information were as important as the quantitative data to be gathered from multiple sources for making a meaningful assessment of the strategic aspects and thereby generating a testable set of hypotheses vis-à-vis the research questions.
All these made it mandatory for us to adopt the case study method of research. Based on an initial quick survey of the automotive industry scenario in India, an informed choice of Tata Motors Ltd. was made for the purpose of the case study.

1.5 OBJECTIVES OF THE STUDY

After selection of the case, the research questions as noted earlier were translated into case-specific objectives. The final objectives of the study were as follows:

i. To examine how Tata Motors (India) Ltd. being a developing country based automotive firm had been responding to the technological changes occurring in the industry at the global level.

ii. To identify from the specific pattern of Tata Motors responses the major features of the firm’s technology management strategy; and

iii. To finally assess whether the chosen technology management strategy in the context of Tata Motors (India) Ltd. had any bearing on the overall corporate growth.

1.6 SCOPE OF THE STUDY

The scheme of economic liberalization was set in motion in 1991 which had far reaching implications for both the marketing environment and the corporate strategy. Considering this, 1991 has been selected as the base year for the survey.
Although initially it was our plan to limit the study period to 2004, in order to duly accommodate the contemporary trends, the terminal year, wherever feasible, has been extended even up to 2008-09 depending upon the availability of relevant data.

The study focuses on the strategic aspects and experience of Tata Motors (India) Ltd. No attempt has been made to generalize the findings at aggregate level or at the level of other companies in India.

1.7 METHODOLOGY AND DATA

The present study adopted for itself the Case Study method the rationale for which has been already stated.

The study is based mainly on secondary data. The needed information were collected primarily from the Company’s Annual Reports; bulletins, other reports, prospectus, chairman’s speech and also from the reports periodically released by concerned trade associations, Society of Indian Automobile Manufacturers (SIAM) and other governmental and non-governmental organizations. A good deal of information were also obtained from journals and various financial newspapers.

Qualitative information of the primary were collected directly from the Company’s Corporate Office, Mumbai, for which repeated personal visits had to be undertaken. Interviews with company officials and executives at various levels of management rendered very useful information relating to the corporate technology management strategy.

For processing and analyzing of the collected data, statistical techniques like time series trend analysis, Pearson’s correlation and
Stepwise regression were extensively used along with the software package SPSS 15.0.

1.8 CHAPTER SCHEME

The final research report has been divided into seven chapters.

Chapter I introduces the study and specifies the objectives and scope of enquiry.

Chapter II delineates the conceptual framework of the enquiry. Based on a detailed survey of the relevant literature, the chapter explores the crucial linkages that determine the pace and pattern of technological development at industry and at firm levels and the implication of these linkages for overall corporate growth.

Chapter III situates the case in its historical context. The chapter presents a brief profile of the Tata Motors (India) Ltd. Indeed, Chapter III establishes the rationale for making an informed choice of Tata Motors (India) Ltd. as the case to be studied.

Chapter IV examined the pattern of responses of Tata Motors (India) Ltd. to the technological changes occurring in the automotive industry at the global level. Longitudinal analysis covering the study period showed that the response pattern had throughout been proactive.
Chapter V by analyzing Tata Motors above response pattern to technological changes at the global level, delineated the salient features of Tata Motors' technology management strategy.

Chapter VI made an assessment of the impact of Tata Motors technology management strategy on its overall corporate growth.

Chapter VII presented the summary of findings along with suggestions for future research.
NOTES


4 See, OICA: "World Motor Vehicle Production: World Ranking of Manufacturers 2008" (http://oica.net/category/production-statistics)


