CHAPTER III

AUTOMOBILE CLUSTERS IN INDIA

Clustering describes the propensity of manufactures within a specific industry to locate operations in the same geographic area. A symbiotic relationship exists between the automobile manufactures, parts suppliers, related services and support industries. In this chapter, we first introduce the three automobile clusters in India which we have taken for our case studies and then present the theoretical approaches which have been adopted for the analysis of cluster formation. We also discuss the fundamentals of clustering, its historical and organizational structure, pre-conditions for cluster development, criteria for identifying automobile clusters, centripetal and centrifugal forces in cluster development, benefits of cluster development, efficiency cycles and the advantages and disadvantages in the evolution of clusters.

3.1 The Automobile Clusters in India

In India, the automobile industry occupies a prominent place due to its deep forward and backward linkages with several key segments of the economy. The automobile industry has a strong multiplier effect and is capable of being the driver of economic growth. A sound transportation system, to which the automobile industry is linked, plays a pivotal role in the country's rapid economic and industrial development. Initially in India, the development of automobile industry was sporadic and localised. However, gradually the industry took a very organized form due to its importance as well as due to technology induction. Presently, there are three automobile clusters in India (see in Map 3.1). These are old historical and administrative cities, created by the British as bases of trade, which later became very important centre's of regional administration due to multifarious reasons.

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**Map 3.1: Automobile Clusters in India**

Major Automobile clusters - Delhi-Gurgaon-Faridabad-Ghaziabad-Gautama Buddha Nagar in (North), Mumbai-Pune-Nasik-Aurangabad-Thane in (West) and Chennai - Bangalore-Dharampuri-Vellore-Kanchipuram-Thiruvallore in (South).
Following Districts and state codes have been used in present analysis:

**Table 3.1: Clustering of Automobile Industry**

<table>
<thead>
<tr>
<th>Districts</th>
<th>District Code (Year-wise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faridabad</td>
<td>19</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>18</td>
</tr>
<tr>
<td>Ghaziabad</td>
<td>09</td>
</tr>
<tr>
<td>G.B. Nagar</td>
<td>10</td>
</tr>
<tr>
<td>Delhi</td>
<td>All</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Districts</th>
<th>District Code (Year-wise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mumbai</td>
<td>22</td>
</tr>
<tr>
<td>Pune</td>
<td>25</td>
</tr>
<tr>
<td>Aurangabad</td>
<td>19</td>
</tr>
<tr>
<td>Nasik</td>
<td>20</td>
</tr>
<tr>
<td>Thane</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Districts</th>
<th>District Code (Year-wise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangalore(urban)</td>
<td>20</td>
</tr>
<tr>
<td>Bangalore(rural)</td>
<td>21</td>
</tr>
<tr>
<td>Chennai</td>
<td>02</td>
</tr>
<tr>
<td>Thrissur</td>
<td>01</td>
</tr>
<tr>
<td>Kancheepuram</td>
<td>03</td>
</tr>
<tr>
<td>Vellore</td>
<td>04</td>
</tr>
<tr>
<td>Dharampuri</td>
<td>05</td>
</tr>
</tbody>
</table>

Source: ASI and NSSO state, district codes of respective years and rounds.

Note-$\$ Represents that there were no district available in that particular year and being created later on.
In the Indian context, the automobile industry has been developed in a cluster form. There are three major clusters in the automobile industry in India. The major automobile clusters are:

1. Delhi-Gurgaon-Faridabad-Ghaziabad-Gautama Buddha Nagar in North India.
2. Mumbai-Pune-Nasik-Aurangabad-Thane in West India.

Although, the automobile industry is partly agglomerated in Jamshedpur and Kolkata in Eastern part of India but this region cannot be considered as a cluster, because there are many defining criteria’s and the region does not fulfill some of them. The main cause of exclusion is no geographical contiguity. Of course, there are several manufacturing units in many other parts of India but these three clusters are expected to become the main hubs for manufacturing in the automobile industry².

Given below is a brief profile of these three clusters wherein major automobile manufacturers are present and where more automobile companies are expected to setup manufacturing facilities.

3.2 The National Capital Region (NCR) Cluster

This cluster is located in the northern part of India in three states namely; Delhi, Haryana and Uttar-Pradesh. The automobile industry is probably the biggest industry in the state of Haryana, which ranks first in India in the production of passenger cars, motorcycles and tractors. Therefore, this cluster largely follows the traditional pattern of auto clusters led by assemblers that served as lead firms.

Haryana accounts for 50 percent of total small passenger cars and two-wheelers production in India. Market leader Maruti Suzuki is based in Gurgaon and Manesar in Haryana. The largest two-wheeler manufacturer in India, Hero Honda along with the other large two wheeler manufacturers, Yamaha and Escorts are also present in the state³.

²Ministry of Heavy Industries and Public Enterprises (2006b).
³Reference has been made to Haryana Online (12th June, 2006).
Maruti Udyog Ltd. started in the year 1982 as a joint venture firm between the Indian government and a Japanese automaker, Suzuki Motor Corporation. Maruti Udyog Ltd. set up its first plant in Gurgaon, then a newly developing industrial town in Haryana adjacent to Delhi, as a "greenfield" plant. It was the first modern assembly plant in India, as it was a close copy of Suzuki's Kosai plant in Japan, in terms of plant layout, equipment, the organization of production and the operating principle.

MUL set up its second plant in Gurgaon in 1992 and a third plant in NOIDA a part of the NCR, in 1999. The firm started production in the year 1983. It has since emerged as the largest car manufacturer in India. It initially focused on the small car segment, which had been virtually untapped in the Indian market until Maruti Udyog Ltd's entry. Maruti Udyog Ltd. cars were 21 percent cheaper than the lowest-priced existing passenger car produced by domestic manufacturers, yet offered much higher
quality, more safety features and greater fuel efficiency\(^4\). In response to the increased variety in consumer tastes, in the early 1990s, the firm also diversified its product range, introducing new middle-sized passenger cars. Maruti Udyog Ltd. served as the lead firm to form and develop the NCR cluster.

### 3.3 Mumbai-Pune Cluster

This cluster is located in the state of Maharashtra in the cities of Nasik, Pune, Aurangabad, Thane and Mumbai. The state is attracting both domestic and foreign manufacturers\(^5\). This cluster employs more than 40 percent of the total workforce employed in the automobile industry in India. In fact, the state of Maharashtra was once called the Detroit of India.


\(^5\)Reference has been made to Business Knowledge Resource Online (22nd June, 2008).
Automobile clustering in Mumbai-Pune region started early in India due to its proximity to the coast for the import of heavy machinery via Mumbai port, availability of power supply, skilled labour pool, very good infrastructure etc. Opening up of the economy in 1991 has given many new reasons for its expansion and promotion like induction of new technology, liberalization in investment policy, concentration of Information Technology Enabled Services (ITES), large number of engineering colleges and a very wide market (in Mumbai).

3.4 Bangalore and Chennai Cluster

Bangalore-Chennai is a leading automobile cluster in India, which accounts for 21 percent of passenger cars, 33 percent of commercial vehicles and 35 percent of the auto components produced in India.
Presently, over 100 medium and large auto companies are located in and around the Bangalore-Chennai cluster. In the auto component industry, Tamil Nadu has more than 50 percent share in the production of inlets and exhaust valves, valve guides, valve tappets, fuel pumps, oil pump assembly, thermostat, timings chair, water pump assembly, starter motors, alternators, camshafts, oil seals, brake linings, wiper motors, air brake assembly and engines. It enjoys 30 to 50 percent share in the voltage regulations, flywheel magnetos steering gears, wheel rims, electric horns, and dashboard instruments. Further, it has 10 to 30 percent share in delivery valves, crankshafts, bi-metal bearings, radiators, clutch, plates, clutch assembly, shock absorbers, tyres and automobile seats.

According to the Confederation of Indian Industry (CII), the automobile industry is one of the key industries in Karnataka. The automobile manufacturers in the state are present mainly around Bangalore, the capital city of the state and Hosur. Big automobile manufacturing companies like Toyota, Volvo and Tata Motors have established themselves in the state.

3.5 Theoretical Approaches of Cluster formation

The story of modern economic growth is a story of industrialization. Economic growth is a feature of cities and regions, which have industrialized, just as the absence of economic growth is a feature of cities and regions which have not industrialized. Notwithstanding isolated cases of cities that are entirely based on a local resource such as a natural attraction or a specialized agricultural product, in general the modern city is presently an industrial or semi-industrial city. The post-industrial growth, which is the characteristic of the more developed nations of today, is based on the foundations created by industrial growth.

The differential growth patterns between more and the less industrialized regions have created widely differentiated sub-national spaces leading to significant spatial inequalities at different scales. However, success at industrialization or the failure to industrialize is not rooted entirely in the local region. Success, failure and intermediate
outcomes are the result of some factors of economic geography such as proximity to resources and markets, transportation cost, localization and urbanization economies and some factors of political economy such as historical path dependency, policy decisions on infrastructure, exchange rates, land use, globalization, etc. Hence, the fact that the extent and type of industrialization varies over space is best understood and explained in terms of economic geography and political economy.8

The forces of pure economic geography are market forces, but they are mediated by political economy, or the state. Therefore, industrialization processes have to be understood in terms of the interaction of markets and states. In the post-globalised era, agglomerations of industrial units are engines of economic growth, ensuring better intra and inter industrial performance. In fact, cumulative causation works in two ways; upward and downward, creating spirals of growth in some regions and decline or stagnation in others. These are processes that operate over a very long run, partly because they set into motion actions by individuals, groups, and sub-national states, which often tend to perpetuate the divergent growth paths.9

3.6 Pre-conditions for Cluster Development

Clusters can be defined as a geographically concentrated and interdependent network of firms linked through buyer-supplier chains or shared factors. The success of an industry cluster hinges on how well such local linkages among firms, education and research institutions, and business associations can be developed. The ‘cluster’ concept particularly emphasizes inter-firm relations that reduce the cost of production by lowering transaction costs among firms.10 Interrelated firms located in proximity can reduce their transportation cost for intermediate goods and can share valuable information on their products more easily. Therefore, for profit maximizing firms, the presence of a well-developed network of suppliers in a region is an important factor for

their location decision. Lastly, economic diversity of a region is another important source of spatial or location-based externalities. Firms located in larger metro areas are more likely to benefit not only from inter-industry technology spillovers but also from easier access to producer services such as legal services or banking. Moreover, the co-location of firms in the automobile industry generates externalities that enhance productivity of all firms in automobile industry (see Fig. 3.1). These benefits include sharing of sector specific inputs, skilled labour and knowledge, intra-industry linkages and opportunities for efficient subcontracting. Firms that share specialized inputs and production technologies are more likely to cooperate in a variety of ways. In automobile industry, it is common for competitors in the market to launch joint projects for new products and process development. Further, a disproportionately high concentration of firms within the same industry increases possibilities for collective action; for example, to lobby regulators or influence bid-prices of intermediate products.

Fig. 3.1: Pre-conditions for Cluster Development
3.7 Historical and Organizational Structure

Research on location and concentration of economic activity has long been of interest to economists, geographers, planners, and regional scientists (Hotelling\(^{11}\); Weber\(^{12}\); Isard\(^{13}\), Losch\(^{14}\); Von Thunen\(^{15}\); Greenhut and Greenhut\(^{16}\)). However, analytic difficulties in modeling increasing returns to scale marginalized the analysis of geographic aspects in mainstream economic analysis (Krugman\(^{17}\)).

Industrial clustering is a process that has been observed from the beginning of industrialization. From the cotton mills of Lancashire and automobile manufacturing in Detroit, to the textile mills of Ahmadabad and Mumbai to the tanneries of Kolkata and Arcot, even the casual observer can visually identify industrial clusters. It seems obvious that competing firms in the same industry derive some benefit from locating in proximity to each other. The benefits that are external to the firm and accrue to similar firms in proximity are called the economies of localization. To put it in another way, at the firm level, it is expected that the size and number of firms (that is the competitive structure) will influence internal returns to scale. In particular, as demand for a firm's goods and services increases (say, due to improved access to consumer markets), the entrepreneur has an incentive to increase the scale of production by restructuring the production process using specialized workers and investing in cost-reducing technologies.

Recent research on externalities, increasing returns to scale and imperfect spatial competition (Dixit and Stiglitz\(^{18}\); Krugman\(^{19}\); Fujita, Masahisa, Paul Krugman, and A. J.

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Venables\(^{20}\) have led to a renewed interest in analyzing the spatial organization of economic activity. This is especially true in the case of geographic concentration or clustering. The above arguments persuades one to sincerely think about the location where an industry will concentrate and which kind of industry will concentrate and where. This chapter endeavors to analyse the above-mentioned propositions in terms of the automobile industry. For most of the part the above discussed insightful theoretical models provide renewed analytical support for the ‘cumulative causation’ arguments made in earlier decades on the core-periphery relationship, on agglomeration economies, and on industrial clustering.

![Fig. 3.2: Components of Automobile Cluster](image)


3.8 Centripetal and Centrifugal Forces of Cluster Development

The main findings from the literature survey done for the study can be organized in two categories;

1. Market access and transport costs;
2. Agglomeration economies.

3.8.1 Market Access and Transport Costs

Under, market access and transport costs, the production is assumed to take place under conditions of constant or diminishing returns to scale. Under these conditions, firm location decisions are taken because transportation has costs associated with it. One implication is that industry is likely to spread out to minimize the costs of reaching consumers in different parts of the country. The folk theorem of spatial economies (Fujita
and Thisse)\textsuperscript{21} says that under conditions of constant or diminishing returns to scale there will be many small plants supplying local markets. However, in the presence of increasing returns to scale, firms are able to concentrate production in relatively few locations, and make choices because of location of operation (Henderson, Shalizi, and Venables)\textsuperscript{22}.

3.8.2 Agglomeration Economies

In addition to market access, firms tend to concentrate production to benefit from localization economies, which are externalities that enhance productivity of all firms in that industry. At the industry level, scale economies accrue to firms due to the size of the industry in a particular location. These economies are external to the firm but internal to the industry. There is considerable theorizing on localization economies in the works of Alfred Marshall\textsuperscript{23}, Kenneth Arrow\textsuperscript{24}, and Paul Romer\textsuperscript{25}; these are often called MAR externalities (from the initials of the primary contributors). They argue that the cost-saving externalities are maximized when a local industry is specialized, and their models predict that externalities predominantly occur within the same industry. Therefore, if an industry is subject to MAR externalities, firms are likely to locate in a few cities where producers of that industry are already concentrated. Later, Porter\textsuperscript{26} emphasized the importance of dynamic externalities created in specialized and geographically concentrated industries.

3.9 Benefits of Cluster Development

Benefits from localization include sharing of sector-specific skilled labour, sharing of tacit and codified knowledge, intra-industry linkages, and opportunities for

\textsuperscript{23}A. Marshall, Principle of Economics, London: Macmillian, 1890.
efficient subcontracting. Further, the presence of disproportionately high concentration of firms within the same industry increases the possibilities for collective action to lobby regulators or bid down prices of intermediate products (Lall, Shalizi, and Deichmann)\(^{27}\). These location-based externalities imply that firms are likely to benefit from locating near large concentration of other firms in their own industry. There is an extensive empirical literature supporting the positive effects of localization economies on economic performance (Henderson\(^{28}\); Ciccone and Hall\(^{29}\)). The benefits of own-industry concentration can, however, be offset by costs such as increased competition between firms for labour and land causing wages and rents to rise, as well as increased transport costs due to congestion effects. Firms in industry sectors, which predominantly use standardized technologies and low skilled workers for production, may not benefit enough from intra-industry externalities to offset costs from increased own-industry concentration.

Demands for manufacturing come not just from final consumers but also from intermediate demand or inter-industry linkages. Therefore, a location with a high share of firms will have a high demand for intermediates, which further increases its attractiveness for manufacturing firms. In addition to these demand effects, there are cost benefits as a large number of intermediate suppliers are attracted into the location, firms using intermediate goods can save on transport costs, making the location still more attractive. Marshall in 1890 and 1919 first recognized the importance of inter-industry linkages as a major agglomerative force\(^{30}\). Venables\(^{31}\) demonstrated that agglomeration could occur through the combination of firm-location decisions and buyer-supplier linkages even without high factor mobility. The presence of local suppliers can reduce transaction costs and therefore increase productivity. Inter-industry linkages can also serve as channels for

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vital information transfers like firms that are linked through stable buyer-supplier chains. Such ongoing interactions make the dynamics of inter-industry externalities so vibrant. Therefore, if the performance of an industry is highly dependent upon the supply of high quality intermediate goods (for example in automobile manufacturing), firms are likely to locate in regions with a strong presence of local suppliers. The presence of local supplier linkages makes buyer industries more efficient and reinforces the localization process.

**Fig. 3.4: Cluster and Efficiency cycle**

![Cluster and Efficiency cycle diagram](image)

Source: Based on the Literature Survey and different Government Reports.

However, there are contradictions between the economies of scale and agglomeration on the one hand, and size related congestion diseconomies on the other in metropolitan regions (Petrakos\(^\text{32}\); Wheaton and Shishido\(^\text{33}\)). On the other hand, according

to Krugman's\textsuperscript{34} there is tension between centripetal forces (higher labour productivity, larger plant size, access to markets and products, that is, backward and forward linkages, thick labour markets, and knowledge spillovers) and centrifugal forces (higher land rents, commuting costs, congestion and pollution, all leading to higher wages and taxes). For indeterminately long periods after industrial development begins, large cities offer increasing returns to capital investment. Eventually, because of lower transportation costs, the costs of size related congestion rise above the benefits of concentration based externalities, so that higher returns become possible in smaller urban centres.

3.10 Advantages and Disadvantages of Cluster Development

Clusters have significant advantages deriving from capital availability and capital productivity, labour availability, labour skills and labour productivity, physical and social infrastructure, political support, and spatial phenomena such as access to consumer markets and coastal regions (most of the time). Even the 'New Economic Geography', literature\textsuperscript{35} allow us moving from the question ‘Where will manufacturing concentrate (if it does)?’ to the question ‘What manufacturing will concentrate where?’ This research work wishes to go beyond these questions, to ask, ‘What manufacturing will locate where and why?’ In addition, to understand the process of industrial location and concentration, it is important to first analyse the location decisions of firms in particular industries. The location decision of the individual firm may be influenced by the several factors and in terms of automobile industries, these are as follows:

1. Availability of infrastructure, access to market, and the external economies provided by localization and urbanization;

2. Local wages, taxes, subsidies, and incentives and the general policy environment, that is the 'political economy';


Table 3.2: Manufacturing Companies in India

(Major manufacturing companies have been plotted in the three main clusters)

<table>
<thead>
<tr>
<th>NCR Cluster</th>
<th>Mumbai-Pune Cluster</th>
<th>Bangalore-Chennai Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maruti Suzuki</td>
<td>General Motors</td>
<td>Hyundai</td>
</tr>
<tr>
<td>Honda Motors</td>
<td>Skoda</td>
<td>Ford</td>
</tr>
<tr>
<td>Eicher Motors</td>
<td>Tata Motors</td>
<td>Hindustan Motors</td>
</tr>
<tr>
<td>Yamaha</td>
<td>Mahindra &amp; Mahindra</td>
<td>Ashoka Leyland</td>
</tr>
<tr>
<td></td>
<td>Bajaj Auto</td>
<td>BMW</td>
</tr>
<tr>
<td></td>
<td>Volkswagen</td>
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<tr>
<td></td>
<td>Mercedes-Benz</td>
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</tr>
<tr>
<td></td>
<td>Eicher Motors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Force Motors</td>
<td></td>
</tr>
</tbody>
</table>

Source: Compiled from literature and government reports.

3.11 Identified Intra and Inter cluster Problems

3.11.1 Production-Related Constraints

Clusters have reported numerous bottlenecks in terms of roads, railway connectivity, port congestion, power quality and availability, input costs, supplier base, lack of skills, attrition, etc. Nevertheless, some of these constraints are found to be cluster specific, in terms of the nature and extent of bottlenecks faced by auto firms.

3.11.2 Transport Infrastructure

The dominant problems specific to Bangalore and Hosur are poor and insufficient roads, poor connectivity to railway station and distance from ports. While some of the auto component manufacturers are closer to their customers in Bangalore-Hosur region and Chennai hub, most of them are far away from their customers and that seems to cause a major price threat from their competitors located near their customers. In Mumbai and Chennai regions, ports are closer, but there is immense port congestion. Further, during rains, the road infrastructure gets affected. Non-availability of deep-sea vessels in Chennai leads to a lead-time of 3-4 days in excess, which is very costly for the firms.

3.11.3 Power

Despite their advantages in terms of better roads and better supplier base, Mumbai-Pune, cluster is facing problems in power quality, because of power
fluctuations. It not only delays the production but also damage the quality of products during production.

**Fig. 3.5: Identified Problems of Automobile Clusters**

Source: Based on Literature Survey and different Government Reports.

### 3.11.4 Labour

High cost of labour at all levels is a serious cluster-specific problem in Bangalore, owing to the fact that this is an IT hub, characterised by high wages. High level of attrition between industries is another particular concern in this region, though it is
common to all regions. Unprofessional labour attitude and lack of skilled work force are the major problems in north India.

3.11.5 Materials

Cost of iron and steel is purely depending upon global demand and domestic consumption. Thus, steel availability and cost is usually unclear which affects yearly automobile production. While the auto industry grows at 15-30 percent per annum, the steel availability grows only at 5 percent. The gap between automobile production growth rate and steel production growth rate (20 percent) is ever increasing the cost of production. Similar problems are associated with high-quality plastic materials, rubber tyres, etc. It explains how the steel cost increased to maintain the same rate of production.

3.11.6 Taxation and Incentives

Octroi taxation was the major cluster-specific issue raised by most firms in Mumbai-Pune cluster. Many firms from Bangalore-Chennai cluster have established or are planning to establish plants in Uttarakhand and Uttar Pradesh, because of huge tax incentives. However, they do acknowledge the severe disadvantages of these states in comparison with Tamil Nadu and Maharashtra in terms of skilled workforce and infrastructure. Thus, these region-specific tax incentives could result in distorted investment decisions that may result in long-term losses for these firms.

3.11.7 Environmental Pollution

Some firms in south India face environment-related problems. First, they report unwarranted interference in their operations by some officials in the State Pollution Control Boards, despite the fact that they comply with all environmental regulations. Secondly, the sludge that is produced out of waste treatment is not disposable readily.

3.11.8 Other Constraints

In the National Capital Region of Delhi, other major concerns are non-availability of land, poor law and order situation and competition from foreign auto-component firms.
due to duty reduction. Auto-component exporters have to offer around 2-5 percent price reduction to their buyers every year. Hence, they are forced to squeeze their margins.\footnote{G. Badari Narayanan and Pankaj Vashisht, "Determinants of Competitiveness of the Indian auto Industry", Indian Council for Research on International Economic Relations. Working Paper No. 201, 2008.}

Infrastructure improvement is required in the following areas: better quality of roads all over India, long-term road-planning, focus on rural areas to avoid further urban congestion, railway corridors for better connectivity to railway stations, deep sea vessel handling capacity in major ports and other measures to minimise port congestion, better power quality and availability. Credit availability should be ensured at reasonable interest rates, mainly for the smaller firms. The incentives and benefits that are meant for the R&D expenditure in the auto industry should be extended for a longer period.

Reducing the testing charges in the Automobile Research Association of India (ARAI) and the National Automobile Testing and Research Infrastructure Project (NATRIP) will benefit smaller players. Encouragement of FDI in the auto sector and promotion of activities by Indian industry to collaborate and interact with global players are required to help Indian industry gear up to global standards. Improving market development assistance is required, mainly for the export oriented small and medium enterprises (SMEs). Instead of focusing on specific areas as export zones, all exporting firms should be treated alike and the incentives should be similar across the board. Assistance in sludge disposal is required for the plants that treat their effluents and environmental clearance procedures need to be faster. Harmonisation of emission norms across states is required and a roadmap for implementing this needs to be put in place.

\subsection*{3.12 Conclusions}

The industry cluster has become an important concept in economic development research and practice. In their ideal form, clusters are essentially the empirical manifestation of the mutually reinforcing influences of first-mover effects, conventional business agglomeration economies, localized technology spillovers, and geographical path dependence. Findings from the analysis in this Chapter are as follows;
1. The automobile industry has benefitted from clustering because of several reasons; reduced inventory costs, transportation time, production time, improved research and development, increased productivity and immediate quality control feedback.

2. Cluster formation started in the automobile industry due to proximity to suppliers, vertical and horizontal integration of firms, supply interruptions, logistic issues, and distance decay.

3. India is an ideal place for automakers and parts manufactures. It exports products as a whole to its neighbouring countries and parts and accessories to African Countries. This is due to availability of cheap skilled and educated labour, quality product, globally competitive costs (per tonne production cost of iron is low in India as compared to China, West European Countries and North America). All these outcomes are result of clustering in automobile industry. Before clusters emerged in India, it was merely an automobile importing country.

4. Firms producing parts and accessories manufacture a variety of products. This is not cost competitive. Hence, it is an utmost requirement to produce one product under one roof to reduce the cost of production and substantially increase the quality.

From the above analysis one can conclude that inter-firm transactions among clusters such as collaboration and information sharing, or intra-industry transactions such as a shared buyer-supplier network, intermediate goods, and specialized labour pools substantially increases the performance. These theoretical assumptions and modeling of a cluster have been empirically analysed by selecting some performance indicators in the automobile clusters in India in the next chapter.