# INNOVATION QUOTIENT (INQ): MEASURING THE INNOVATION STATUS OF INDIAN AUTO COMPONENT MANUFACTURERS

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***Abstract*-**Innovation has been acknowledged to be a key necessity for the sustained and successful existence of an organisation. Organisations in the Indian automobile and associated industries (e.g., auto component industry) have been exposed to global manufacturing standards and approaches over the past few decades due to the advent of global auto manufacturers into the country. Accordingly, these organisations need to enhance their innovation status to sustain competitiveness and be effective. However, it is necessary that the present innovation status be measured to build effective innovation strategies to propel the organisation to international standards of operation and competition. The present study used an exploratory empirical study to assess the innovation status of organisations in the Indian auto component industry by measuring their innovation quotient (InQ). The study found that the InQ of firms in this industry sector varied from very low to high. Furthermore, joint ventures and technology alliances were characteristics of firms with high InQs. Recommendations are provided in the light of the findings.

***Keywords*: innovation; innovation measurement; innovation quotient; InQ; India; innovation drivers; auto component industry**

### 1.1 Introduction:

*"Innovate or perish", "If you don't innovate, someone else will" and "Faster, Better, Cheaper"* (Business Standard, 2007; Economic Times, 2017; NASA quoted in Bignami, 2000).

India's automotive sector has witnessed steady growth in the post-liberalization period, both in vehicle and component manufacturing. Due to unprecedented changes experienced by this sector and fast growth trajectory, the industry is facing many new challenges like changes consumer patterns, alternative vehicles, massive disruptions due to rapid changes in mobility, autonomous driving, electric vehicles and digitalization. It becomes imperatives for Indian auto-manufacturers to devise long-term strategies to achieve sustainability and competitiveness in global market arena. The industry needs to gear up for the future by investing in R&D and technology that integrates their entire business value chain. Thus automotive sector looks ahead to the alternative ways to drive innovation and building technological capabilities to meet these new mobility challenges.

The automobile industry in India is world's fourth largest, with the country currently being the world's 4th largest manufacturer of cars and 7th largest manufacturer of commercial vehicles in 2017. Indian automotive industry (including component manufacturing) is expected to reach Rs 16.16-18.18 trillion (US$ 251.4-282.8 billion) by 2026 (IBEF, 2018). Future trends indicate that India will be a key market in the global automotive sector and will move up from their global position to 3rd by 2020. This has spurred the need for research on innovation in order to come out with game changing products and technologies. It could be inferred that this will have a downstream impact on firms in the auto component industry necessitating organisations to have some mechanism to assess their current level of innovation and take appropriate action to improve or sustain their innovation status. However, it could be seen that the innovation level of an organisation was not generally measured (Boston Consulting Group [BCG], 2007a), a factor that could facilitate understanding of the current innovation level of an organisation and spur enhanced innovation activity.

This study, therefore, presents an approach to measure the innovation level (Innovation Quotient [InQ]) in Indian auto component industry. The study is aimed at describing the measurement of the innovation quotient of selected organisations in Indian auto component industry.

### 1.2 Structure of Indian Automobile Industry

The Indian auto component industry manufactures a wide spectrum of products including engine parts, equipment and electrical parts, body and chassis, suspension and braking parts, drive transmission and steering parts, and so on (Automotive Component Manufacturers Association of India [ACMA], 2010). Figure 1.1 depicts the product segments of the auto component industry in India.

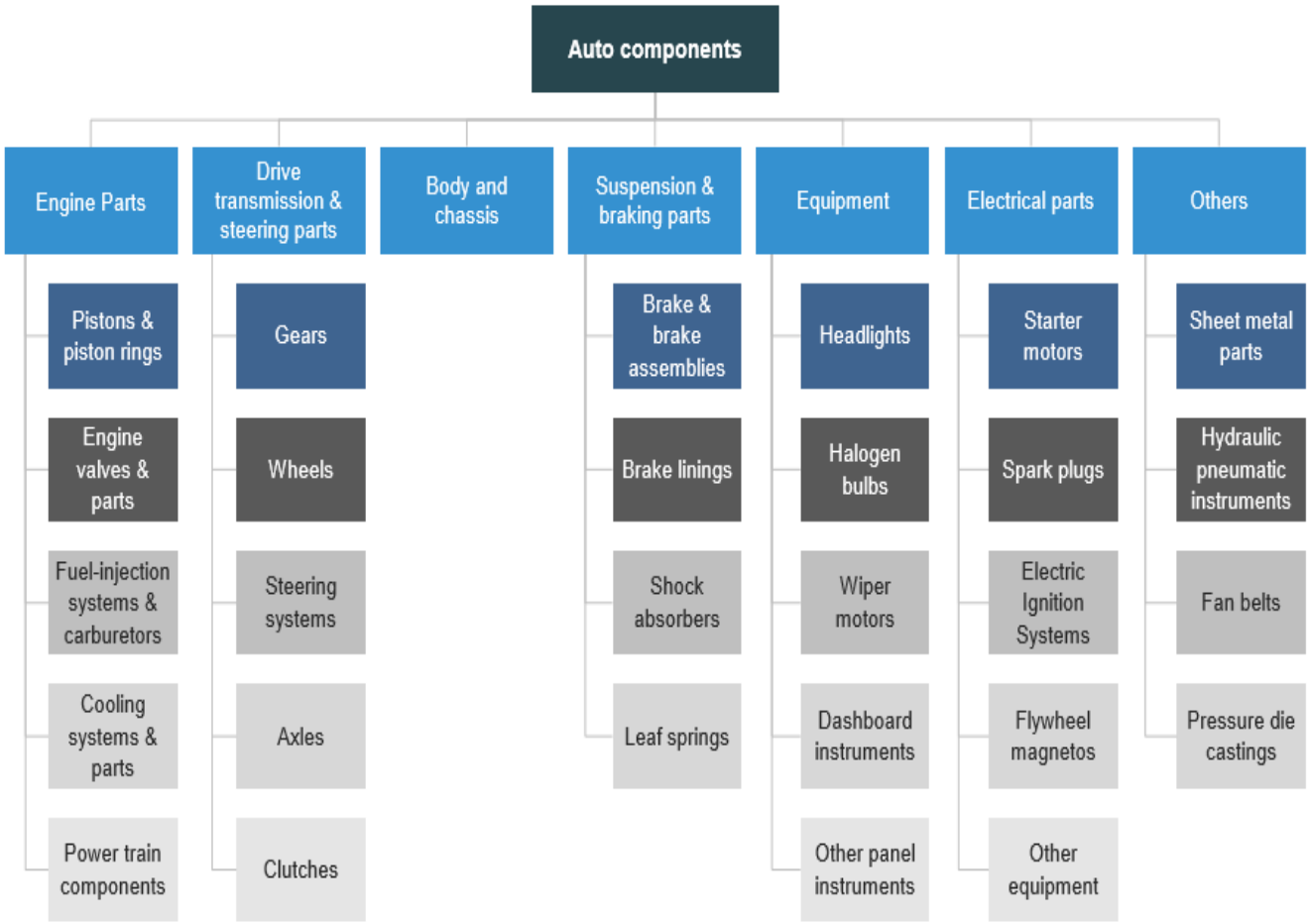


**Figure 1.1: Product Segments of the auto component industry in India**
*Source: IBEF, 2017*

The auto component industry is organised into vehicle OEMs (original equipment manufacturers) and different tiers of auto component manufacturers (ACMs). The tier system indicates that different organisations have different roles in the whole automotive manufacturing supply chain. On the whole, the auto component industry has three tiers of organisations. Tier 1 suppliers are ACM firms that deal directly to the vehicle OEMs and supply automobile parts or systems. On the other hand, Tier 2 suppliers are suppliers which supply automobile components to firms which are not OEMs. Tier 3 suppliers are firms which supply raw, or nearly raw, materials, such as plastic or metal. It can be inferred that all participants in the automobile industry (i.e., OEMs, Tier 1, and Tier 2 firms) are essentially customers of Tier 3 suppliers since they all require raw materials (Amatech Inc., 2017). Furthermore, Tier 1 suppliers generally function in a "built-to-print" manner. In other words, the manufacture of components is in accordance to the precise requirements of the OEMs and hence Tier 1 suppliers do not necessarily possess considerable design competencies (Auto Tech Review, 2015). A visualisation of the structure of the auto component industry is depicted in Figure 2.

The ownership structure of the auto component industry is as follows (Borgave & Chaudhari, 2010):

- Indian companies without nil or very minimal collaboration with foreign companies;
- Indian companies with foreign collaboration; and
- Wholly-owned subsidiaries of Multi-National Companies (MNCs) or units in which they have a majority stake.

That is, ACMs in India may be wholly-owned domestic firms; majority-owned domestic firms; majority-owned foreign subsidiaries; wholly-owned affiliates of foreign firms; or joint ventures (Tiwari & Kalogerakis, 2017).

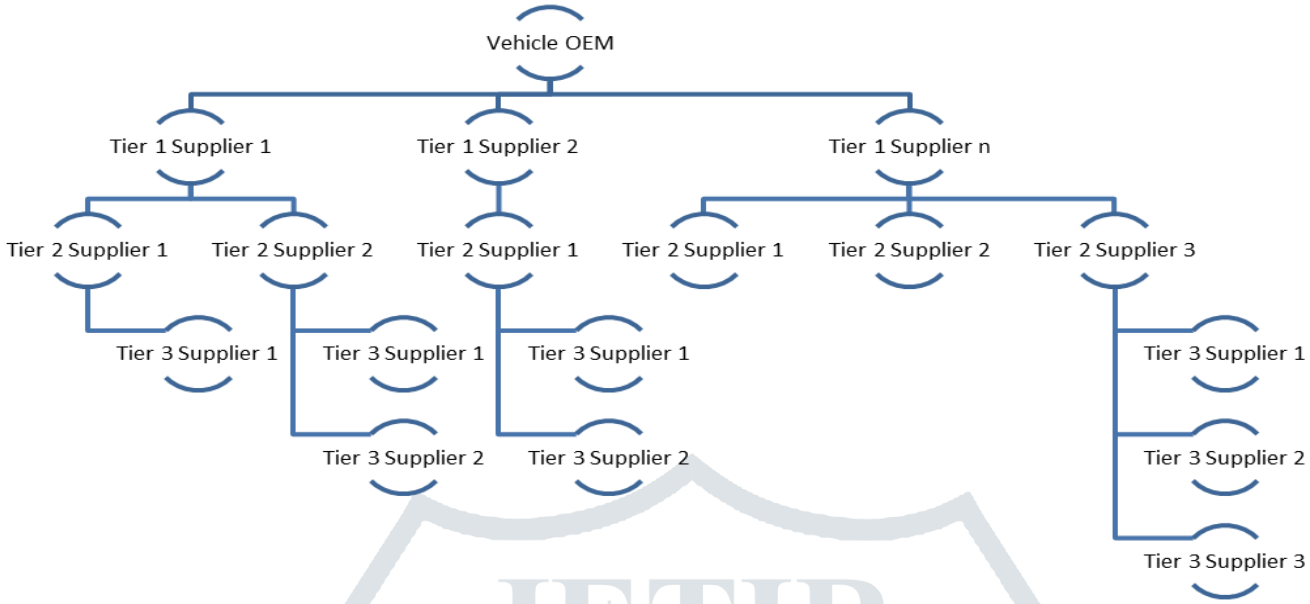


**Figure 2: Structure of the Auto Component Industry**

**2.3 Review of Existing Literature:**

**Innovation**

Innovation (from the Latin 'innovare' which means 'to make something new') is defined by the online Merriam-Webster dictionary (2017) as the "act or process of introducing new ideas, devices, or methods." Simply stated, innovation is the successful usage of novel notions.

According to Utterback (1986), innovation could be evolutionary and consist of repetitive and aggregate development. In contrast, it was suggested by other researchers (e.g., Bessant, 2008; Carayannis, Gonzalez, & Wetter, 2003; etc.) that innovation could involve change that was revolutionary and disruptive or radical. Conversely, Bessant, Lamming, Noke, and Phillips (2005) remarked that not all innovation results in worthwhile outcomes. Additionally, insecurity and dissatisfaction is frequently created by the process of innovation in organisations and related supply chains. The capacity to innovate does not expand in isolation, and consists of various levels of collaboration (intra- and inter-organisational) and synchronisation (Storer & Hyland, 2011).

Overall, it could be seen that innovation has become essential to the continued existence of an organisation. In the present day, organisations function in an evolving environment that is increasingly more complex and competitive and a market that constantly changes. Hence, to maintain a significant position in the global market, it is necessary that organisations enhance the volume of their innovations and develop new products, services, or business models. Further, the automotive industry is one industry sector that lends itself to innovation where manufacturers can be motivated to innovate due to customer requirements (e.g., luxury, safety, fuel economy, etc.), international competition, and environmental guidelines and standards.

In his book *The New Age of Innovation* (Prahalad & Krishnan, 2008), C K Prahalad observed that in the 21st century the only core competence needed by an organisation to succeed is innovation. Thus, innovation is a crucial requirement for a business to succeed in the intensely competitive business marketplace. The significance of innovation as a differentiator in the marketplace which separates successful organisations from others has been highlighted by reports by the Boston Consulting Group (BCG, 2007b, 2010). Many forms can be taken by innovation varying from the creation of new products and services to the revamping of present practices and the launch of totally unique models of business. Additionally, innovation is highlighted to be a matter of top strategic focus for many firms and it is anticipated that spending on innovation will increase (BCG, 2007b, 2010).

Various dimensions of innovation have been offered by researchers. In general, there are two kinds of innovations: product innovation (i.e., a new idea, method or device); and process innovation (i.e., a new way of doing things) (Kuratko, Ireland, Covin, & Hornsby, 2005; Reiner, Demeter, Poiger, & Jenei, 2008). These dimensions of innovation offer enhanced value to a firm's customers and assist in enhancing the firm's competitive advantage. Firms typically innovate in various ways and the innovations can span incremental modifications to existing products and services to drastically new services and products (Worthington, Collins & Hitt, 2009).

The next section provides more detail about the various types of innovation.

**Types of innovation**

Literature reveals various types of innovation, for example, from the perspective of products, business or strategy concept, services, processes, value, financial, marketing, etc. Schumpeter (1939) proposed five kinds of innovation, and hence bases of competitive benefit. These are connected with uniqueness in products, production approaches, supply sources, market exploration, and approaches to business organisation.

Subsequently, researchers (e.g., Baker, 2002; Hamel, 1996; Hamel & Prahalad, 1994; van Zyl, 2006) streamlined the categorisation of innovation leading to three basic types defined by the chief goal of the proposal, i.e., products, processes, and strategy. Additionally, a specific instance of innovation could perhaps consist of a blend of the three types.

It was suggested by Rothberg (1981) that product innovation, from the perspective of an organisation, consists of alterations to, or a supplement to, the items that comprise its product line. Product innovation may generate competitive benefits through exclusive products that are adequately set apart to obtain a share of the present market or establish a previously unknown or unexploited market.

A process innovation may consist of process modification, or enhancement, successfully established and offering sufficient enhancement to position the organisation among its competitors. Competitive benefit may be created in the form of organisational enhancements that result in distinction in value, time-to-market, after-market support, etc. It was suggested by Schilling (2005) that process innovations are often associated with enhancing production proficiency or competence. Consequently, process innovations may not be perceived by the client at all times. For example, processes which have an internal effect on the organisation's competitive benefit, such as, knowledge management, organisational learning, and change management, are not typically evident to the customer. It can be seen that, as with products, a process need not be entirely new to signify an innovation.

The third type of innovation, strategy innovation, as the name suggests indicates innovation associated with the strategy of an organisation. It must be noted, again, that strategy innovation does not necessitate a complete change in strategy and can be limited to changes to or additions to a previous business concept, as long as it can be effectively confirmed and ensures robust market positioning. Accordingly, competitive benefit may be generated by strategy innovation through administration and positioning that offers long-term differentiation, and furthers product and process innovation. Differentiation at the strategic level can develop new markets, predict prospective markets, or rejuvenate existing markets so that a firm can proactively position itself against its competition (Baker, 2002; Hamel, 1996).

Disruptive innovation describes "the transformation of business models and value networks by technology or business innovation" (EY, 2016, p. 11). Disruptive innovation is characterised by the entry of new services or products at the lowermost end of a proven market; the commencement of services or products at an inferior level that is not viewed as a risk by the traditional market leaders; non-consumers are the adopters of such innovations. That is, persons who due to the price or availability of products or services could not previously access them (Imber, 2013).

Radical innovations signify development of such outcomes that the "revolutionary alteration of the organization and its support networks must occur to accommodate and implement change" (Cooper, 1998). Increase in radicalism results in a significant surge in risk as radical initiatives, to a large extent, move away from present (recognised and comprehended) practices. They can produce chaos in traditional markets and generate the development of new ones.

The next section provides more detail about the measurement of innovation.

**Measuring innovation**

It can be inferred that the level of innovation in an organization requires measurement so that the organization can determine or refine its innovation strategy. However, it has been found that while the need for measurement is recognised very few organisations actually do so (BCG, 2007a). Nevertheless, several models and frameworks are available in academic and business literature for the purpose of measuring the innovation quotient of an organisation. A few are described in this section.

***European Innovation Scoreboard (EIS)***

The European Innovation Scoreboard (EIS) measures the comparative strengths and weaknesses of national innovation systems and aids countries in identifying areas of improvement (EIS, 2017). It offers a relative scrutiny of innovation performance in the European Union (EU) member countries, and other European and neighbouring countries. Figure 3 depicts the EIS 2017 measurement framework.

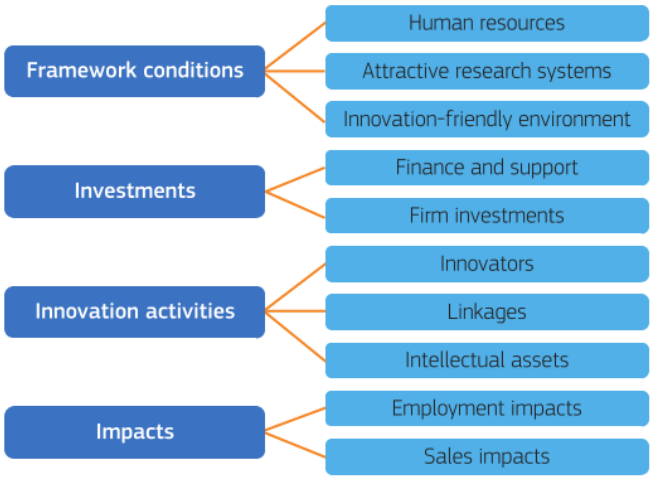


**Figure 3: EIS 2017 Measurement Framework**

*Source: EIS, 2017, p. 8*

The various dimensions of the EIS measurement framework are depicted in Figure 4.

**1. FRAMEWORK CONDITIONS**
*1.1. Human resources*
1.1.1. New doctorate graduates
1.1.2. Population aged 25-34 with tertiary education
1.1.3. Lifelong learning
*1.2. Attractive research systems*
1.2.1. International scientific co-publications
1.2.2. Top 10% most cited publications
1.2.3. Foreign doctorate students
*1.3. Innovation-friendly environment*
1.3.1. Broadband penetration
1.3.2. Opportunity-driven entrepreneurship
**2. INVESTMENTS**
*2.1. Finance and support*
2.1.1. R&D expenditure in the public sector
2.1.2. Venture capital expenditures
*2.2. Firm investments*
2.2.1. R&D expenditure in the business sector
2.2.2. Non-R&D innovation expenditures
2.2.3. Enterprises providing training to develop or upgrade ICT skills of their personnel
**3. INNOVATION ACTIVITIES**
*3.1. Innovators*
3.1.1. SMEs with product or process innovations
3.1.2. SMEs with marketing or organisational innovations
3.1.3. SMEs innovating in-house
*3.2. Linkages*
3.2.1. Innovative SMEs collaborating with others
3.2.2. Public-private co-publications
3.2.3. Private co-funding of public R&D expenditures
*3.3. Intellectual assets*
3.3.1. PCT (Patent Cooperation Treaty) patent applications
3.3.2. Trademark applications
3.3.3. Design applications
**4. IMPACTS**
*4.1. Employment impacts*
4.1.1. Employment in knowledge-intensive activities
4.1.2. Employment fast-growing enterprises of innovative sectors
*4.2. Sales impacts*
4.2.1. Medium and high tech product exports
4.2.2. Knowledge-intensive services exports
4.2.3. Sales of new-to-market and new-to-firm product innovations

**Figure 4: Dimensions of the EIS measurement framework**
*Source: EIS, 2017, p. 10*

From the figure it can be seen that people, environment (e.g., finance, opportunities, etc.), networks (e.g., collaboration), and outcomes are the chief dimensions which are measured by the EIS. Nevertheless, the emphasis of this model is on innovation at a country level and hence its applicability for measuring the innovation quotient of an organisation is limited.

***CII Framework***
The Confederation of Indian Industry (CII, 2011) provided a blue print of innovation excellence which consists of a new innovation framework (Figure 5), guidelines, parameters, key drivers, and a measurement system to aid Indian firms in identifying gaps and taking corrective action. The framework is composed of two parts: Innovation Drivers, which contains seven innovation drivers, and Results, which contains three result criteria for evaluation. The framework indicates that the different drivers of innovation influence and shape each other. Moreover, they are seamlessly linked. The centre of all innovation is recognised to be Customers and Competition and hence this is in the centre of the framework.

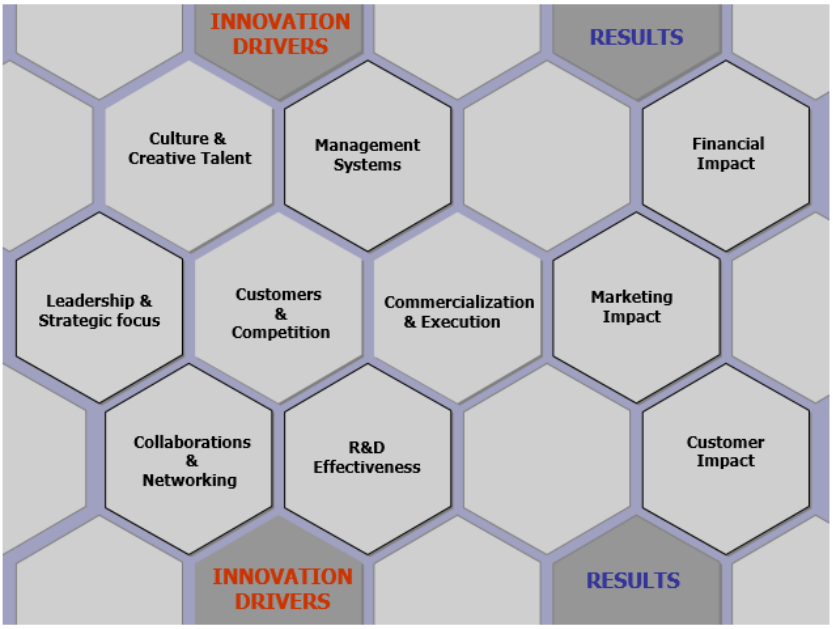


**Figure 5: CII Innovation Management Framework**

*Source: Confederation of Indian Industry (CII, 2011)*

This framework measures the Innovation Index of a firm using 100 parameters (sub-divided into the 10 portrayed categories). It can be seen again that people (e.g., leadership, culture and creative talent), environment (e.g., finance, management systems, etc.), networks (e.g., collaboration), and outcomes (e.g., marketing impact, financial impact) are the chief dimensions which are measured by this model. Also, this model pertains to organisations, in general.

***IIP- Potential Innovation Index***

Using the potential innovation index (PII) defined by Corona Armenta (2005), Galvez, Camargo, Rodriguez, and Morel (2013) provided a "general referential framework of internal innovative practices for an ideal company" (p. 38). They also employed a group of innovation practices and multi-criteria decision making tools (Boly, 2008). The practices are definite activities that a firm performs to direct and drive the process of innovation, outline its strategy, and to develop itself or its work processes. Based on the IIP score, firms can fall into one of four categories (Proactive, Preactive, Reactive, or Passive). Proactive are the "most dynamic and most offensive companies, these who create technological changes in a long-term vision." Preactive are "companies that don't ignite the changes, but which anticipate them by the use of a very active system of technology watch." Reactive are companies "which react to the dynamics of their environment." Passive are companies which "adopt a defensive attitude in front of disturbances of the environment, that is to say that they think only of surviving" (Galvez et al., 2013, p. 39). Table 1 lists the six principal innovation practices and the associated sub-practices considered in this model.

**Table 1: Innovation Practices in IIP**

*Source: Galvez et al., 2013*

| Innovation Practice | Sub-practice |
|---|---|
| IP1. Creativity and Concept Generation | a) Use of tools to increase the creativity<br>b) Integration of the clients and suppliers in the conception process<br>c) Organization, compilation and management of information from the exterior |
| IP2. New Product development | a) Use of advanced tools for design aid<br>b) Existence of a methodology to the design process<br>c) Hardware Equipment |
| IP3. Human Resources Management | a) Management of competences and the skills of the society<br>b) Innovation stimulation |
| IP4. Technological Strategy | a) Strategy integrated to favor the innovation<br>b) Network operation<br>c) Client Importance<br>d) Financing |
| IP5. Project Management | a) Project administration<br>b) Management of project portfolio<br>c) Organization of tasks tied to the Innovation |
| IP6. Data and Knowledge Management | a) Continuous Improvement of the innovation process<br>b) Politics of Management of the intellectual property<br>c) Knowledge Capitalization |

It can be seen that this model pertains to organisations, in general. Also, people (e.g., human resource management) and environment (e.g., project management, data and knowledge management, etc.) are the chief dimensions which are measured by this model.

***Innovation Quotient***

In a study, Mishra and Sahay (2010) attempted to measure the innovation status of Indian manufacturing companies, including ACM firms. Thus, they attempted to investigate where the Indian manufacturers are positioned on innovation by proposing the term Innovation Quotient (InQ) to indicate the measure of innovation in a firm and also measuring the InQ of firms using a custom list of innovation enablers/drivers/attributes.

Mishra and Sahay (2010) identified the attributes and enablers to innovation by surveying organisational stakeholders from different industry sectors in India, such as, IT, ACM, pharmaceutical, food, engineering, and realty. The authors defend their selection of these sectors by rationalising that they represented key industrial sectors not only from an economic standpoint but also from the standpoint of evidence of significant innovation activity. These attributes were processed for duplication, ambiguity, similarity and affinity and were organised into five categories namely culture-related (13 attributes); employee-related (eight attributes); environment-related (five attributes); management-related (11 attributes), and network of technology partner, suppliers, customers, competitors, etc. (three attributes).

The authors provided a formula for the computation of InQ, namely:

$$InQ = \frac{Organisational\ score\ across\ the\ five\ categories * 100}{maximum\ possible\ score}$$

where,

Organisational score across the five categories = sum of the individual scores for Culture (A) + Employee (B) + Environment (C) + Management (D) + Network (E)

The various attributes contribute to a category-wise maximum score. Table 2 summarises the computations across the five categories. The "% of total score" indicates that the internal facets of organisation culture, management, and employees have a greater influence on innovation in firms than the external facets of environment and network.

**Table 2: Category-wise breakup of total score**

| **Category** | **Computation** | **% of total score** |
|---|---|---|
| Culture | 13 x 5 = 65 | 32.5% |
| Employee | 8 x 5 = 40 | 20.0% |
| Environment | 5 x 5 = 25 | 12.5% |
| Management | 11 x 5 = 55 | 27.5% |
| Network | 3 x 5 = 15 | 7.5% |
| **Total** | **40 x 5 = 200** | **100.0%** |

Figure 6 depicts the graphical representation of the category-wise breakup of the total score.

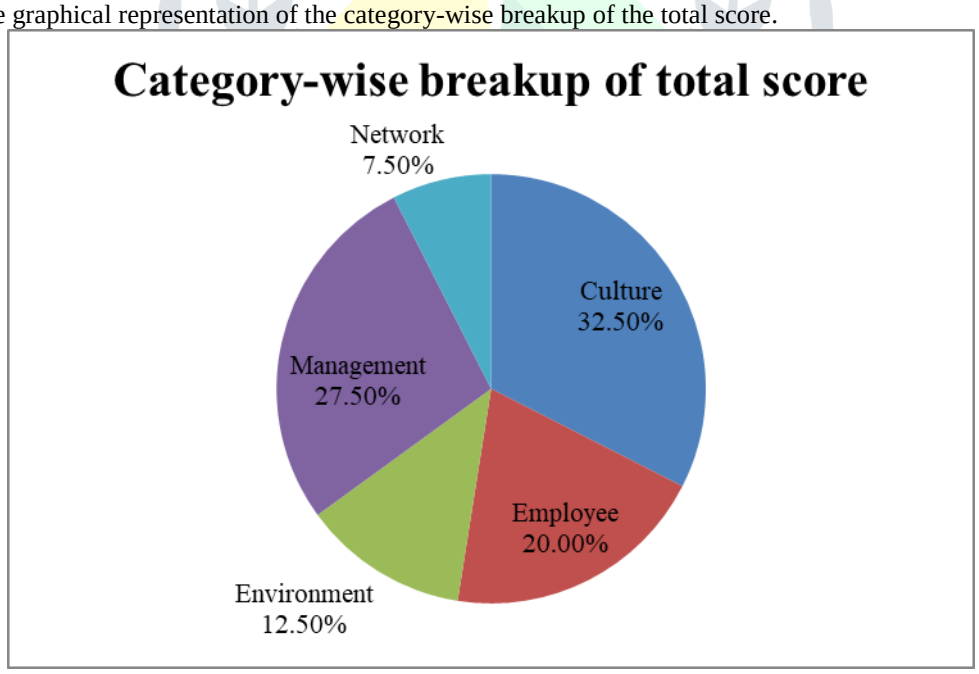


**Figure 6: Category-wise breakup of the total score**

They illustrated a sample InQ computation of an organisation which scored 122 overall on the five categories. It could be seen that the InQ of the firm was 61% which was categorised as a high score.

$$InQ = \frac{122 * 100}{200} = 61\%$$

As with the earlier models, it can be seen that this model also pertains to organisations, in general, including ACM firms. Moreover, people (e.g., employees, management), culture, network, and environment were again the chief dimensions are measured by this model. However, its simplicity lends itself to customisation and/or elaboration, as required.

***Innovation Quotient Inventory (INQ-I)***

The Innovation Quotient Inventory (INQ-I) offers, or attempts to offer, a statistically consistent and legitimate inventory to numerically evaluate the innovation capacity of a firm (Richards, 2014). This model consists of eight orientations, each of which is believed to drive and influence a firm's approach to innovation. Moreover, the eight orientations are also associated with four cognitive capabilities (Figure 7). It can be seen that this model also views innovation as being influenced by people, networks, the overall organisational environment, and outcomes. Also, the focus of the model is organisations in general.

| THE INQ-I's 4 COGNITIVE CAPACITIES | THE INQ-I's 8 ORIENTATIONS |
|---|---|
| IMAGINE | CREATIVE and STRATEGIC |
| TRANSFORM | TRANSFORMATIONAL and LEARNING |
| CONNECT | COLLABORATIVE and CONNECTIVE |
| ENGAGE | CULTURAL and LEADERSHIP |

**Figure 7: Eight Orientations of the INQ-I Aligned with the Four Cognitive Capacities**
*Source: Richards, 2014, p. 93*

***Innovation Radar***

Sawhney, Wolcott, & Arroniz (2006) measured innovation using the Innovation Radar which they described as consisting of four major aspects that serve to shelter organisations. These are the offerings, customers, processes, and access points that an organisation uses to position its offerings in the market. Other dimensions can be included (i.e., solutions, platform, relationship, organization, value capture, networking, supply chain, and brand) to operate as avenues of pursuit (Figure 8). This model is also designed for organisations in general and considers the influence of people, the environment, and outcomes on innovation.

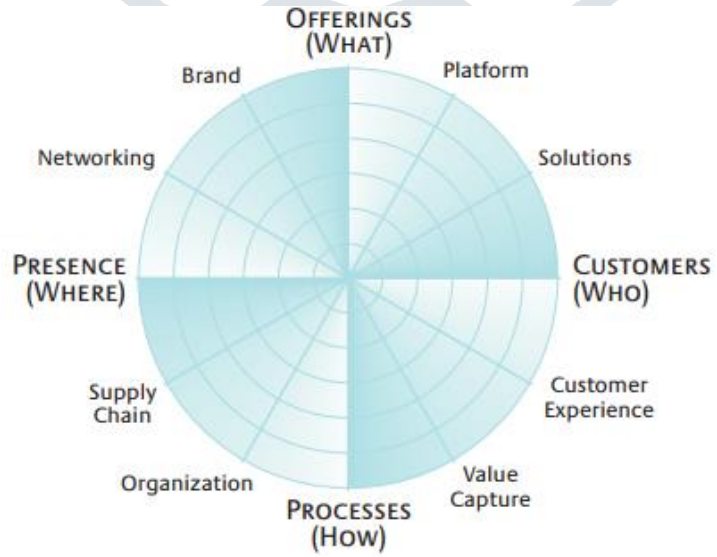


**Figure 8: Innovation Radar**
*Source: Sawhney et al., 2006, p. 77*

***Comparing the different models to measure innovation***

Overall, it can be seen that the approaches to measuring innovation can be varied. Moreover, different factors can be utilised to measure innovation. Table 3 provides a comparison of the different models to measure innovation.

**Table 3: Comparison of the different models to measure innovation**

| Model | Author (s) | Measures | Applicability |
|---|---|---|---|
| European Innovation Scoreboard (EIS) | EIS, 2017 | • *Framework conditions* (Human resources, Attractive research systems, innovation-friendly environment)<br>• *Investments* (Finance and support, firm investments)<br>• *Innovation activities* (innovators, linkages, intellectual assets)<br>• *Impacts* (employment impacts, sales impacts) | Country-level measurement rather than organisation-level |
| CII Framework | Confederation of Indian Industry (CII), 2011 | • *Innovation Drivers*: Leadership and Strategic Focus; Customers and Competition; Collaborations and Networking; Culture and Creative Talent; (Innovation) Management Systems; R&D Effectiveness; Commercialization and Execution<br>• *Results*: Marketing Impact; Financial Impact; Customer Impact | Generic organisation level. Can be customised to apply to auto component industry. |
| IIP-Potential Innovation Index | Galvez et al., 2013 | Proactive, Preactive, Reactive, Passive | Generic organisation level. |
| Innovation Quotient (InQ) | Mishra & Sahay, 2010 | Uses 40 attributes organised into five categories (culture, employee, environment, management, and network) to compute the InQ of a firm | Generic organisation level. Utilised for a sample of firms from different industries. |
| Innovation Quotient Inventory (INQ-I) | Richards, 2014 | Creative, Strategic, Transformational, Learning, Collaborative, Collective, Cultural, Leadership | Generic organisation level. |
| Innovation Radar | Sawhney et al., 2006 | Offerings, Customers, Processes, Presence | Generic organisation level. |

Since the model proposed by Mishra and Sahay (2010) had already been used with a variety of firms from different industries including the auto component industry, this model was used in the present study to measure the innovation quotient of Indian ACM firms. The next section describes the methodology used in the present study.

## Method

### Participants

It is generally accepted that the case study approach incorporating the investigation of companies to comprehend particular cases is the most suited for the development of theories (Eisenhardt, 1989; Weick, 1989; Yin, 2017). Accordingly, this study utilised the case study approach to explore the innovation status in ACM firms.

A total of 11 auto component companies were considered to be the cases in the current study. Purposive sampling was employed to identify the companies to ensure representation from the various sectors of the auto component industry. The following were the inclusion criteria to identify firms for participation in the present study:

a) The firm should be an auto component manufacturer
b) The sample should be located across India in various auto hubs (North, South, West/Central India, etc.).
c) The firm should be a wholly-owned domestic firm or majority-owned domestic firm or majority-owned foreign subsidiary or wholly-owned affiliate of foreign firms or a joint venture.
d) The firm must be small (<200 Crores in annual revenue) or large (>200 Crores in revenue)

Accordingly, the sample was composed of automobile Assembly manufacturers (36.4%), Tier 1 suppliers (36.4%), Tier 2 suppliers (9.1%), and the remainder (18.2%) were ancillaries to a truck manufacturer with a European JV partner (Figure 9). The selected organisations were located in the auto component hubs in Western, Northern and Central India.

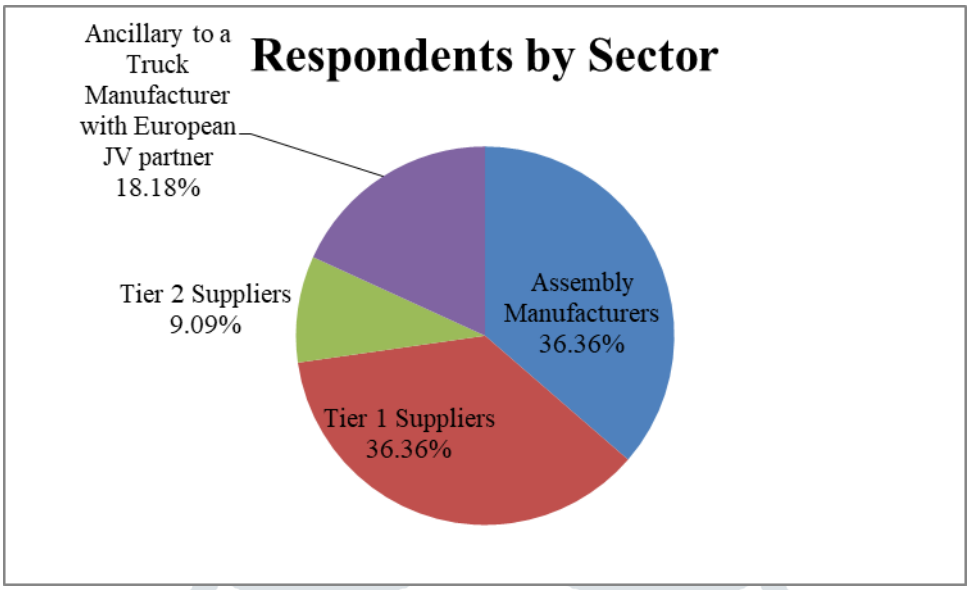


**Figure 9: Distribution of Respondents by auto component sector**

Table 4 summarises the profiles of the participating organisations. Six of the firms were small-sized (i.e., <200 Crores in annual revenue) and the remainder were large (i.e., >200 Crores in revenue). It can be seen that the Assembly Manufacturers and Tier 1 Suppliers were significantly larger in scale (both sales and number of employees) in contrast to the Ancillaries of a Truck Manufacturer and the Tier 2 supplier. Overall, the sample could be considered to adequately represent both small- and large-sized ACM firms.

Also, Assembly Manufacturers and Tier 1Suppliers appeared to be more likely to enter into technology tie-ups as 3 of the 4 Assembly Manufacturers and 1 of the Tier 1 Suppliers had entered in joint ventures or technology alliances. Interestingly, three of the Tier 1 Suppliers were ancillary firms.

**Table 4: Profiles of the Responding Organisations**

| **Type of firm→** | **Assembly Manufacturers** | | | | **Tier 1 Suppliers** | | | | **Tier 1 supplier (ancillary to a Truck Manufacturer with European JV partner)** | | **Tier 2 supplier (ancillary to a Truck Manufacturer with European JV partner)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Organisation→** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| **Sales (in INR Crores)** | **400** | **800** | **450** | **800** | **560** | **20** | **140** | **160** | **1.5** | **6** | **6** |
| **Employees** | **200** | **900** | **900** | **450** | **1050** | **70** | **550** | **650** | **70** | **150** | **120** |
| **Tech Tie-up** | **JV** | **TA** | **Nil** | **JV** | **MNC** | **Nil** | **Nil** | **JV** | **Nil** | **Nil** | **Nil** |

**JV—Joint Venture; TA—Technology Alliance; MNC—Ancillary to a Multinational Car Manufacturer*

**Instrument**

The researcher designed a questionnaire in English integrating the 40 enablers/facilitators/drivers of innovation identified by the author in an earlier study (Mishra & Sahay, 2010). This questionnaire was utilised to obtain the rankings of the impact of these drivers to innovation in the auto component industry on a five-point Likert scale (ranging from No impact at all to Very high impact). Responses were provided using the Likert scale to make the questionnaire easier for the respondents to use. Please refer to Annexure 1 for the questionnaire.

As mentioned earlier, the 40 enablers/facilitators/drivers are grouped into five categories, namely: culture-related (13 attributes); employee-related (eight attributes); environment-related (five attributes); management-related (11 attributes), and network of technology partner, suppliers, customers, competitors etc. (three attributes). Each of these categories is briefly described in the following paragraphs.

- Culture-related drivers indicate the overall aspects of organisational culture (e.g., attitude to cost competitiveness, speed of decision-making, culture of respective others' ideas, encouraging risk taking, etc.) that influence innovation in a firm. A favourable culture can facilitate innovation whereas an unfavourable culture can impede innovation.
- Employee-related drivers, as the name suggests, pertain to employee-related aspects in an organisation that influence innovation. For instance, technically competent, motivated and involved employees are more likely to initiate and/or support innovation efforts. On the other hand, the organisation can support the transformation of employees by providing development and empowerment.
- In this context, environment signifies the market environment of the organisation. The position and exposure of an organisation can cause it to view innovation differently. For instance, a global organisation with international competition which

is a leader in its market segment would be more enthused to seek avenues to innovate as this would help it sustain its market position.

- Management-related attributes are those which depict the role of the management in innovation. For instance, innovation initiatives would fail without commitment and support of the management.
- The last category, Network, indicates that innovation cannot take place without the involvement of external stakeholders, such as customers, suppliers, and partners.

The next section presents the findings from the study.

**Results**

Ratings for the 40 innovation attributes were obtained from the 11 participating ACM firms. As mentioned earlier, the participants were required to provide a rating for each item on the questionnaire. Items that did not receive a response were given a score of zero (0) and it was considered that all the parameters were rated. Using the formula provided by Mishra and Sahay (2010), the score of an organisation was directly summed and computed as a percentage of the maximum possible score (i.e., 200).

$$InQ = \frac{Organisational\ score\ across\ the\ five\ categories * 100}{maximum\ possible\ score}$$

where,

Organisational score across the five categories = sum of the individual scores for Culture (A) + Employee (B) + Environment (C) + Management (D) + Network (E)

The InQ computed for the participating organisations is summarised in Table 5. The table is organised by type of ACM firm, i.e., assembly manufacturers, Tier 1 suppliers, etc. The table also provides details of the mapping of each organisation by category and attribute. It could be seen from the data that the innovation status of assembly suppliers appeared to be at a higher level than the other companies. Moreover, their rating on culture, employee, and network was better than those of Tier 1 and Tier 2 suppliers. This could be due to the fact that assembly manufacturers have a bigger scale of operation. Moreover, they are supported by their technology and partners.

**Table 5: InQ Scores of the Participating Firms**

| **Type of firm→** | | **Assembly Manufacturers** | | | | **Tier 1 Suppliers** | | | | **Tier 1 supplier (ancillary to a Truck Manufacturer with European JV partner)** | | **Tier 2 supplier (ancillary to a Truck Manufacturer with European JV partner)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Organisation→** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| **Category↓** | **Max Score** | | | | | | | | | | | |
| Culture | 65 | 47 | 31 | 29 | 38 | 31 | 15 | 34 | 35 | 13 | 25 | 14 |
| Employee | 40 | 32 | 28 | 27 | 31 | 21 | 13 | 21 | 31 | 13 | 22 | 13 |
| Environment | 25 | 19 | 17 | 17 | 19 | 17 | 6 | 16 | 18 | 5 | 8 | 7 |
| Management | 55 | 46 | 36 | 34 | 37 | 33 | 14 | 32 | 41 | 14 | 26 | 10 |
| Network | 15 | 13 | 11 | 7 | 11 | 11 | 3 | 11 | 11 | 3 | 11 | 3 |
| **Total score** | **200** | **157** | **123** | **114** | **136** | **113** | **51** | **114** | **136** | **48** | **92** | **47** |
| **InQ** | **100** | **78.5** | **61.5** | **57** | **68** | **56.5** | **25.5** | **57** | **68** | **24** | **46** | **23.5** |
| **Organization Size** | | **Large** | **Large** | **Large** | **Large** | **Large** | **Small** | **Small** | **Small** | **Small** | **Small** | **Small** |

Figure 10 depicts the InQ score by category for the participating organisations. It can be seen that although the total scores for organisations 3 and 7 are identical, they differ significantly across the categories. For instance, Organisation 3 fares better on the Employee, Environment, and Management aspects whereas Organisation 7 fares better on Culture and Network. Similarly, organisations 4 and 8 have the same score but converge only on the score for the Network facet. The scores of the organisations with the lowest overall scores (9 and 11) converge on the Employee and Network aspects. Thus, it can be concluded that consideration of the total score will not be adequate as the category-wise scores provide more robust indication of the actual status.

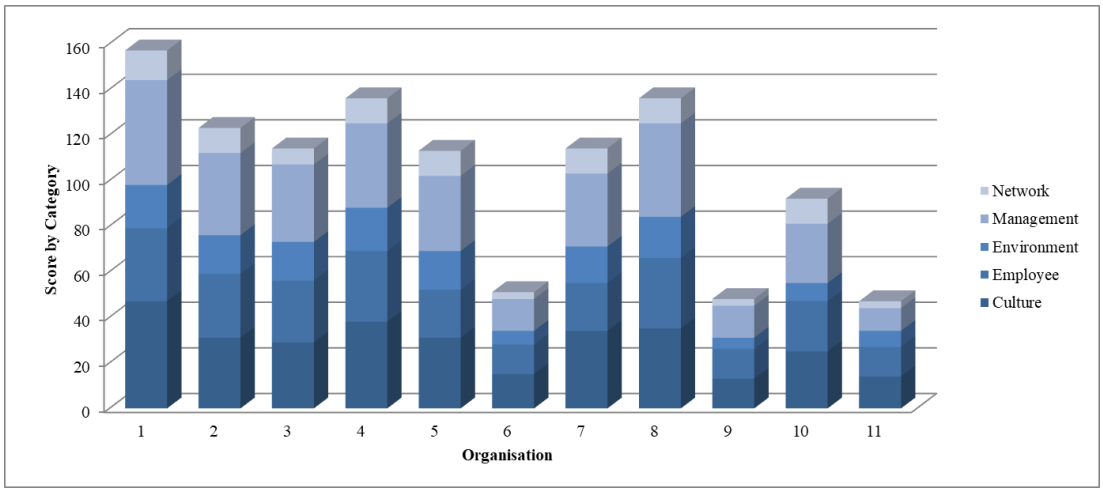


**Figure 10: InQ score by category**

As seen in Table 5, in contrast to small units (sales up to INR 200 Crores), large auto component suppliers—both assembly and parts—with sales greater than INR 200 Crores, could be expected to have an enhanced awareness of business processes, encounter greater threats from competition, and appear accordingly to be well-organised to support a healthier innovation climate. On the other hand, assembly units (organisations 1-4) which have technology support could be seen to have enhanced access to improved technology, current knowledge, and superior employee, culture, and network ratings. Additionally, foreign partners appear to have been proficient in adding value to their accomplishments. Consequently, it can be implied that these organisations are well-positioned to innovate.

Moreover, it could be inferred that small-sized conventional Indian firms which have low revenues from sales, few employees, poor management bandwidth, and ineffective culture of improvement, are not equipped to recognise the power of innovation. Moreover, they do not have a global outlook and place greater emphasis on meeting supply obligations. This situation is true not only for established units which are subsidiaries of a truck OEM but also for newly opened units resulting from a JV of a large car manufacturer.

Additionally, it could be surmised that the use of a moderate management approach to define an organisation's culture and vision is fundamentally related to size and also experience with global technology, for instance, by means of a technology partner or JV. This study found that regardless of size, the majority of the auto component manufacturers obtained a high (>50%) innovation score with international exposure and visionary management. In contrast, the few (27%) auto component manufacturers without JVs or TAs had significantly low InQ scores.

Moreover, large-sized companies were found to have a good InQ score (over 50%) when they had good management and /or a technology or joint venture partner as in few cases. Additionally, large companies had higher innovation potential and climate possibly due to money and management /staff bandwidth. Also, it could be inferred that they were not averse to taking risks and had adequate disposable income to spend. In the case of the small companies, it could be inferred that they were more involved in day-to-day survival issues and hence could not progress beyond that into product innovation.

**Discussion and Conclusion**

As previously discussed, innovation is a differentiating parameter for developing successful organisations. In the long run, successful organisations are those which are able to measure their innovation level and also exhibit an effective capacity to manage their evolution from present to international benchmark levels of innovation. This is expected to be especially true in the auto component industry, in particular, due to the severe competition with international players.

As could be seen from the preceding section, it is evident that an organisation's InQ can be potentially evaluated on three levels. Firstly: at the total InQ level to assess the gap with regard to the total score of all the studied organisations and in comparison to benchmarks. Secondly, at the category level: to determine the category-specific gap by comparing the scores to understand and derive improvement approaches applicable to the individual categories. Thirdly, at the attribute level: to determine the status with respect to benchmarks and propose improvements. Since the score of every organisation at total, category, and attribute levels may differ, it is significant to note that the strategy for InQ improvement has to, accordingly, be specific to an organisation. Moreover, an organisation's InQ can be evaluated against industry benchmarks of InQ and also the InQ of successful organisations (global or otherwise). This will help determine the reasons for the differential in InQ at the total and category levels and hence enable an organisation to formulate strategies to raise their InQ level.

Thus, it can be inferred that the InQ score would initiate attempts to improve innovation activity in the organisation and hence improve the InQ score. Moreover, organisations will have to improve their category-level score and subsequently the attribute-level score to determine strategy and areas for improvement.

Nevertheless, a general strategy for auto component firms in India would be to take the increasing organisation size into consideration, improve access to technology by means of in-house R&D or joint ventures or technology partners. Moreover, a culture of improvement through Kaizen should be promoted along with robust schemes to reward innovation activity. Providing continual training on technology to employees and encouraging their participation in seminars will also help increase the innovation competencies in the organisation.

Overall, the present study measured the InQ of organisations from the auto component industry in India and found that the InQ of firms in this industry sector were varied with scores ranging from 23.5 (very low) to 78.5 (high) out of a possible maximum score of 100. Moreover, the majority (7 out of 11) of the firms had scored higher than 50%. Thus, it is evident that while there is significant innovation activity in the sector, it would be worthwhile to invest some effort to enhance the extent of innovation activity across the different kinds of firms. Improving the innovation activity would also result in an improved competitive edge and hence sustained success in the industry.

However, this study was not without limitations. The study has not been statistically tested and verified for validity due to the small sample size and is based on cases of individual organisations. Further, the organisations studied were situated in the different auto component hubs in Western, Northern and Central India. Thus, future studies require incorporating representation from the Southern and Eastern hubs to ensure higher generalizability of the study findings. Additionally, an exploratory study can be performed by interviewing stakeholders from the auto component industry to gain awareness concerning the interconnection of the innovation drivers. Moreover, key organisations in the various technology segments can be studied to understand the innovation climate across tiers and technology (e.g., sheet metal, forging, machining, casting, engine assembly, gear box assembly, axle assembly, steering assembly, etc.).

A future direction could be to perform benchmarking of successful innovating organisations in Japan and developed nations from the West using the same methodology. This will help derive recommendations for improved innovation from their experiences.

This study did not use relative weightages of the different innovation attributes and categories to compute the InQ of the participating firms. This could be further scrutinised via a broad-based exploratory study to derive the actual weightage of the individual attributes.

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**Annexure 1: Questionnaire used in the study**

Listed here are some attributes which drive/enable/facilitate Innovation. Please provide your rating for each of these on a scale of 0 to 5 to indicate your organisation's level with regard to each of these.

| S. No. | Category | Attributes which drive-enable-facilitate Innovation | No impact at all (0) | Very low impact (1) | Low impact (2) | Medium Impact (3) | High impact (4) | Very high impact (5) |
|---|---|---|---|---|---|---|---|---|
| 1 | Culture | Global orientation | | | | | | |
| 2 | Culture | Attitude towards Cost competitiveness | | | | | | |
| 3 | Culture | Peaceful working culture of the Organisation | | | | | | |
| 4 | Culture | Culture of respecting others' ideas | | | | | | |
| 5 | Culture | Flexibility | | | | | | |
| 6 | Culture | Quick decision making | | | | | | |
| 7 | Culture | Learning Environment /continuous education | | | | | | |
| 8 | Culture | Promoting creativity at work | | | | | | |
| 9 | Culture | Encourage risk-taking | | | | | | |
| 10 | Culture | Innovation sustaining Organizational culture | | | | | | |
| 11 | Culture | Continuous improvement/Kaizen culture | | | | | | |
| 12 | Culture | TQM practices | | | | | | |
| 13 | Culture | TPM practices | | | | | | |
| 14 | Employee | Employee Involvement | | | | | | |
| 15 | Employee | Employee Empowerment | | | | | | |
| 16 | Employee | Employee Development/nurturing | | | | | | |
| 17 | Employee | Technical Competence | | | | | | |
| 18 | Employee | Motivated employees | | | | | | |
| 19 | Employee | Intrapreneurship-entrepreneurial mind set of employees | | | | | | |
| 20 | Employee | Dedicated talent pool for ideation | | | | | | |
| 21 | Employee | Live by values of the organisation | | | | | | |
| 22 | Environment | Competition from the foreign companies | | | | | | |
| 23 | Environment | Global exposure | | | | | | |
| 24 | Environment | Market leader | | | | | | |
| 25 | Environment | Deep understanding of the Key Factors of Success of the Industry | | | | | | |
| 26 | Environment | Deep understanding of the trends in global auto business | | | | | | |
| 27 | Management | Management Commitment to Change | | | | | | |
| 28 | Management | Willingness to Change | | | | | | |
| 29 | Management | Accept the need of change | | | | | | |
| 30 | Management | Financial backup /support | | | | | | |
| 31 | Management | Appropriate Incentive policy to reward/share innovation benefits | | | | | | |

| S. No. | Category | Attributes which drive-enable-facilitate Innovation | No impact at all (0) | Very low impact (1) | Low impact (2) | Medium Impact (3) | High impact (4) | Very high impact (5) |
|---|---|---|---|---|---|---|---|---|
| 32 | Management | Visionary/strong leadership | | | | | | |
| 33 | Management | Clear business goals | | | | | | |
| 34 | Management | Strong-big-challenging Vision | | | | | | |
| 35 | Management | Encourage organizational Transparency | | | | | | |
| 36 | Management | Good R&D set up | | | | | | |
| 37 | Management | Strong KMS (Knowledge management system) | | | | | | |
| 38 | Network | Strong communication network with customers | | | | | | |
| 39 | Network | Collaboration and Partnership with their buyers | | | | | | |
| 40 | Network | Access to newer technology trends-alliance/partner/networks | | | | | | |