

Strategic Partnership in Research and Development and Its Impact on Environmental and Social Performances in Indian Aerospace Industry

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Abstract

Purpose – Strategic partnership is an important supply management strategy for sustainable supply chain performance. In the present study, the impact of strategic partnership in Research and Development on environmental and social performances has been assessed related to Indian aerospace industry. For the study various Micro, Small and Medium Enterprises (MSMEs), Private enterprises, Government owned companies and other Research and Development Organisations, who are engaged in the design, development and manufacture of components, sub-assemblies and major assemblies of aerospace related items such as aircraft, helicopters, space launch vehicles and associated systems in India have been considered.

Design/Methodology/approach- Conceptual research framework was developed with three constructs. The research framework of the present study was developed and tested based on research gaps identified through various literatures. Data was collected from the companies through survey methodology with questionnaire as an instrument. Statistical analysis was carried out for 263 responses received from various companies under aerospace industry using SPSS AMOS 20. Hypotheses of the model were tested using Structural Equation Modelling (SEM) methodology.

Findings – The results of the study shows that strategic partnership in research and development in Indian aerospace companies has a significant impact on environmental and social performances of the company.

Research limitations/implications- Present study is limited to environmental and social performance and further the study can include other dimensions such as economic and competitiveness of an industry.

Originality/value – Literature review indicates that not much research work has been done on this subject and considered as one of its kind in Indian aerospace industry. This study contributes knowledge to decision makers in the company for achieving sustainable supply chain performances.

Keywords - Strategic Partnership, Supplier Collaboration, Environmental performance, Social performance, Structural Equation Modelling.

Paper type -Research paper

1. Introduction:

It has been reported that Indian aviation market is playing major role for the sustainable economic growth of India. As per the economic survey report published by Ministry of Finance, the civil aviation sector in India has significant untapped potential for economic growth. Further the survey reports also indicates that India's domestic air traffic is growing at a rate of 14% per year over the last 6 years and will be a third largest overall (including domestic and international traffic) by the year 2025 (Ministry of Finance, 2021). For the growth of civil aviation market, Government of India has given lot of impetus through new National Civil Aviation Policy (Ministry of Civil Aviation, 2016) and provides opportunities for developing an ecosystem for the growth of various aviation subsectors, i.e. airlines, airports, cargo, maintenance repairs and overhaul services (MRO), general aviation, aerospace manufacturing and skill development.

Further Government of India's initiatives like Atmanirbhar Bharat (2020), and Make in India (2014), have focussed not only on the self-reliance in production of aerospace and defence products but also on establishing the strategic alliances for production of aerospace and defence products in India.

The growing civil aviation sector in India and various initiatives by the Government in this direction are creating huge opportunities for Indian aerospace companies for sustainable business growth. In order to utilise these opportunities, there is a need to focus on development of sustainable supply chain for enhancing companies competitiveness in the global market. Aerospace industry is one of the highly competitive and regulated global industries which require a powerful collaborative framework to work with their supplying partners for design, development and maintain aerospace products to meet customer needs (Braziotis, et al., 2016).

According to Rebolledo and Nollet (2011), aerospace industries are highly technology intensive with complexity and variety of technologies and require high precision for the manufacture of aerospace products and operations are unique in nature as compared to other manufacturing industries. Hence, suppliers' management throughout the aerospace supply chain remains a major challenge for the industry (Koblen and Niznikova, 2013).

The supply chain management in aerospace industry is challenging in nature due to dependence on foreign sources for aerospace grade materials, stringent quality standards, and high production cycle time, low volumes, limited customers and high risk element. These multifaceted challenges can be effectively managed through strategic partnership or collaboration strategies which are gaining more and more importance in aerospace industry.

It is also observed from the review of various research articles that not much of research work has been carried out strategic partnership as supply chain management strategy related to aerospace sector. This research gap has been taken up in the present study to investigate the impact of strategic supplier partnership in research and development on environmental and social performances in an Indian aerospace industry. For the study purpose, companies like micro, small and medium enterprises (MSMEs), private sectors and public sectors engaged in design, manufacturing and processing of aerospace product components, sub and major assemblies of aerospace products like aircraft, helicopters and satellite launch vehicles have been considered.

The paper is structured with nine sections. The section 1 is the introduction highlighting growth of Indian aviation market and the opportunities available for various companies working for Indian aerospace industry. Literature review on the various parameters considered for the research is presented at section 2. The section 3 includes conceptual research framework and hypotheses development. The research methodology is presented in the section 4. The data analysis, discussions, conclusions and limitations of the present study are presented in section 5 to section 9. References are indicated after the end of section 9.

2. Literature Review

2.1 Strategic partnership:

It is noted from various research articles that both terminologies of supplier collaboration or supplier partnership are being commonly used as supply chain practices in sustainable supply chain management. Supplier collaboration is described as supplier partnerships, joint venture, consortia and strategic alliances. Partnership is an inter-organisational relationship in which the participating partners agree for investment in resources, sharing of information, sharing of risks and rewards. Partnership also includes joint working of partners for achieving the mutually agreed goals as well as jointly makes decisions and solves problems that yield a competitive advantage (Soosay et al., 2008; Braziotis, et al., 2016). Supply chain partnership is also a strategic partnership between two or more firms for the joint effort and collaborates in one or more core value creating activities such as research, product development, manufacturing, marketing, sales, and distribution (Augus and Hassan, 2008).

Supply chain collaboration is a partnership process in which more than two independent partners work together to mastermind and execute supply chain operations for the fulfilment of common goals and mutual benefits (Cao and Zhang, 2011; Blome et al., 2013). Collaboration is considered as one of the main strategies in the supply chain, which could help organizations to increase their competitive advantages (Mehdikhani and Valmohammadi, 2019). According to

Spekman and Davis (2016), collaboration in the context of supply chain can be a win-win arrangement for both parties to improve their business and competitive advantage.

Cao and Zhang (2011) highlighted that many research has been carried out on supply chain collaboration across different type of industries and opined that research have to be carried out for a particular type of industry for consistent results and to extend further for longitudinal research studies as a scope for future research. Supply chain collaboration has become a strategic issue for companies that wish to achieve their economic, social, and environmental sustainability targets (Chen, et al., 2017). Research on Sustainable Supply Chain Management in emerging economies is still in its infancy when compared to research on developed countries and need to consider supplier collaboration and sourcing as an essential part of the supply chain (Sánchez-Flores et al., 2020).

According to Soosay and Hyland (2015) the supply chain competitiveness can be enhanced through supply chain collaboration and considered as an important research topic in the field of supply chain management. It has also been mentioned that limited empirical studies have been carried out on the role of strategic supply partnership in the supply chain management process and its impact a firm's performance (Augus and Hassan, 2008).

The importance of supply chain collaboration for achieving sustainable supply chain performance have been highlighted in several research articles (Dubey et al., 2017; Fritz, 2019; Panigrahi et al., 2019; Wang and Dai, 2017). By establishing direct contact with suppliers and manage the relationship through collaboration has a positive influence on supplier adoption of sustainable business practices (Koberg and Longoni, 2019) and long term future collaborations (Ramanathan and Gunasekaran, 2014).

Considering views of various researchers on collaboration as explained above, the present paper attempts to address the impact of strategic partnership in research and development on environmental and social performances in the context of aerospace companies in India.

2.2 Partnership in Research and Development (R&D):

In aerospace industry, design, development and manufacture of aerospace products require highly complex technologies and needs collaboration with partners (Braziotis, et al., 2016). Indian aerospace sector is still at nascent stage and there is a need to improve in development of aerospace technologies as compared to global aerospace industries. As there will be huge demand in future for number of aircraft for civilian and as well for defence sectors, Indian aerospace companies have to acquire required technologies to become self-reliant in the design, development and manufacture of aircraft. This is possible only through collaboration or partnership with strategic partners for design and development of aerospace products.

According to Mocenco (2015), partner's role in the new generation aircraft development programs is becoming increasingly important and management of strategic partners in supply chain has become a key factor for major manufacturers in the aircraft industry.

Razaei, et.al. (2014) conducted study on benefits of supplier partnership in various functions such as production, marketing and sales, purchasing and logistics, research and development and finance related to high-tech small and medium enterprises (SMEs) and found that partnership in research and development area only had a significant impact on overall firm performance. The study has also concluded that through partnerships in research and development, firms were able to develop their competitive advantage. Further Sarpong, et.al., (2023) opined that sustainable innovation systems which results in competitive advantage to the firm can be established through investment in R&D, collaboration with learning institutions or firms and investment on training of R&D personnel for skill development. Outsourcing of R&D activities can also be considered as strategic partnership in R&D where in a firm can engage domestic or offshore suppliers for the design activities. It is also reported that reduction in cost and time with high quality design can also be achieved by the firm through working with domestic suppliers who have specialised skilled designers Lee (2020). On the other hand, a firm can engage offshore suppliers when a firm need to develop a new product or design concept for specific requirements of targeted countries wherein the firm will not be having required knowledge or skill for the new product development. This means knowledge or skill can be acquired from offshore suppliers through partnership in R&D. In this context, Teirlinck and Spithoven (2013) also highlighted the challenges involved in R&D outsourcing and

research co-operation which are similar to that of engaging domestic suppliers and offshore suppliers for R&D. According to them, in case of R&D outsourcing, exchange of information takes place in an interactive mode with suppliers for solving the technical problems. In case of research co-operation, knowledge generation is based on joint participation in research activities by both firm and suppliers. Authors also mentioned that research co-operation provides more complex knowledge and managing with suppliers requires more attention.

It is evident from the above that collaboration or partnership in R&D will improve innovation and resulting in competitive advantage which improves performance of a firm. It is also noted from the literature review that not much research work has been done on assessing the impact of partnership in R&D directly on environmental and social performances of a firm. Hence the present study was taken up to address this area.

2.3 Environmental performance:

It is evident from the literature survey that many researchers have addressed environmental performance of a company or firm in the through Green Supply Chain Management (GSCM). It is mentioned that environmental factors have an important bearing on overall performance and competitiveness of an organization (Das, 2017).

According to Fritz (2019), the major difference between the terms green supply chain management (GSCM) and sustainable supply chain management (SSCM) is that GSCM will be used to refer only to environmental performance, while SSCM refers to the economic, environmental, and social performance. Author has mentioned that GSCM is a part of sustainable supply chain management and currently there is no agreement on how to define and differentiate both concepts. Fritz (2019) also evolved GSCM concept by considering green concepts at all stages of supply chain like green design, green suppliers, green purchase, green manufacturing, green packaging, green warehouse, green transport and green customers.

It is observed that number of research articles is being published in the field of GSCM and according to Gong, et al. (2019) the cumulative amount of articles published in this field has grown up exponentially during the period 2009 to 2019. It is also reported that most of the literatures focuses on qualitative analysis and recommended for quantitative analysis through large scale data collection.

Wong, et al. (2015) highlighted that the concept of green supply chain integration (GSCI) in an organisation which includes internal green supply chain management, supplier green supply chain integration, customer green supply chain integration and community green supply chain integration. In respect of supplier green supply chain integration, one of the GSCI practices indicated is the strategic collaboration and integration with suppliers for environmental improvements which involves working closely with suppliers to achieve collective environmental goals by providing required support to suppliers including sharing of resources.

Çankaya and Sezen (2018) in their study on effects of GSCM practices on three dimensions namely, economic, environmental and social dimensions of sustainability performances, they found that even though some supply chain practices considered for study have not supported fully for all three dimensions of sustainability, but green manufacturing practices are fully supported all three dimensions. Geng, et al. (2017) carried out meta-analysis of selected research articles published during the period 1996 to 2015 related to Asian emerging economies and found that GSCM practices lead to better performance in respect of economic, environmental and operational aspects.

Lutra, et al. (2016), in their study on the impact of critical success factors (CSFs) on GSCM towards sustainable supply chain in automobile industries in India have found that supplier management (strong partnership with suppliers) has a significant impact on GSCM. It is also opined that as a part of sustainable supply chain performance, there exists an opportunity for investigating social parameters through GSCM.

It is evident from the above research articles that green supply chain management (GSCM) in the supply chain has a significant impact on environmental performance of a firm and also the supplier partnership is one of the critical success factors for the GSCM.

2.4 Social performance:

It is observed that number of research articles on supply chain performances has been published in respect of economic and environmental dimensions of sustainability. Earlier firms were focussing only on economic aspect of sustainability and subsequently firms provided stimulus on environmental and social aspects of sustainability, even though they are difficult to measure them (Panigrahi, et al., 2019). It is noted from the literatures on GSCM that researchers have addressed environmental and economic performances and not much on social performance (Çankaya and Sezen, 2018).

In respect of social sustainability, Mani, et al. (2020) conducted a study on supply chain social sustainability in small and medium manufacturing enterprises (SME's) and its impact on firm's performance by considering six social dimensions such as equity, safety, philanthropy, health and welfare, ethics and human rights. As per findings of the study, there is a significant relationship between SME's social sustainability practices and their firm's supply chain performance. This has implied that small and medium manufacturing enterprises need to commit and address those social issues that might have an impact on their supply chain performance.

Ahmadi, et al. (2017) conducted study on assessing the social sustainability of supply chains considering social dimensions like training, education and community influence, occupational health and safety management system. Even though the analysis has shown least importance to occupational health and safety based on the responses received, authors suggested that this is an important social dimension and needs to be addressed in all manufacturing industries. According Zhang, et al. (2017), the social responsibility in the supply chain can be improved through supplier development practices like collaboration and training based on suppliers' capability gaps.

3. Conceptual research frame work and hypotheses development:

Based on the research gaps identified through literature review as mentioned at section 2, the present research work was taken up to study the strategic partnership in research and development and its impact on environmental and social performance related to Indian aerospace companies. The objectives of the present research are:

- a) To assess the impact of strategic partnership in research and development on environmental performance of Indian aerospace companies and
- b) To assess the impact of strategic partnership in research and development on social performance of Indian aerospace companies

Accordingly, research framework shown at Figure 1 with three constructs or dimensions.

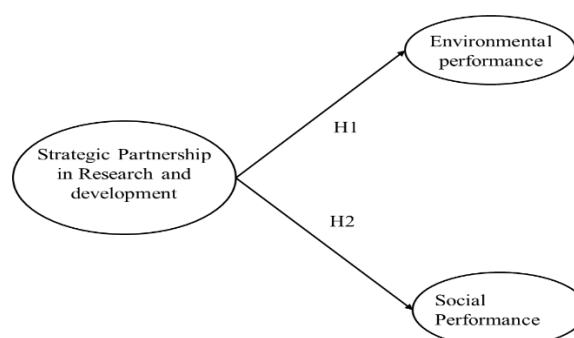


Figure 1. Research framework

The hypotheses for the proposed research framework are as follows:

H₁: Strategic partnership in Research and Development will impact significantly on the environmental performance of a company.

H₂: Strategic partnership in Research and Development will impact significantly on the social performance of a company.

4. Research Methodology:

4.1 Questionnaire design and variable Measurement scale:

To test above defined research hypotheses, a survey questionnaire for obtaining quantitative data was developed for three constructs. The questionnaire has been developed from the various research articles and tested by the researchers as mentioned in the literature review at section 2. In the present study, a total of 15 Likert based questions or items were designed asking the respondents to rank their importance of agreement on a scale of 1 to 5 with '1 Strongly Disagree' and '5 as Strongly Agree'.

4.2 Sample data collection:

In the context of Indian Aerospace Industry, sample aerospace companies considered includes micro, small and medium enterprises (MSMEs), private sectors, public sectors and Government research and development organisations engaged in the manufacturing and processing of aerospace product components, sub and major assemblies of aerospace products like aircraft, helicopters and satellite launch vehicles. Convenience sampling plan was considered for selection of companies for obtaining responses. The list of aerospace companies was identified from the Aerospace and Defence directory (SIATI, 2021).

For the present study, aerospace companies located in Karnataka, Telangana and Tamil Nadu were selected having AS 9100 and ISO 9001 quality certifications and supplying aerospace components as Tier 1, Tier 2 and Tier 3 suppliers to Original Equipment Manufacturers (OEM). As per the definition, AS 9100 certification includes all ISO 9001 standards plus additional regulatory requirements specific to aerospace industry like risk management, project management and design and development (Tomic et al., 2012) and it is a requirement for the firms who are involved in the manufacture of aerospace assemblies.

Responses were collected from the selected sample firms through a structured questionnaire sent through e-mail and also in Google form. The respondents were proprietors of MSMEs, senior management level professionals working in operations management functions like manufacturing, production planning and outsourcing departments in respect of private firms and public sectors. Respondents also include scientists from Government research and development organisations involved in the development of aerospace product and its components. As far as data collection is concerned, a total of 263 responses were collected through a structured questionnaire against the constructs considered in the research frame work.

4.3 Descriptive Statistics

According to the characteristics of the sample respondents, it is emerged that 36 % of respondents are each from MSME and public sectors respectively. The respondents from Government organisations amount to 28%. In continuation, 49 % of the respondents have more than 30 years of work experience while 31 % of them have 21 to 30 years of work experience and 16% of them have more than 11 to 20 years and 4% of respondents are having work experience of less than 10 years in aerospace companies. As this research work was mainly focussed on aerospace companies, 68% companies are having AS 9100 and balance 32% is having ISO 9001 certifications.

4.4 Statistical tool for testing the research framework:

For the research framework, Structural Equation Modelling (SEM) statistical tool was used to test the hypotheses related to constructs considered in the model. This tool can handle multivariate and evaluate the causal

relationship in a model. With the help of Structural Equation Modelling, relationship between constructs can be presented in a graphical language along with various measurable indicators which is easy to understand the research framework (Takkar, 2020)

5. Results and Analysis:

5.1 Reliability and Validity:

Table 1 shows the relevant items, their standardized loading (correlation coefficients) and the Composite Reliability (CR) and Cronbach Alpha (CA) results through Confirmatory Factor Analysis (CFA) technique that was adopted to validate the hypothesized measurement model consisting of three constructs namely Strategic Supplier Partnership in research and development, environmental and social performances as shown in Figure 1. Furthermore, the standardized loading of indicators under each construct is given in Table 1.

Cronbach's alpha reliability coefficient was calculated in order to assess the psychometric properties of the questionnaire which means whether responses are consistent between indicators. Cronbach's alpha value ranges from 0 to 1, with value closer to 1 indicating greater stability, more correlated and consistency. Analysts frequently use 0.7 as a benchmark value for Cronbach's alpha (Nunnally, 1978).

The results of Cronbach's alpha (CA) are depicted in Table 1 are higher than acceptable value of 0.7 indicating an acceptable consistency and stability of the instrument. Secondly, with respect to composite reliability (CR) it is observed from Table 1, it is observed all items demonstrated a loading greater than 0.50 clearly validating the convergence.

Table 1: Reliability and item loading of strategic partnership in Research and Development, environmental performance and social performance constructs

Constructs	Indicators	Loading	CR	CA	AVE
Research and Development (RD_SR)	Partnership will address environmental concerns of customers in terms of eco-friendly design of products (RD_SR_1)	0.729	0.875	0.876	0.585
	Technology transfer from partners creates healthy working environment (RD_SR_2)	0.712			
	Partnership will evaluate needs of customers jointly (RD_SR_3)	0.834			
	Jointly share resources for mutual benefits (RD_SR_4)	0.821			
	Top Management commitment is required for collaboration with partners for R&D(RD_SR_5)	0.719			
Environmental Performance (ENV_PERF)	Partnership helps in Reduction in the cost of procurement of environmental hazardous materials (ENV_PERF_1)	0.779	0.905	0.906	0.706
	Partnership helps in Reduction in environmental pollution (ENV_PERF_2)	0.785			
	Partnership ensures proper disposal of hazardous materials (ENV_PERF_3)	0.877			
	Partnership enables new processes and provides protection against health hazardous activities (ENV_PERF_4)	0.913			

Social Performance (SoP)	Transfer of Technology from partners ensures good working environment like lighting, air conditioning, etc.,(SOP_1)	0.748	0.840	0.840	0.568
	Partnership helps in acquisition of new set of skills by employees resulting in competitive advantage (SOP_2)	0.691			
	Partnership focus on multiskilling of employees to reduce product cost (SOP_3)	0.722			
	Partnership encourages strict compliance to safety regulations (SOP_4)	0.846			

Note: CR - Composite Reliability, CA - Cronbach Alpha, AVE – Average Variance Explained

Table 2 shows the discriminant validity among three constructs considered for the study and observed that they do not statistically overlap each other, since the inter-item correlation values are less than the square root of Average Variance Explained (AVE) value and are free from the problem of multi-collinearity.

Table 2: Discriminant Validity of the Measurement Model:

Dimensions	RD_SR	ENV_PERF	SOP
RD_SR	0.765*		
ENV_PERF	0.444	0.840*	
SOP	0.511	0.614	0.754*

* Square Root of AVE values shown in Table 1

1. Structural Equation Modelling (SEM) and analysis:

Figure 2 shows the assessment of significance and the relevance of the structural model relationships among three dimensions using AMOS.

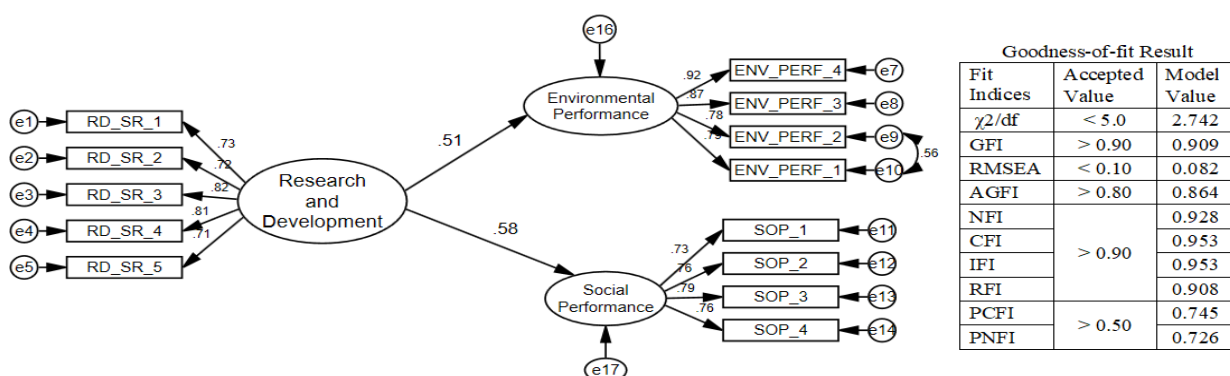


Figure 2: SEM model result between Research and Development, Environment and Social Performance dimensions

After running the Confirmatory Factor Analysis (CFA) to check the reliability and validation of the items, the defined research hypotheses shown in conceptual frame work (Figure 2) are tested for Regression analysis and the results for direct relationship between strategic partnership, environmental and social performances are shown in Table 3.

Table 3: Standardized Regression weights for direct relationship between Research and Development, environmental performance and social performance dimensions

Path analysis	Standard Estimate (β)	Standard Error (SE).	Critical Range (CR)	p-value
Research and Development → Environmental performance	0.506	0.103	7.229	0.000*
Research and Development → Social performance	0.585	0.095	7.349	0.000*

* Significant at 5 % level.

It is observed from the Table 3 that Research and Development has a significant ($\beta = 0.506$; CR = 7.229, $p < 0.05$) impact on Environmental performance and hence hypothesis 1 (H1), could be fully asserted. The interpretation is that, for one unit increase in the rating scale of agreement on Research and Development construct, one could expect about 0.506 times (51 %) (more than half a times) increase in Environmental performance given other factors remain fixed or same. In other words, for every new 10 respondents rating agree/strongly agree for Research and Development dimension, one would expect about five respondents ($\beta = 0.506$) are likely to give a rating as agree or strongly agree to environmental performance dimension.

In similar fashion, it can be seen from the Table 3 that Research and Development has a 59 % influence on Social performance, meaning that for every additional 10 respondents who rate agree or strongly agree with the outsourcing dimension, one would expect about six respondents ($\beta = 0.585$, 58 %) ranking positively to Social performance.

From the table in the figure 2, it is also observed that the values of various fitness indices are towards accepted values as recommended by Hair et.al (2012) for indices like relative/normed chi-square (χ^2/df), Root mean square error of approximation (RMSEA), Goodness-of-fit statistic (GFI), adjusted goodness-of-fit statistic (AGFI), Normed-fit index (NFI) and CFI (Comparative fit index). Hence the developed research framework is appropriate for the present research work.

In summary, the overall validity of the conceptual framework can be considered satisfactory.

2. Discussions:

From the analysis of the results, it has been inferred that the hypotheses developed for the research framework are well accepted. As per the analysis, having a strategic partnership in research and development had a significant influence on environmental performances by effective management of hazardous materials through new technological process and reducing pollution through effective disposal solutions. The partnership in research and development also helps in developing multiskilling, acquisition of new set of skills, improvement in working conditions, health and safety. Improvement in environmental and social performances will leads to improved operational performance of a company.

3. Conclusions:

The present study was taken up based on the research gaps identified through extensive literature review. As per the literature review, it is observed that not much of research has been carried out on strategic supplier partnership related

to Indian Aerospace Industry. This research work was taken up basically to address the importance of strategic partnership in Indian aerospace industry, as there will be a huge opportunities available in the future for MSMEs, Private and Public sectors, as explained in the introduction section. It is of the opinion that this research work is of first of its kind and the results of the study are really encouraging. Through this research work, aerospace companies under MSMEs, Private and Public sectors have understood the importance of partnership for the growth of their companies in aerospace related work.

4. Limitations of the study:

The present work was carried out considering involvement of strategic partners in research and development activity and its impact on environmental and social performances of an aerospace company. As a part of sustainable supply chain performance, scope of present research work can be further extended to include operational and competitiveness performance of an aerospace company also.

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