CHAPTER – 3
TECHNOLOGY CHALLENGES IN INDIAN AUTOMOTIVE TYRE INDUSTRY

a. Research and Development

The phrase research and development (also R and D or, more often, R&D), according to the Organization for Economic Co-operation and Development, refers to "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications"

Overview

New product design and development is more often than not a crucial factor in the survival of a company. In an industry that is fast changing, firms must continually revise their design and range of products. This is necessary due to continuous technology change and
development as well as other competitors and the changing preference of customers. A system driven by marketing is one that puts the customer needs first, and only produces goods that are known to sell. Market research is carried out, which establishes what is needed. If the development is technology driven then it is a matter of selling what it is possible to make. The product range is developed so that production processes are as efficient as possible and the products are technically superior, hence possessing a natural advantage in the market place.

In 2006, the world’s four largest spenders of R&D were the United States (US$343 billion), the EU (US$231 billion), China (US$136 billion), and Japan (US$130 billion). In terms of percentage of GDP, the order of these spenders for 2006 was Japan, United States, EU, China, with approximate percentages of 3.4, 2.6, 1.8, and 1.4 respectively. The top 10 spenders in terms of percentage of GDP were Israel (4.53%), Sweden (3.73%), Finland (3.45%), Japan (3.39%), South Korea (3.23%), Switzerland (2.9%), Iceland (2.78%), United States (2.62%), Germany (2.53%) and Austria (2.45%).
In general, R&D activities are conducted by specialized units or centers belonging to companies, universities and state agencies. In the context of commerce, "research and development" normally refers to future-oriented, longer-term activities in science or technology, using similar techniques to scientific research without predetermined outcomes and with broad forecasts of commercial yield.

Statistics on organizations devoted to "R&D" may express the state of an industry, the degree of competition or the lure of progress. Some common measures include: budgets, numbers of patents or on rates of peer-reviewed publications. Bank ratios are one of the best measures, because they are continuously maintained, public and reflect risk.

In the U.S., a typical ratio of research and development for an industrial company is about 3.5% of revenues. A high technology company such as a computer manufacturer might spend 7%. Although Allergan (a biotech company) tops the spending table 43.4% investment, anything over 15% is remarkable and usually gains a reputation for being a high technology company. Companies in this
category include pharmaceutical companies such as Merck & Co. (14.1%) or Novartis (15.1%), and engineering companies like Ericsson (24.9%). Such companies are often seen as poor credit risks because their spending ratios are so unusual.

Generally such firms prosper only in markets whose customers have extreme needs, such as medicine, scientific instruments, safety-critical mechanisms (aircraft) or high technology military armaments. The extreme needs justify the high risk of failure and consequently high gross margins from 60% to 90% of revenues. That is, gross profits will be as much as 90% of the sales cost, with manufacturing costing only 10% of the product price, because so many individual projects yield no exploitable product. Most industrial companies get only 40% revenues.

On a technical level, high tech organisations explore ways to re-purpose and repackaging advanced technologies as a way of amortizing the high overhead. They often reuse advanced manufacturing processes, expensive safety certifications, specialized embedded software, computer-aided design software, electronic designs and mechanical subsystems.
Research and development is nowadays of great importance in business as the level of competition, production processes and methods are rapidly increasing. It is of special importance in the field of marketing where companies keep an eagle eye on competitors and customers in order to keep pace with modern trends and analyze the needs, demands and desires of their customers.

Unfortunately, research and development are very difficult to manage, since the defining feature of research is that the researchers do not know in advance exactly how to accomplish the desired result. As a result, higher R&D spending does not guarantee "more creativity, higher profit or a greater market share."

Research and Development alliance

An R&D alliance is a mutually beneficial formal relationship formed between two or more parties to pursue a set of agreed upon goals while remaining independent organisations, where acquiring new knowledge is a goal by itself. The different parties agree to combine
their knowledge to create new innovative products. Thanks to funding from government organizations, like the European Union's Seventh Framework Programme (FP7), and modern advances in technology, such as EuresTools, R&D alliances have now become more efficient. Research and development is nowadays of great importance in business as the level of competition, production processes and methods are rapidly increasing. It is of special importance in the field of marketing where companies keep an eagle eye on competitors and customers in order to keep pace with modern trends and analyze the needs, demands and desires of their customers.

**Research and Development in Indian Tyre Industry**

In order to deliver outstanding performance tyres we know the overriding importance of extensive research and development, as well as close cooperation with premium car manufacturers. That is why long before the launch of a new car, engineers from the car manufacturer and our tyre development group get together to define and discuss requirement specifications for specific vehicles.
Technology generation in the Indian tyre industry is essentially geared to development research, involving the change of tread design, reinforcement material etc. Most of the major players do not engage in basic research due to the high costs involved. The source of technology for the domestic firms has been through reverse engineering, joint ventures and collaborations.

Fig 4: Comparison of R&D Expenditure, Exports, Sales & Raw Materials Expenditure among all companies for the period from 2000-07

Note: The primary vertical axis depicts expenditure on R&D (at current prices) in Rs (crores), while the secondary vertical axis depicts the percentage of exports and raw material expenses in relation to sales.

Source: CMIE database (figures generated from the 40 listed companies in the sector)

A significant proportion of R&D effort in the tyre sector is carried out by four or five top companies. The proportion of raw material
expenditure in relation to sales has witnessed a sharp spurt in 2007. The proportion of exports to total sales continues to be negligible in the tyre sector and a major portion of the sales revenue is garnered through the domestic market.

**Expenditure on Imported Technology and R&D Intensity: Comparison between Top Ten Firms and All Other Companies in the Tyre industry**

![Chart showing comparison of expenditure on imported technology and R&D intensity between top ten firms and all other companies in the tyre industry over the years 2000 to 2007.]

**Fig 5:** Comparison of expenditure on imported technology (at current prices) and R&D intensity among top ten players and all remaining firms (sectoral aggregate) in the Indian tyre sector.

**Note:** The primary vertical axis depicts expenditure on imported technology (at current prices) in Rs (crores), while the secondary vertical axis depicts R&D intensity (in percentages).

**Source:** CMIE database

Tyre technology upgradation is an extremely difficult process, particularly in the Indian scenario, due to several factors. First, since
tyre technology encompasses various disciplines such as polymer, chemical, steel etc. compromises have to be made in the upgradation of technology because of a) the conflict and complimentarity inherent in these disciplines, b) the usage pattern of the tyres and c) the cost factor. Further, a tyre’s performance could be affected due to factors such as the weather, loading pattern etc. Despite these bottlenecks technology upgradation in Indian tyre industry during the last few decades has been significant. This has been possible to some extent due to government approvals of collaborations with MNCs in this sector. The emphasis given by Indian tyre companies to applied research, the setting up of well-equipped in house R&D centers by large tyre companies, manned by experts and experienced professionals have also helped in technology upgradation. Indian tyre technology has exhibited versatility in maintaining inflow of technology through foreign collaborations and tailoring the same to Indian needs.

Apollo Tyres

Apollo Tyre Limited’s R&D centre was started at Perambra, Kochi and was shifted to Vadodara. All activities of the centre are extensively
supported by series of sophisticated equipment, which help research scientists develop products as per customers' specific requirements.

Apollo Tyre Limited has expertise in development of compounds for improved performance, raw material development, analytical research, reverse engineering, advanced design using CAD, finite element analysis (FEA) modeling of tyres, simulation testing of the designed product and product validity & reliability studies.

The R&D centre boasts of a pool of specialists from areas such as polymer science, rubber technology, inorganic & organic chemistry, textile technology, physics and mathematics.

**Apollo Tyres plans R&D facility in Germany**

Apollo Tyres may set up a research and development facility in Germany, a country known for its forte in tyre technology, said Mr. Onkar S Kanwar, CMD, Apollo Tyres.

The R&D facility is a stepping-stone towards strengthening the company's existing alliance with a German university (Leipzig Institute of Polymer Science) that has professionals from various global tyre
majors as experts. These experts are helping Apollo on the development of novel technology for tyres.

Similar exercise

It is looking at two other universities in Germany for a similar exercise. This initiative is quite similar to that of Michelin (the world's largest manufacturer of tyres) - it has a tie-up with the University of Actron, US for tyre research and development.

Apollo is also working with Indian institutes such as National Institute of Design, Ahmedabad and IIT Kharagpur for design and development of rubber technology, respectively.

MRF

The MRF R&D team has made strides in developing Radial-tyre technology for Indian roads, based on its cross-ply techno competence. MRF has laid great emphasis on strong R&D and continuous product upgradation, which has led to the successful development of the unique tyre technology for cross-ply tyres. Additionally, MRF has developed its
very own radial tyre technology to suit the tough service conditions on Indian roads - for both, the passenger and commercial segments. This has led to the launch of several innovative products.

Backed by a superior R&D, MRF tyres are rolled out of six interdependent facilities, which are built over 450 acres and with over 15,000 dedicated people. MRF has over 3000 strong dealer network with 180 offices. What this means is that the company boasts of the largest range of tyres in India - from heavy duty truck tyres to 2-wheeler tyres.

MRF started as a toy balloon maker in 1946 in South India and quickly grew to become one of India's largest and most respective companies. Renowned for product superiority and innovation, MRF continues to be one of the leading tyre makers in India.

**MRF Design Process**

The design process at MRF starts from the customer - input from individual customers are compiled by marketing and given to Corporate
Technical MRF's R&D and Product Development Division or vehicle specific requirements are received from the OE customer.

MRF's team of 300 engineers and scientists give MRF enormous strength in product design.

MRF uses cutting edge technologies in predictive testing and design validation before it leaves the drawing board. These advances have significantly brought down the time to market for new designs.

Advanced raw materials are tested and approved in our NABL accredited laboratories. MRF works closely with global suppliers in using the latest developments in material across the globe. The MRF laboratories have the latest in testing equipment and closely monitor the quality of the material going into the tyres at the time of approval. The prototypes for verification and validation testing are manufactured in one of MRF's 6 factories all of which are TS 16949/ISO 9001 certified. The tyres then go through testing for confirming the architecture and a series of indoor testing to ensure that they meet MRF's tight standards.
and also those required by the OEM or by any of the national standards like BIS/JIS/ETRTO/T&RA.

Tyres are now handed over to the Vehicle Dynamics Group, who now validates the design on the vehicle. These tests are done at the test track in a series of manoeuvres at various speeds, pushing the tyres to the limits of its capabilities.

Ceat Tyres

The Company is giving great emphasis to innovation in product and process technology and operational efficiencies. The year 2007-08 saw significant R&D efforts to develop new products and enhance quality of tyres. The new products so developed have performed well in the domestic as well as international markets. Successful efforts were made into re-engineering the products and to reduce costs and optimize material consumption.

Behind every successful product is a great R&D effort. At CEAT, ‘long distance’ is not just a term, it is the way we think and plan. Every
innovative step is toward giving the customer a high-end product. Our research people are doing a great job at that since 1984.

Every tyre that leaves our facility has been tried and tested for best performance, (we also have the approval of the Department of Scientific and Industrial Research (DSIR) on that). Aided by modern design tools we can develop, test and process our products within a short time span. With this we are able to introduce better products to keep up with the evolving market needs.

We have always been avid propagators of advanced technology. And with good reason. High tech processes enable us to presuppose the customers’ needs and simulate their on-the-road experience, to create the perfect product.

*So, where the durability of our products is concerned: rest assured.*
*When we say long distance, we stay long distance*

**JK Tyres**

The Engineering Design Department at the Indian Institute of Technology-Madras is home to the Raghupati Singhania Centre for
Excellence for Tyre and Vehicle Mechanics, yet another instance of industry-academia collaboration. JK Tyre has sponsored the centre that was set up in 2004 for carrying out research on tyre dynamics and design.

You leave your footwear outside and enter the centre and are greeted by Dr R. Krishna Kumar, Professor and Head, Department of Engineering Design, IIT-Madras, who is in-charge of the research being carried out at the centre.

**Noise and vibration**

“Research on tyres has changed a lot over the years. The requirement of tyres itself has changed, thanks to the varying road conditions. Noise and vibration are important, as much as reliability is,” he says.

The centre has graduates, doctorates and post-doctoral researchers working on various aspects of a tyre. The cooperation with JK Tyre is good and the company readily shares information with the
centre, for the researchers to come up with solutions, says Dr Krishna Kumar.

“We are right now looking at noise and vibration,” he says. With roads improving and cars being able to travel at higher speeds, tyre noise and vibration have become important issues. Rolling resistance — the loss of energy due to the deformation of rubber — is another issue the centre is working on. After all, it has an impact on the fuel consumption of a vehicle. In trucks, says Dr Krishna Kumar, 30 per cent of the fuel consumed is tyre dependant. To tackle this, research has to be focused on tyre design and materials.

**Competing requirements**

Over the years, according to him, the requirement of a tyre itself has changed. Cars are more powerful, roads are better, and people use the same vehicle for driving long-distance and for city commute. The vehicle users have also become more aware of noise and vibration caused by the tyres, as cars are driven at higher speeds.
All this means that the tyre not only has to be long-lasting, they have to be suited for higher speeds, with reduced noise and vibration levels, should handle better and not be too expensive — all competing requirements. The research at the centre is focused on these issues, instead of finite element analysis, which is what it started out doing. Apart from conducting computer-simulated tests of various parameters, tyres are also tested out on the Irungattukottai race track, on the western outskirts of Chennai.

Budget, no issue

Dr Krishna Kumar says the centre has received complete support from JK Tyre, with budget not being an issue at all. The tyre company and the research centre have constantly exchanged information and the research being done is subject to periodic review at different levels in the company. “There is no meaning in technical education if there is no close interaction with industry,” says Dr Krishna Kumar.

He adds that an engineering institution has to be like a medical college, which has a hospital attached to it. “Theory (theoretical
knowledge) is not removed from practice, but you need much more rigorous theory to understand practice," adds Dr Krishna Kumar.

The IIT-M administration has supported this effort wholeheartedly. "The director himself has sat on the reviews," says Dr Krishna Kumar. IIT-M has a strong focus on the automobile industry in its teaching programmes. The Engineering Design Department offers a dual-degree programme in automobile engineering and a dual-degree programme in bio-medical design. This interaction with industry has helped the institute structure its curriculum in such a way that there is a course and a laboratory going together that enthuses students. Ashok Leyland and Bosch have funded the department building.

**JK Tyre plans R&D centre at IIT Madras**

JK Tyre has signed an agreement with the IIT, Madras to set up a centre to carry out research on tyre mechanics.

With an initial funding of Rs 1.5 crore, the facility - Centre of Excellence for Tyre and Vehicle Mechanics - is expected to start
functioning from September. Over the next 3-4 years, the company will commit about Rs 5-7 crore to this centre.

Dr R. Mukhopadhyay, Director (Research and Development), JK Tyre, told Business Line after signing the agreement on Tuesday that the centre will have supercomputing facilities that will help in simulation studies on tyre designing. This will considerably bring down the design cycle time of tyres.

JK Tyre would provide the inputs to the centre, to be co-ordinated by Dr R. Krishna Kumar of IIT’s mechanical engineering department, which would in turn build a data bank and use the data to conduct simulation and predictive studies.

Under the agreement, the centre is required to publish papers in international technical journals to be peer reviewed so that Indian tyre manufacturers can showcase their capability to global auto giants.

JK Tyre would continue with its research on rubber materials and provide the data to the centre, which would evaluate it.
One of the objectives of the centre would be to integrate tyre
design with vehicle design - a tyre that is designed for a particular
vehicle and not a generic design.

Dr Krishna Kumar said that JK Tyre's commitment to the centre
would be one of the largest such sponsored research by the private
sector among the IITs.

Dr S. Srinivasa Murthy, Head of the mechanical engineering
department, and Prof V. Kalyanaraman, Dean, Industrial Consultancy
and Sponsored Research, said that IIT, Madras also hopes to set up a
centre of excellence in automotive design to conduct research on
subjects like engine design, alternate fuels, pollution and the like with
participation by vehicle manufacturers.

Goodyear Tyre Industry

The technical divisions of the company's centres in Luxembourg
and Akron are working on a number of tyre technologies, new tyre
materials and compounds, focusing on tyre safety performances, such
as wet braking or aquaplaning resistance as well as on environmental
and legal requirements, such as the reduction of noise or rolling resistance, which will lead to reduced fuel consumption.

The company has launched several tyre technologies in the past six months, such as the Active corner-grip technology of the new Eagle F1 Asymmetric, in Europe and South Africa. The Active corner-grip technology increases the tyre-to-road contact on the inside of the contact area for cornering with more control. Through the tyre’s active corner-grip technology, with reinforcement in the inner sidewall of the tyre, deflection is reduced during cornering for a more even distribution of pressure across the whole contact patch. This, consequently, provides more control and grip on the road.

The active corner-grip technology reinforces the inside tyre wall and limits the tendency of extreme drifting forces towards the outside of the tyre. The centre of gravity is brought back toward the centre of the tread, which provides more grip on the inside of the tyre. Goodyear also launched the AirMax concept for truck tyres, in Europe. AirMax is a new concept in the Goodyear family of Max technologies.
The inflation pressure can be reduced without reducing the weight capacity of the axle by increasing the air volume in the tyre. This results in less road damage and, more importantly for the operator, the ability to increase the front-axle load. Meanwhile, the company has identified safety in wet conditions as one of customer’s main concerns. Goodyear focuses on tread design to improve safety on and off the road. The asymmetric tread design of the new Goodyear Eagle F1 Asymmetric is the latest addition to the company’s tread design technology.

The tread design of a tyre contributes to safety in wet conditions. Several components work together. The chipper is a key contributor to safety in the wet, forcing local pressure on the open tread water dispersal zone, which is a crucial area for manoeuvring on wet surfaces.

The deep-centre grooves channel the surface water in order to achieve the most efficient steering response. The additional downward pressure aids evacuation channels on the inside of the tyre. This pressure disperses the water from under the tyre. Tread design is also the secret to ensuring a quiet ride.
Special tyre noise engineers are working on improving the tread design. Different tread block sizes and a staggered tread block arrangement result in an audible reduction of the noise frequency peaks when the tread blocks meet the road. This reduces the overall noise emission and allows for silent driving comfort.

“We consider the tread design as a breakthrough concerning noise emission and wet performance,” says Goodyear South Africa’s product manager Chris Tyre.

Goodyear is also conducting extensive research on rubber compounds and the effect they have on the environment. Recently, the European Commission awarded Goodyear a major research and development grant. The €3-million grant, is part of the European Union’s Life-Environment programme.

One of the project’s main tasks is to develop a new biofiller as an alternative to traditional fillers used in tyres. This new filler, which will be made out of renewable resources like cornstarch, may have
significant environmental impact and lead to a reduction of carbon
dioxide emissions during its production process.

Together with Goodyear, Italian research company Novamont
will focus on the development of the new biofiller and assess its
dispersion capabilities in tyre formulations. Novamont focuses on the
development of products derived from renewable raw materials of
agricultural origin, like starch. Goodyear has concentrated on the
development of environment-friendly tyres for many years.

Goodyear presented its first tyre using Bio Tred compounding
technology, a patented innovation developed by the company, in 2001.
Bio Tred permitted the partial replacement of carbon black and silica by
a new starch-based filler material, resulting in environmental
advantages. The starch used in the production of Bio Tred is derived
from corn, in a process similar to the one used in food industries. In the
first instance, starch is treated to obtain microdroplets, which then
undergo a specific treatment to transform them into biopolymeric filler.
The end product has physical properties that differ substantially from
those of traditional fillers.
Silica filler has played an important role for a number of years and will continue to be an important contributor to tyre performance, especially in the ultrahigh-performance tyre segment.

“Cars never stop evolving. Today’s high-performance vehicles are more luxurious and sophisticated than ever before. Throughout the technical evolution over the last several years, we’ve seen the car manufacturers’ trend towards producing heavier and more powerful vehicles: the first Audi Quattro compared with today’s RS4, for example; the 200 PS compared with the 420 PS; and 1 331 kg compared with 1 721 kg; or the Golf GTI, which had a weight of 830 kg, the latest model weighing more than 1,3 t,” explains Tye.

Automotive safety systems can be categorised into two general types. The passive safety systems help to protect people in accidents, while the active safety systems help drivers to avoid accidents in the first place. With the evolution of tyre technology, there is a visible increase in active safety effectiveness. As the tyre is the vital link between all active safety systems and the road, it is the key contributor to active safety. As a result, the overall safety is increased to an even
higher level, especially when driving or braking on wet roads. Another important development is in the industrial tyre business.

The development of Goodyear’s new AirMax concept is the result of demand from truck manufacturers to be able to increase the weight capacity of front axles, without compromising any vehicle or tyre performance criteria. Extra equipment to meet increasingly stringent emission regulations and indivisible loads, such as car transporters, are two reasons for this.

Also, the need to reduce road damage has become an important issue, with some countries penalising vehicles that cause damage. In recent years, there have been weight gains on trucks owing to emission control equipment, more sound insulation around the engine and extra spray suppression equipment, to meet legal requirements. Safer, more spacious and comfortable cabs have pushed up kerb weights still further and payload margins have been reduced. Most of this increase goes on the front axle. “This is why truck manufacturers have turned to Goodyear to develop tyres that offer higher load indices without undesirable side effects,” comments Tye.
He adds that at the moment tyre engineers are concentrating on improving the rolling resistance of their tyres in an effort to improve fuel consumption and says that Goodyear has made some strides in the field. With the research and development grant, the European Commission also recognises and supports the company’s initiative to develop an ultralow rolling-resistance tyre with the new compound made from environment-friendly resources such as cornstarch.

The objective of the project is an in-depth analysis of a tyre’s structure, aimed at minimising energy loss while the vehicle is in motion. This project has the potential to lead Goodyear to tyres with lower rolling resistance, better durability and shorter braking distances.

Goodyear, together with its development partner BMW, will develop the tyre formulations and test the prototype tyres to improve the structure of the tyre.

The ultrahigh-performance market is a segment which constantly requires a significant investment in research and development, as well as testing, to be able to outperform the competition.
The racing tread compound of the new Eagle F1 Asymmetric is the result of many months of intensive research in the Goodyear laboratories.

The tyre's compound is a mixture of many different ingredients. The tyre contains about 15 different compound mixtures, while each mixture again contains several ingredients. The tread compound alone contains 20 different ingredients.

Meanwhile, Goodyear's brand-new Regional Haul Steer (RHS II) and Regional Haul Drive (RHD II) truck tyres, which feature the new KMax technology, have made improvements on the tyre performance in regard to mileage. Goodyear comments that significantly more mileage is the most outstanding improvement of the Regional RHS II and Regional RHD II tyres, as well as shorter wet stopping distances and improved fuel consumption.

Goodyear's KMax technology is a combination of dedicated tyre construction, pattern geometry and materials, which ensures long tyre life without compromising other characteristics.
However, there is a trade-off between various tyre performances, which shows the complexity and challenges in tyre development, the company adds.

Goodyear South Africa’s public relations manager, Lize Hayward, mentions that some of the main challenges for the tyre industry in South Africa are the import of foreign tyres, skills shortages and the impact of tyre industry on the environment. According to the Department of Trade and Industry, there are 182 homologated foreign brands filtering into South Africa from other parts of the world.

"More disturbing is the number of low-cost tyres filtering in from developing nations, especially China. The challenge is especially to guard against products of questionable quality coming into the market," she adds. The tyre and rubber industry is highly technical in content. Therefore, the necessary skills are scarce at senior level and black economic empowerment is thus a challenge. Tyres are not biodegradable, which presents a big challenge. However, new initiatives are continually being developed to tackle the problem.
“In the near future, we don’t expect any significant changes to the look of tyres; however, Good-year will continue to work on special design innovations and features, which will bring benefits to consumers,” concludes Hayward.

Bridgestone Tyres

In the last ten years, Bridgestone has made several important technological innovations. We have realized enormous progress in computer-aided design, which we have developed into our Grand Unified Tire design Technology (GUTT®).

This automatic tire simulation and design method has changed the conventional approach to tire construction and simplified tire development processes. In the field of on-road tires, this technology has been applied to create DONUTS® for passenger cars, commercial trucks and buses, and is the primary reason why Bridgestone occupies the No. 1 position in Formula-1 motor sports racing. In the category of off-the-road tires, GUTT® has greatly contributed to the design and manufacture of extremely durable tires, as well as helped shorten the development term for new tires.
At the same time, Bridgestone has continued to accumulate substantial knowledge of tires at the molecular level. Technological advancements have resulted in an optimum mixture ratio of carbon, silica and rubber that successfully extends tire tread life. The company has also invested millions of dollars in the off-the-road tire research and development in order to improve product quality and performance. For example, our plants employ sophisticated technology such as X-Ray and supersonic inspection devices to assure tire quality.

Engineering Technology in Tyre Industry

1. Tyre with Cotton (reinforcement) Carcass:

   In the starting phase of proper Bias or Cross ply tyre, cotton plies were used as main reinforcing material (end of 19th and early 20th Century). Cotton reinforcing material had inherent problems of low strength and high moisture regainer. Leading to large number of plies to get the requisite casing strength for the tyre weight of the tyre and poor heat dissipation. This, in turn, gave an adverse impact on Tyre weight and buck rendering poor performance.
2. Tyre with Rayon (reinforcement) Carcass:

With the development of viscose and rayon the strength of reinforcing material went up and found application in tyres in early 20th Century. Due to higher strength of rayon it was possible to reduce number of plies and weight of the tyre. Since less number of plies were needed to match cotton strength, concept of ply rating developed. It was also possible to have higher ply ratings now.

3. Tyre with Nylon (reinforcement) Carcass:

Persuient to development and introduction of Polyamide (Nylon) the strength and flexing behavior of reinforcing materials improved substantially resulting in further reduction of number of plies, consequently the weight of the tyres. This development substantially improved the heat and impact resistance of the carcass leading to better tyre performance and higher durability. Nylon casing gave a boost to retread ability. Thus effective cost of the tyre in operation became much more economical.
Development of Tyre Technology due to change in Reinforcing material is basically in the case of Cross Ply or Bias Tyres. Bias tyre has cotton, Rayon or Nylon Cords, bound as plies and each ply (i.e. Cords) cross each other at a definite angle anchoring at the bead.

4. Radial Tyre-Textile/Textile belt (Rayon/Nylon/Polyester):

In spite of continuous development in Bias Tyre Technology, inherent problem of high heat development and poor life remains a continuous challenge.

In early 1950s new concept of Tyre design was developed namely "RADIAL" wherein plies were made highly flexible by keeping cords at 90 and in order to improve tyre life, inextensible (stiff) belts were placed on top of the Carcass under tread. This led to stiffer tread portion, leading to higher Tread life (Mileage) and much more comfortable ride due to flexible carcass. This was beginning of 'Revolution' in tyre technology. Initially Radial tyres were introduced with Casing Plies as well as belt material of textiles.
5. Radial (Construction) Tyre - Textile/Steel belts:

Once Steel Tyre cord got developed it found its immediate application in Belt material, keeping casing plies of Textile, to further improve durability.

6. Radial (Construction) Tyre - Textile/Glass Fibre Belt:

Similarly, development of glass fibre which is practically inextensible, led to application in passenger and Light Commercial Vehicle tyres with Textile Casing, providing corrosion free radial Tyre belt material.

7. Low Aspect Ratio (Cross Ply or Bias) Tyre:

A new concept of low aspect ratio (ratio between section height and section width) of the tyre in cross ply construction was introduced for higher speed and better performance.

8. Tubeless Tyre (Cross Ply):

Concept of tubeless tyre in cross ply construction wherein an
inner liner compound based on chlorobutyl or Halo Butyl which is impermeable to gases, was introduced eliminating the usage of tubes. This concept could not find sustained application in India due to bad roads and poor handling/maintenance of Rims other than in OTR range. However, Tubeless tyres are produced for Export Market. Gradually this concept will become fully acceptable with the advent of new generation vehicles and improved service facilities.

9. Radial (Construction) Tyre - Textile/Aramid Belt:

Due to poor roads and inadequate vehicle maintenance, Steel belts had corrosion problem due to cuts and chips in the tread. This led to trials with Aramid belt (Textile material with very high strength and Low extensibility).

10. Radial (Construction) Tyre - All Steel:

In developed countries, Radial Truck/Bus tyres use steel wires in casing as well as in Belts to achieve the optimum advantage of radial construction. In India also this construction was tried since late 1970s by Indian Companies using tyres of collaborators. This could not
succeed. Indian companies started experimentally since late 1980s (themselves or with collaborators) which continues and the product has found gradual entry into low load application.

11. Tubeless Tyre - Radial Construction:

As in the case of Bias Tyres, the concept of tubeless tyre was extended to radial construction and introduced in later half of the century in Developed countries. A tubeless tyre not only has tube eliminated but provides for smoother ride and vehicle handling. This is slowly entering into the Indian market with the advent of new generation vehicles.

12. Low Aspect Ratio - Radial (Construction) Tyres:

The concept of low aspect ratio tyre, after gaining the experience from cross ply construction, was introduced in Radial construction also. The present trend of tyre development for high speed tyre is being pursued in this direction. Tyres with aspect ratio up to 0.65 are being manufactured today enabling Indian Industry to adopt high speed rating e.g. 190 kmph, 210 kmph etc.
13. High Performance Passenger Car Radial Tyre:

High Performance Passenger Car radial tyres not only have very low aspect ratio (0.65 - 0.35) but also have substantial changes in construction. Very low aspect ratio enables use of large diameter wheels which, in turn, allows better stability at high speeds. The tyre contour is based on the cross section of a fully loaded tyre and this reduces the energy losses within the tyre and reduced dynamic fatigue. High performance Passenger tyres are made with speed rating upto ZR indicating speed capability in excess of 240 kmph. In India, this concept has not yet been found popular though customers are demanding tyres upto 220 kmph (V Rating).

14. Run Flat (Puncture Proof) Tyre - New Concept:

A new concept of run flat tyre (puncture proof) was introduced by Continental in early 1980s wherein the basic construction of the rim and bead was changed by which on loosing air the tyre tread sits on the rim thus enabling one to drive at a reasonable speed for a long distance till the flat tyre could be attended to. This revolutionises the OE need
for a new vehicle as the Stepney tyre can also be dispensed off. However, there is very slow progress of this concept. This has not been tried in India so far.

15. Fuel economy/low rolling resistance tyre - special compound:

Tremendous work is being carried out towards the development of tyres with modified special compounds, besides tyre construction aspect, to reduce rolling resistance thus gaining in fuel consumption. However, the ultimate advantage is obtained by Radial Construction which is gradually finding its well deserved place in Indian Industry.

16. Green Tyre (Environment Friendly):

This is the latest development in Passenger Radial tyres. These tyres have a rolling resistance appreciably lower than normal tyres. These tyres have high proportion of non petroleum based material used in their construction and are called environment friendly or 'green tyres'.
This concept is well perceived and will gradually find its application world over, including India.

Product Standard

BUREAU OF INDIAN STANDARDS (BIS) had decades back prescribed Standards for various categories of tyres. However, the Standards were voluntary in nature, i.e., it was optional for tyre companies to take BIS certification and emboss BIS mark on tyres.

Safety Standard

In line with the Safety Standards for tyres in some of the developed countries, Government of India decided to formulate Automotive Industry Standards (AIS) which would be mandatory in nature.

Government of India also decided to merge AIS with BIS. Currently, there is a unified standard for tyres of Commercial Vehicles (Bias and Radial), Passenger Cars/Jeeps (Bias and Radial) and Two-Three
wheeler tyres. At present AIS/BIS standards are not evolved/notified for other categories of tyres, viz. tractor/farm, industrial, OTR etc.

The merged Standard, expected to be published in the near future for mandatory application, would be applicable to all tyres produced domestically and imported. However, as exported tyres are subject to the standards of importing countries, the above Standard would not be mandatory on tyres exported from India.

b. Product and Process Innovation

Innovation is an important topic in the study of economics, business, design, technology, sociology, and engineering. Colloquially, the word "innovation" is often synonymous with the output of the process. However, economists tend to focus on the process itself, from the origination of an idea to its transformation into something useful, to its implementation; and on the system within which the process of innovation unfolds. Since innovation is also considered a major driver of the economy, especially when it leads to new product categories or increasing productivity, the factors that lead to innovation are also considered to be critical to policy makers. In particular, followers of
innovation economics stress using public policy to spur innovation and growth.

Those who are directly responsible for application of the innovation are often called pioneers in their field, whether they are individuals or organizations.

In the organizational context, innovation may be linked to performance and growth through improvements in efficiency, productivity, quality, competitive positioning, market share, etc. All organizations can innovate, including for example hospitals, universities, and local governments.

While innovation typically adds value, innovation may also have a negative or destructive effect as new developments clear away or change old organizational forms and practices. Organizations that do not innovate effectively may be destroyed by those that do. Hence innovation typically involves risk. A key challenge in innovation is maintaining a balance between process and product innovations where process innovations tend to involve a business model which may
develop shareholder satisfaction through improved efficiencies while product innovations develop customer support however at the risk of costly R&D that can erode shareholder return. In summary, innovation can be described as the result of some amount of time and effort into researching (R) an idea, plus some larger amount of time and effort into developing (D) this idea, plus some very large amount of time and effort into commercializing (C) this idea into a market place with customers. Fortunately, however, a consistent theme may be identified: innovation is typically understood as the successful introduction of something new and useful, for example introducing new methods, techniques, or practices or new or altered products and services.

Distinguishing From Invention and Other Concepts

In business, innovation can be easily distinguished from invention. Invention is the conversion of cash into ideas. Innovation is the conversion of ideas into cash. This is best described by comparing Thomas Edison with Nikola Tesla. Thomas Edison was an innovator because he made money from his ideas. Nikola Tesla was an inventor.
Tesla spent money to create his inventions but was unable to monetize them.

It is useful, when conceptualizing innovation, to consider whether other words suffice. Invention—the creation of new forms, compositions of matter, or processes—is often confused with innovation. An improvement on an existing form, composition or processes might be an invention, an innovation, both or neither if it is not substantial enough. It can be difficult to differentiate change from innovation. According to business literature, an idea, a change or an improvement is only an innovation when it is put to use and effectively causes a social or commercial reorganization.

Innovation occurs when someone uses an invention or an idea to change how the world works, how people organize themselves, or how they conduct their lives. In this view innovation occurs whether or not the act of innovating succeeds in generating value for its champions. Innovation is distinct from improvement in that it permeates society and can cause reorganization. It is distinct from problem solving and
may cause problems. Thus, in this view, innovation occurs whether it has positive or negative results.

So far there is no evidence where innovation has been measured scientifically. Scientists around the world are still working on methods to accurately measure innovation in terms of cost, effort or resource savings. Some of the innovations have become successful because of the way people look at things and need for change from the old ways of doing things.

Innovation in Organizations

A convenient definition of innovation from an organizational perspective is given by Luecke and Katz (2003), who wrote:

"Innovation . . . is generally understood as the successful introduction of a new thing or method . . . Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services.

Innovation typically involves creativity, but is not identical to it: innovation involves acting on the creative ideas to make some specific
and tangible difference in the domain in which the innovation occurs.

For example, Amabile et al. (1996) propose:

"All innovation begins with creative ideas . . . We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is necessary but not sufficient condition for the second."

For innovation to occur, something more than the generation of a creative idea or insight is required: the insight must be put into action to make a genuine difference, resulting for example in new or altered business processes within the organization, or changes in the products and services provided.

"Innovation, like many business functions, is a management process that requires specific tools, rules, and discipline."

From this point of view emphasis is moved from the introduction of specific novel and useful ideas to the general organizational processes and procedures for generating, considering, and acting on
such insights leading to significant organizational improvements in terms of improved or new business products, services, or internal processes.

**Economic Conceptions of Innovation**

Joseph Schumpeter defined economic innovation in *The Theory of Economic Development*, 1934, Harvard University Press, Boston. The introduction of a new good — that is one with which consumers are not yet familiar — or of a new quality of a good. The introduction of a new method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.

The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before. The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
Market outcome from innovation can be studied from different lenses. The industrial organizational approach of market characterization according to the degree of competitive pressure and the consequent modelling of firm behavior often using sophisticated game theoretic tools, while permitting mathematical modelling, has shifted the ground away from an intuitive understanding of markets. The earlier visual framework in economics, of market demand and supply along price and quantity dimensions, has given way to powerful mathematical models which though intellectually satisfying has led policy makers and managers groping for more intuitive and less theoretical analyses to which they can relate to at a practical level.

In the management (strategy) literature on the other hand, there is a vast array of relatively simple and intuitive models for both managers and consultants to choose from. Most of these models provide insights to the manager which help in crafting a strategic plan consistent with the desired aims. Indeed most strategy models are generally simple, wherein lie their virtue. In the process however, these
models often fail to offer insights into situations beyond that for which they are designed, often due to the adoption of frameworks seldom analytical, seldom rigorous. The situational analyses of these models often tend to be descriptive and seldom robust and rarely present behavioral relationship between variables under study.

From an academic point of view, there is often a divorce between industrial organisation theory and strategic management models. While many economists view management models as being too simplistic, strategic management consultants perceive academic economists as being too theoretical, and the analytical tools that they devise as too complex for managers to understand.

Innovation literature while rich in typologies and descriptions of innovation dynamics is mostly technology focused. Most research on innovation has been devoted to the process (technological) of innovation, or has otherwise taken a how to (innovate) approach.
Sources of Innovation

There are several sources of innovation. In the linear model of innovation the traditionally recognized source is manufacturer innovation. This is where an agent (person or business) innovates in order to sell the innovation. Another source of innovation, only now becoming widely recognized, is end-user innovation. This is where an agent (person or company) develops an innovation for their own (personal or in-house) use because existing products do not meet their needs. Eric von Hippel has identified end-user innovation as, by far, the most important and critical in his classic book on the subject, Sources of Innovation.

Innovation by businesses is achieved in many ways, with much attention now given to formal research and development for "breakthrough innovations." But innovations may be developed by less formal on-the-job modifications of practice, through exchange and combination of professional experience and by many other routes. The more radical and revolutionary innovations tend to emerge from R&D,
while more incremental innovations may emerge from practice – but there are many exceptions to each of these trends.

Regarding user innovation, a great deal of innovation is done by those actually implementing and using technologies and products as part of their normal activities. Sometimes user-innovators may become entrepreneurs, selling their product, they may choose to trade their innovation in exchange for other innovations, or they may be adopted by their suppliers. Nowadays, they may also choose to freely reveal their innovations, using methods like open source. In such networks of innovation the users or communities of users can further develop technologies and reinvent their social meaning.

Whether innovation is mainly supply-pushed (based on new technological possibilities) or demand-led (based on social needs and market requirements) has been a hotly debated topic. Similarly, what exactly drives innovation in organizations and economies remains an open question.
More recent theoretical work moves beyond this simple dualistic problem, and through empirical work shows that innovation does not just happen within the industrial supply-side, or as a result of the articulation of user demand, but through a complex set of processes that links many different players together – not only developers and users, but a wide variety of intermediary organisations such as consultancies, standards bodies etc. Work on social networks suggests that much of the most successful innovation occurs at the boundaries of organisations and industries where the problems and needs of users, and the potential of technologies can be linked together in a creative process that challenges both.

Value of Experimentation in Innovation

When an innovative idea requires a new business model, or radically redesigns the delivery of value to focus on the customer, a real world experimentation approach increases the chances of market success. New business models and customer experiences can't be tested through traditional market research methods. Pilot programs for new innovations set the path in stone too early thus increasing the
costs of failure. On the other hand, the good news is that recent years have seen considerable progress in identifying important key factors/principles or variables that affect the probability of success in innovation. Of course, building successful businesses is such a complicated process, involving subtle interdependencies among so many variables in dynamic systems, that it is unlikely to ever be made perfectly predictable. But the more business can master the variables and experiment, the more they will be able to create new companies, products, processes and services that achieve what they hope to achieve.

**Diffusion of Innovations**

Once innovation occurs, innovations may be spread from the innovator to other individuals and groups. This process has been proposed that the life cycle of innovations can be described using the 's-curve' or diffusion curve. The s-curve maps growth of revenue or productivity against time. In the early stage of a particular innovation, growth is relatively slow as the new product establishes itself. At some point customers begin to demand and the product growth increases
more rapidly. New incremental innovations or changes to the product allow growth to continue. Towards the end of its life cycle growth slows and may even begin to decline. In the later stages, no amount of new investment in that product will yield a normal rate of return.

The s-curve derives from an assumption that new products are likely to have "product Life". i.e. a start-up phase, a rapid increase in revenue and eventual decline. In fact the great majority of innovations never get off the bottom of the curve, and never produce normal returns.

Innovative companies will typically be working on new innovations that will eventually replace older ones. Successive s-curves will come along to replace older ones and continue to drive growth upwards. In the figure above the first curve shows a current technology. The second shows an emerging technology that current yields lower growth but will eventually overtake current technology and lead to even greater levels of growth. The length of life will depend on many factors.
Goals of Innovation

Programs of organizational innovation are typically tightly linked to organizational goals and objectives, to the business plan, and to market competitive positioning.

One survey[citation needed] across a large number of manufacturing and services organisations found, ranked in decreasing order of popularity, that systematic programs of organizational innovation are most frequently driven by:

- Improved quality
- Creation of new markets
- Extension of the product range
- Reduced labour costs
- Improved production processes
- Reduced materials
- Reduced environmental damage
- Replacement of products/services
- Reduced energy consumption
Conformance to regulations

These goals vary between improvements to products, processes and services and dispel a popular myth that innovation deals mainly with new product development. Most of the goals could apply to any organisation be it a manufacturing facility, marketing firm, hospital or local government.

Failure of Innovation

Research findings vary, ranging from fifty to ninety percent of innovation projects judged to have made little or no contribution to organizational goals. One survey regarding product innovation quotes that out of three thousand ideas for new products, only one becomes a success in the marketplace. Failure is an inevitable part of the innovation process, and most successful organisations factor in an appropriate level of risk. Perhaps it is because all organisations experience failure that many choose not to monitor the level of failure very closely. The impact of failure goes beyond the simple loss of investment. Failure can also lead to loss of morale among employees,
an increase in cynicism and even higher resistance to change in the future.

Innovations that fail are often potentially good ideas but have been rejected or postponed due to budgetary constraints, lack of skills or poor fit with current goals. Failures should be identified and screened out as early in the process as possible. Early screening avoids unsuitable ideas devouring scarce resources that are needed to progress more beneficial ones. Organizations can learn how to avoid failure when it is openly discussed and debated. The lessons learned from failure often reside longer in the organisational consciousness than lessons learned from success. While learning is important, high failure rates throughout the innovation process are wasteful and a threat to the organisation's future.

The causes of failure have been widely researched and can vary considerably. Some causes will be external to the organisation and outside its influence of control. Others will be internal and ultimately within the control of the organisation. Internal causes of failure can be divided into causes associated with the cultural infrastructure and
causes associated with the innovation process itself. Failure in the cultural infrastructure varies between organizations but the following are common across all organisations at some stage in their life cycle:

➢ Poor Leadership
➢ Poor Organization
➢ Poor Communication
➢ Poor Empowerment
➢ Poor Knowledge Management

Common causes of failure within the innovation process in most organisations can be distilled into five types:

➢ Poor goal definition
➢ Poor alignment of actions to goals
➢ Poor participation in teams
➢ Poor monitoring of results
➢ Poor communication and access to information

Effective goal definition requires that organisations state explicitly what their goals are in terms understandable to everyone
involved in the innovation process. This often involves stating goals in a number of ways. Effective alignment of actions to goals should link explicit actions such as ideas and projects to specific goals. It also implies effective management of action portfolios. Participation in teams refers to the behaviour of individuals in and of teams, and each individual should have an explicitly allocated responsibility regarding their role in goals and actions and the payment and rewards systems that link them to goal attainment. Finally, effective monitoring of results requires the monitoring of all goals, actions and teams involved in the innovation process.

Innovation can fail if seen as an organisational process whose success stems from a mechanistic approach i.e. 'pull lever obtain result'. While 'driving' change has an emphasis on control, enforcement and structure it is only a partial truth in achieving innovation. Organisational gatekeepers frame the organisational environment that "Enables" innovation; however innovation is "Enacted" – recognised, developed, applied and adopted – through individuals.
Individuals are the 'atom' of the organisation close to the minutiae of daily activities. Within individuals gritty appreciation of the small detail combines with a sense of desired organisational objectives to deliver (and innovate for) a product/service offer.

From this perspective innovation succeeds from strategic structures that engage the individual to the organisation's benefit. Innovation pivots on intrinsically motivated individuals, within a supportive culture, informed by a broad sense of the future.

Innovation, implies change, and can be counter to an organisation's orthodoxy. Space for fair hearing of innovative ideas is required to balance the potential autoimmune exclusion that quells an infant innovative culture.

Public Awareness

Public awareness of innovation is an important part of the innovation process. This is further discussed in the emerging fields of innovation journalism and innovation communication.
'Radialisation' in India - Current Status & Future Trends

"Rate of radialisation is actually an index of the status of road development, vehicle engineering and the economy in general". Notwithstanding the problem areas, constraints and limitations, the tyre companies have kept pace with the technological improvements that radialisation signifies and offer state-of-the-art product (tyres), comparable to the best in the world.

Radialisation can be aptly classified as the most important innovation in tyre technology. Despite its several advantages (additional mileage; fuel saving; improved driving) radialisation in India earlier did not catch on at a pace that was expected, since its introduction way back in 1978. This could be attributed due to several factors, viz. Indian roads generally not being suitable for ideal plying of radial tyres; (older) vehicles produced in India not having suitable geometry for fitment of radial tyres (and hence the general, and wrong, perception that radial tyres are not required
for Indian vehicle; unwillingness of consumer to pay higher price for radial tyres etc.

➢ However, the situation has radically changed in recent years, especially for the passenger car tyre segment where radialisation has crossed 98% mark and is expected to reach 100% in two to three years. In the Medium and Heavy Commercial vehicle segment current level of radialisation is upto 8%, and that in the LCV segment is estimated at 18%.

➢ A few years back a beginning was made in Radialisation of truck and bus and LCV tyres and this process is gaining momentum.

**Future of Radialisation**

The future of radialisation will be governed by the following factors:

➢ Cost - Benefit Ratio

➢ Road Development

➢ Overload Control

➢ User Education

➢ Retreading Infrastructure.
India has come a long way since liberalisation in 1991. After initial hiccups, various sectors of industry have successfully taken up the subsequent competitive challenges via the restructuring of operations, rationalisation of resources, improved product mix, efficient supply chain management and enhanced efficiencies. Today, a large number of Indian companies are looking at global markets with increased confidence.

Currently, amidst murmurs of an economic slowdown, a debate is on among economic and industrial circles about how to meet emerging challenges and ensure that India’s growth story does not lose any of its lustre. The Index of Industrial Production estimates released by the Central Statistical Organisation point to disturbing trends. Industrial growth slid to 5.3% in January 2008, against 11.6% in January 2007. While curbing inflation may be the government’s current focus, the industrial slowdown needs to be tackled on an urgent basis, too.

While Indian external trade reforms are well on course, internal reforms have somehow lagged behind. While import duties have been brought down, much needs to be done to enhance the competitiveness
of industry. Changes in the policy framework could achieve greater competitiveness, I believe, and this is the time to carry these out. Here, is present automotive tyres as a case study, and discuss how the tyre industry has emerged globally competitive—but with its global ambitions thwarted by the policy regime.

However, all is not well with the tyre industry. Of late, threats to the industry’s competitive edge has arisen from the rising cost of power, rising interest rates and constraints on the supply of raw material. The industry is raw material-intensive, using natural rubber, nylon tyre cord fabric, carbon black, synthetic rubbers and rubber chemicals. Natural rubber, which alone accounts for 42% of raw material costs, is seeing consumption outpace production in the country, as the latter slackens.

Market conditions are tight for this commodity. Domestic natural rubber prices have spiralled from an average of Rs 70 per kg in 2005-06 to Rs 105 per kg now. With the tyre industry’s annual consumption being 4.6 lakh tonnes, every Re 1 extra means a burden of Rs 46 crore. But even availability is a problem now. Yet, customs duty on the import
of this raw material, at 20%, is double that on the finished product (10%). This distorts the tyre industry’s cost structure and is out of whack with accepted principles of tariffs, which should be lowest in basic raw materials, higher on intermediates and highest on finished goods.

To make matters worse, natural rubber exports are being encouraged. A pertinent question that needs to be debated is whether we should be exporting our natural produce in the form of raw material or value added finished goods. The export of value-added rubber products currently stands at Rs 5,500 crore per annum, and is growing. Under these circumstances, is it prudent to allow the export of natural rubber (in its primary form) at all?

On the other hand, the import of finished products such as vehicle tyres—given the low import duties on these—is on the increase. According to DGCI&S, government of India, while the import of truck and bus tyres was up by 73%, that of passenger car tyres was up by 116% in 2006-07. Industry estimates point to further increases in the import of truck and bus as well as passenger car tyres in 2007-08.
Time is ticking away on the industrial clock. There is urgent need for a broad based facilitative policy regime aimed at increasing the competitiveness of various sectors of Indian industry and providing them an equitable market environment vis-à-vis their international counterparts. Emergence as global players requires constant investments in process and product innovation. A conducive policy environment, aimed at rectifying policy inconsistencies, could go a long way in reversing the industrial slowdown currently being experienced in several sectors. It would keep hope afloat, and signal to Indian industry that the efforts are not at cross-purposes, but aimed jointly at a strong comeback.

Product and Process Innovation in Apollo Tyres

Production of automobile tyres stood at 7 mn units in FY06. A figure 18% higher than FY05. Production of automobile tubes at 6.2 mn units, 14% higher than in FY05. In terms of segment-wise growth, truck and bus tyres posted 11%, light trucks posted 8%, passenger car radials posted 34% and farm vehicles notched up 13%. Tyres accounted for 90% of ATL’s turnover in FY06, while tubes and flaps and alloy wheels
accounted for the rest. The company aims to increase the production to 10,000 passenger car radial tyres from about 6,500 tyres per day at present. This massive operation is supported by 7,300 people that ATL employs across locations.

**Product and Process Innovation in JK Tyres**

In a move that would heighten competition for French tyre major Michelin and Bridgestone in the Indian market, Delhi-based JK Tyres will soon sell radial tyres manufactured by Mexico’s Tornel — the company it acquired last year — in the Indian market. The tyres would be competitively priced at Rs 15,000-Rs 25,000 and come with the specification that JK Tyres doesn’t have in India. “To test the market with Tornel radial tyres, we would introduce those tyres in the Indian market. After gauging the customer response, we would go on full steam with Tornell tyres in India,” JK Tyres and Industries marketing director A S Mehta said.

The tyres will start selling in the market from January 2010.
In an effort to expand operations overseas, JK Tyre and Industries had acquired Tornel for Rs 270 crore. Around 70% of the company’s tyres are used to cater to customers in Mexico and Brazil. At present, the company is not interested in any American firm as it has already made inroads into that market.

With India and South America under its domain, JK Tyres has now set sights on the South East Asian market to cater to customers at that end. The company is planning to set up a plant in Thailand through acquisition or green field project route. “Right now, it’s just in the planning process. The plan will take some time to mature into reality,” Mehta said.

JK Tyres will also increase tyre prices by 3-5% in December to battle high input costs. “Rubber prices are troubling everybody. We have not yet increased, but we will have to. It will be anywhere in the range of 3-5%. We will be able to finalise later this month,” Mehta said. Rubber prices, which make up nearly 60% of the cost of tyres, have been rising steadily in the past. They have shot up nearly 24% in October-December putting pressure on the margins of tyre makers.
Toriel's three plants in Azcapotzalco, Tultitlan and Hidalgo together have a production capacity of 290 tonne per day while JK Tyre at its four plants in India have a combined capacity of 650 tonne per day.

JK Tyres will raise its car radial capacity by 11% at a plant in Gwalior to five million tyres, Mehta said.

**Using Innovation to Defend Margins**

‘Big leaps’ in technology must come from advances in either the tyre architecture or from changes in the tyre’s physical and chemical properties. Michelin’s 63 inch tyre, the biggest tyre in the world made for Caterpillar trucks.

The automobile sector has been among the hardest hit industry segments during the ongoing global economic downturn. Suppliers of components to vehicle manufacturers have taken a hit because of the slowdown. Faced with a slump in demand, companies are finding it difficult to protect margins.

Michelin, the second biggest tyre manufacturer, with a track record of innovation extending over a century, has also suffered a
setback. In France, Michelin's home base, output in the automobile sector fell by 3.1 per cent in September when compared to a year ago. French carmakers, among them Renault and Puegeot, have shut plants and sent workers home, implying that the slump will not only be deep but will also last long.

Impact of recession

How does Michelin plan to cope with the slowdown? Senior company officials told journalists recently that it intended to dig deep into its legacy as an innovator to protect margins in turbulent times. The company's global centre for innovation is located at Ladoux, near Clermont Ferrand, where Michelin is headquartered. Clermont Ferrand is about 425 km south of Paris. The tyre may be a marginal component in an automobile but is a critical factor in fuel efficiency in a vehicle. Michelin's Managing Partner Didier Miraton points out that about one-fifth of the fuel consumed by a car is linked to the tyre. In trucks and tractors, it is about 30 per cent.
As consumers become more energy conscious, as they have in the wake of the recent spiral in oil prices, tyre companies are under pressure to not only cut costs but also make them energy-efficient.

He observes that Michelin is a “technology company” because technology plays an important role in ensuring that the tyres it makes are constantly improving in terms of fuel-efficiency and safety. Mr. Miraton explains: “The manner in which the tyre grips the surface determines how the vehicle brakes and accelerates.” The other challenge for tyre makers is the constant search for better, particularly lighter, raw materials so that they are lighter but tougher. These properties ensure that the tyre is more fuel-efficient while also conserving scarce raw materials. “About 60 per cent of the noise caused by a vehicle is from the contact of the tyre on the road,” says Mr. Miraton. He points out that when electric vehicles, which have less noisy engines, are on the roads in greater numbers, the noise generated by the tyre will constitute a much bigger proportion of noise generated by vehicles.
Objectives

There are at present about 900 million vehicles worldwide, up from 50 million vehicles 20 years ago. It is expected that the global vehicle population will touch 1.5 billion. Michelin’s objective is to halve fuel costs when the vehicle doubles in a few years from now. “Our key objectives are to halve consumption of raw materials that go into tyres, halve noise generated by tyres and to halve braking distance to increase safety by that time,” says Mr. Miraton.

The key to achieving these ambitious objectives is to reduce the mass of a tyre, which will improve fuel consumption. Mr. Miraton says this can only be achieved by forging “partnerships with suppliers, government and public authorities, universities and research institutes.”

World’s biggest tyre

Michelin’s 63 inch tyre, the biggest tyre in the world, is an example of basing innovation on partnerships. The company developed this earthmoving tyre, made specifically for Caterpillar’s 797B, the
gigantic trucks that work in some of the biggest open-pit mines, in close association with the truck manufacturer.

Michelin and Caterpillar worked in a “parallel format”, which meant that Michelin’s manufacturing facility in Spain was being built even as the product was being developed at the company’s facility near Ladoux near Clermont Ferrand. The R&D facility, which is the Michelin’s global innovation centre, employs over 4,000 people working full-time on every conceivable aspect of tyre technology.

Mr. Miraton observes that the “big leaps” in technology must come from advances in either the tyre architecture or from changes in the tyre’s physical and chemical properties. He says the company is now operating in “an extremely volatile environment.” But he is hopeful that the company will be able to weather the storm because more than 60 per cent of the company’s business is from the replacement market for tyres. “The crisis is going to impact everyone, but we are hopeful that we will ride the storm,” he says.
Michelin is in “an advanced stage of negotiation on setting up a tyre plant in India.” “The short-term situation does not change our picture of India,” he says.

Apollo is a name synonymous with pioneering innovation in the Indian Tyre Industry. Being the first tyre company to reach revenue of US $ 1 billion and enjoying significant global presence, Apollo leverages its core R & D expertise to drive innovation, adapting to the unique needs of a diverse and ever changing market.

They wanted to position themselves as a company whose core value offering was not tyres or technology, but ideas. The emphasis was on communicating the youthful, dynamic and aggressive brand characters of Apollo and synergizing it with the innovation and product range.

INSTA envisioned a futuristic look within minimalist conventions which would just juxtapose technology with innovation. The play on levels achieved individualized focus on products and branding. The luminescent and transparent treatment ensured an inviting stand which
also scored on style. The design achieved its objective by successfully communicating Apollo's edge in innovation and cultivating a keen interest in its offerings in the global arena. The resounding success of this project was reaffirmed with the prestigious Gold award at the Tyre Expo, Singapore.

Conclusion

R&D has a special economic significance apart from its conventional association with scientific and technological development. R&D investment generally reflects a government's or organization's willingness to forgo current operations or profit to improve future performance or returns, and its abilities to conduct research and development.

The emphasis given by Indian tyre companies to applied research and the setting up of well-equipped in-house R&D centers by the companies, which are manned by experts and experienced professionals, have also helped in technology upgradation. Indian tyre technology has exhibited versatility in maintaining inflow of technology
through foreign collaborations and tailoring the same to Indian needs. R&D is essentially business or market driven. However, raw material suppliers could also help in conceiving new projects. Compound development and in-process problems have been the main thrust of in-house R&D in the Indian tyre industry.

A glance at Indian roads will confirm the revolution that automobiles in India have undergone over the past 15 years. The Indian tyre industry, with as many as 43 tyre companies and 58 manufacturing plants, has kept pace with the scenario. India is among the few countries to have attained near self-sufficiency in domestic tyre manufacturing capability. All categories are made locally, from 1.5-kg moped tyres to 1.5-tonne earthmover tyres, and from rugged steel radial truck tyres to high-performance car radial and tubeless tyres. Indian tyre-makers have invested in R&D and product innovation, and have done well as OEM suppliers to the world's top auto firms. Indian tyre exports are expanding, too, and even to quality-conscious markets such as the US and EU.