CHAPTER IV
REVIEW OF LITERATURE

4.1 Introduction

Review of literature is a vital part of the research because it deals with the critical analysis of various published and unpublished works related to the study undertaken and estimates the existing research gap. Therefore, a brief review of various journal articles, conference reports, notes, short stories and editorial related to the technical textiles in India and G7 countries has been done below in order to discuss the uniqueness of the present study. Following is the list of published work which helped the researcher to find the research gap and work further to bridge that gap.

The study relating to textile research in India and G7 countries highlight the impact of globalization and liberalization and has been reviewed and summed up in this chapter. This chapter provides the review of related research to the present study.

(Apparel Fortnightly, 2002) mentioned that phasing out of the MFA was foreseen as a big achievement in the liberalized world trade and a boom for developing nations including India. However, the effect of such liberalization would not be the same for all nations of the developed world. Some will emerge as major gainers while others will be worst hit by the time the textile trade is integrated with the WTO regime. Those countries, which were well established in the world apparel markets enjoyed a high.

(Kareem, 2001) analyzed determinants of India’s machinery exports from 1970- 87 at aggregate and disaggregate level by using secondary data. Multiple regression analysis was applied and no unanimity was found as far as the significance of the
variables was concerned like world demand, domestic demand and import substitution. It was found that domestic demand was not significant in case of non-electrical machinery and world demand was significant in case of agricultural machinery and implements, for Nigeria and Nepal.

(T.S. Papola, 1968)\textsuperscript{140} analyzed wage criteria in the Indian cotton textile industry. The main purpose of the study was to study the evolution of wage criteria and relative emphasis was laid on each of them in the Indian cotton textile industry. Regression analysis was used for analyzing the data. The regression analysis showed a positive influence of cost of living on wage movements. The study found out that the reliability of these results might be affected by the lack of independence among the dependent variables.

4.2 Studies related to Bibliometrics in General

(Arundhaty Das, 2000)\textsuperscript{5} presented a bibliometric analysis of the articles published by the institute in the field of ‘plasma sciences’. It was found that nearly 8,400 articles were written from institutions in India in the field of ‘plasma physics during the period 1989 – 1998. Institute of Plasma Research contributed 198 articles (83\%), which was also the highest for an institution. It was found that the mathematical theoretical treatment had been attributed for most of the articles (62\%). Multiple authorship patterns were common. However, 17\% of articles were written by a single author.

(Cardona & Marx, 2006)\textsuperscript{12} analyzed the work of Georg(e) Placzek with the aim of illustrating the power and virtues of bibliometric techniques and their pitfalls.
(Chakravarthy, 1981) studied the pattern of multiple authorship. It is a proven trend for geology from 1940 to 1970 ranging from 84.97% in single authors to 48.36%, rest being two authors and multiple authors. The Indian contributions gained 76.74% in 1940 and 52.56% in 1970 from the single authors.

(Giri raj G Halkar et al., 1998) made a bibliometric study in the Journal of Family Welfare during the period 1990–97. His analysis included authorship pattern, country wise and institutiona wise distribution of papers, etc. The study also covered subject wise breakup of articles, average length of papers and study of references provided in the articles.

(Gunasekaran et al., 2006) found out from their study that the 6,186 articles from 569 journals and 12 non-journal were of the same Indian researchers. The average impact factor for journal article during this period was 1.359. He found that 26% papers published by Indians were in the US journals. It was 21% and 20% respectively for Indians and UK. In 2002, 563 institutions contributed 6,199 papers and 68% was contributed by Indians.

(Gupta and Sujit Bhattacharya, 2004) attempted to highlight the method of bibliometrics in studying the dynamics of science and technology tools and techniques available in bibliometrics. They concluded that there was a wider acceptance among academicians and policy makers.

(Hazarika, Goswami, and Das, 2003) made a bibliometric study of the 1,402 research articles published in the journal ‘The Indian Forester’ from 1991 to 2000. In their study, the state-wise distribution indicated that the Uttar Pradesh had contributed a maximum number of papers with 35.16%. Nagaland and Sikkim counted the lowest
number of contribution with 0.14%. Multiple authorship papers were dominant in the field of Indian Forestry with 64.55%, while single authored papers were 35.45%.

(Humayoon Kabir, 1993) investigated the characteristics of bibliometric literature by analysing the issues of Library and Information Science Abstract (LISA) from 1964 to 1990. The LISA has 27 years of literature on bibliometrics. The data regarding the author, title of the article, name of the journal/conference proceedings/other forms of publications, language and year of publication were recorded. The study reveals that single author contributions are maximum and the team research is not popular among the researchers in bibliometrics. The ratio between single and multi-authored papers is 2:2:1. Multi-authored papers increased slightly during the period. It was found that there was not even a single entry of bibliometrics in LISA up to 1968. English language was the predominant language of communication accounting for more than 76%. Other languages of publication included Russian, Spanish, French, Japanese, German, Portuguese, etc. More than 90% bibliometrics literature was published in journals with scientometrics occupying the first rank. The use of conference proceedings, monographs and theses/dissertations as media of bibliometrics literature publishing increased, while reports decreased. The articles based on library science studies come to approximately 40%.

(Kotar, 1998) conducted a study of Tekstilec 1989-1997, for bibliometric and content analysis of articles. His study reported that during the period of 1989 to 1997, 202 authors published 338 articles on textile.
(Krishna Kumar, 1992) gave a short study of the origin of the term bibliometrics, purpose, laws, techniques and representative examples.

(Krishna Moorthy, 2005) studied on industrial relations in the textile industry in Tamil Nadu. The study covered a period of 15 years from 1989-2003. The percentages and mean average analysis were carried out. The major findings of the study were that both the number of disputes and the number workers involved in the disputes had come down gradually in the post reforms period in Tamil Nadu. With the measures taken by Government and labour department, the workload of adjudication machinery decreased and the efficiency of conciliation machinery was reflected in its functions.

(Lalithamba and Ananda, 1997) made an attempt to analyze the bibliometric study on library buildings. The objective of the study was to identify, examine and analyze the literature in the field of library buildings and aid to libraries in decision making with regard to journal selection. They applied Bradford’s law of scattering to find out the value of ‘n’ i.e., the number of a journal in the nuclear zone.

(Lancaster, 1992) has studied a bibliometric analysis of the citations to Ranganthan’s writings over the period 1956-1990. The findings indicate that his influence had not diminished over the years.

(Leimkuhler, 1967) analyzed the Bradford’s Law of Scattering was the inverse function of the Bradford’s distributions.

(Paramjit Singh Kawatra, 1994) dealt with the definition, application of bibliometrics in library user studies and stated the limitations and applications.
(Sengupta, 1985) gave a bird’s eye view on bibliometrics. He defined the meaning, definitions of the bibliometric terms and the three fundamental laws with mathematical applications.

(Subir K Sen and Sunil Kumar Chatterjee, 1990) made an attempt to provide the well organized glossary of terms for bibliometrics. The terms were collected from the original sources where a definition cum description was available. In many cases, they modified or reworded the definitions. In cases of adopted terms from other areas of knowledge such as statistical and mathematics, they did not include those terms whose definitions were easily available and adopted terms which had significant applications and much use in bibliometrics.

(Swain, 2010) conducted a bibliometric study of Library Philosophy & Practice journal for a period of 2004 to 2009. This study revealed the compliance of authorship productivity pattern by Lotka’s Law.

(Vickery, 1948) published first notable paper on Bradford’s Law of Scattering in which the results of an analysis of 1,600 periodical references, borrowed from various libraries by the Butterwick Research Laboratories were compared with Bradford’s work and discovered that the Law as Bradford’s stated was not in total agreement with his algebraic expression.

4.3 Studies related to Textile Industry

(Anand, 2008) in a paper on "Designer Natural Fibre Geotextiles- A New Concept" describes the development in flat weft knitting technology which is used for the production and designing of novel natural fibre geotextiles with its interactive
behaviour in different types of soil conditions. The author observes that the vegetable fibre yarn have high modulus, high strength, low elasticity, low breaking extension, much more environment-friendly and biodegradable, all this makes possible to produce strong geotextiles. The flat weft-knitting machine is redesigned to enable very rough and absolutely straight natural fibre yarns to be included into a geotextiles structure. The geotextiles made by the knitted and woven vegetable fibre show the best results and have superior qualities over the mid-range of synthetic geotextiles for soil reinforcement.

(Bhandari and Maiti, 2007) analyzed the efficiency of Indian textile manufacturing firms by using Translog Stochastic Frontier Production functions at firm-level on India’s textile firms and estimated technical efficiency of firms. They found that the average technical efficiency varied between 68-84% across the select years and individual technical efficiencies different way such as age and size during the post liberalization period.

(Chaudhary, 2007) in the paper on "Technical textiles - An evolving stage in India" has discussed the impact of post-Multi Fiber Agreement (MFA) period on Indian textile industry. Post MFA period has brought relief to the developing countries but it made the competition tough due to the cost competitive and low-quality products. The author observed that in spite of strong base of Indian textile industry in the world, its presence in technical textiles in negligible. The reason behind this negligence is the requirement of expensive equipment and skilled workers for producing the technical textile products, which are concentrated in developed countries. However, India meets the consumption of technical textiles by imports from the developed countries. So the
government is also interested in promoting this segment and has taken various initiatives to remove the backwardness of the technical textiles in India. It is inferred that India can develop its base in Technical textiles because of the abundance of raw material and cheap labor but there is a need of concentration of both government and private sector.

A study of US Technical textile industry conducted by (Chi, T., 2009) on "Measurement of business environment characteristics in the US Technical textile industry: an empirical industry" elaborates the measurement of Business Environment Characteristics (BEC) with developing reliable and sound instruments in operations management. The study is based on one of the models of BEC frameworks that consist of four dimensions namely diversity, complexity, hostility and dynamism which proves the BEC model legally accepted.

(Dattilo, King, Cassill, and Leung, 2002) in their paper "Medical Textiles: Application of an absorbable bi-directional surgical suture" report the use of an absorbable bi-directional barbed surgical sutures in a range of different surgical procedures. The most important feature of the barbed suture is that it does not require knots and it does not need to be removed for wound closure. It is summed up that the barbed suture reduces problems related to current sutures on the market. So, this new polymer product will have an indicative effect on the future wound closure industry.

(Dhir, 2010) in a presentation on "Stimulating Growth for Technical Textiles in India" emphasized on the factors responsible for the slow growth of the Technical Textiles in India and also point out the ways that could stimulate its demand. It is concluded that India's consumption for Technical textiles is quite low on the global
map but the rate of growth of consumption is higher than most of the developed countries. In order to fulfill the domestic demand for Technical textiles, manufacturers should educate the consumers, large number of manufacturers should be entered in the market that will result in price decrease, higher and highest quality talent should be attracted towards Technical textile industry, government should take steps for implementing regulations, investment in R&D and product innovation should be increased to enhance the consumption.

(Kothari, 2009)\textsuperscript{61} authored a paper on "Technical Textiles- Growth potential and prospects in India" which points out that the government of India recognized the importance of Technical textiles in 2000 and decided to give priority while implementing textile policy for the growth and development of technical textiles in India. The study shows the current status of world market and market size in India and highlights the areas where India can advantage significantly by adopting and developing applications of technical textiles. It is concluded that India's presence in technical textile area is relatively small at present.

(Nagaraj, 1989)\textsuperscript{84} studied the trends in compound annual growth rates of textile industry during 1986-87 and better growth rate (5.8 per cent), and registered units (3.3 per cent) and total growth rate were (4.6 per cent) during the period.

(Pal and Chakraborti, 2011)\textsuperscript{99} provided some estimates of structural ratios and their growth rates in the jute industry in India. The study concluded that jute industry in India survived mainly on the basic of cheap labor and raw material without any significant technological improvement.
In order to promote the production of hometech textiles, the primary need would be to catch the attention of entrepreneurs in the field of hometech textiles. Entrepreneurs are still keeping away from the hometech textiles in view of the following hindrances. (i) The aspects of Hometech textile and marketing are highly multifaceted and Indian entrepreneurs in textiles have never been exposed to this difficult situation, therefore, they have genuine doubts and anxieties about success in such ventures; (ii) Hometech textiles demands specific raw materials, machinery and equipment, which are mostly imported and therefore, require huge capital towards the project cost; (iii) Hometech textiles being at a growing stage in India, innovation of technology for product development and establishing specific markets with enough volumes require huge working capital for a minimum period of five years, so the entrepreneur could anticipate fruits of high value addition usually associated with hometech textiles. Moreover, market development will require continuous promotional efforts, which need considerable investments as well as lead time: (iv) The developed countries have achieved a saturation point in mass of the hometech textiles and they are moving towards developing countries including India in a competitive manner in globalized markets. They are well experienced in various aspects of hometech textiles and financial strength, while Indian entrepreneurs have little or no experience or knowledge in this direction; (v) The existing norms and mandatory requirements of hometech textiles in India are either outdated or non-existing that makes difficult task for entrepreneurs launching hometech textiles.

(Saxena and Srivastava, 2010) authored a paper on "Sunscreen shelter fabric- A review" which throws light on the significant use of textiles for protecting the skin against Ultraviolet (U.V.) radiation. The authors described the physic- mechanical,
physic-chemical and chemical properties of the textile which are required for avoiding of solar radiation. The development of effective sunscreen shelter fabric depends on fabric structure, UV blocking capability, weathering, flexibility and flame retardation. The UV absorption of shelter fabric is influenced by some factors i.e. nature of the fibre, an influence of dyeing and moisture content.

(Sharan, 2013)\textsuperscript{124} in the paper entitled "Expanding Horizons of Textiles – A Versatile Product" tried to show an over view of the use of non apparel textiles. The paper exhibits that how the applications of textiles have crossed many obstacles beyond the regular use which man can never expect. The author is of the opinion that it is the functional character in producing the desired performance which has turned the textile materials to be in demanding place for out of home articles. There are several factors that support the augmented consumption of textiles in special applications. Over the past several decades, textile fibres have captured an inevitable place in composition and as an essential part of the product structure. It is predicted that in future almost all textile products including what we wear and walk on seem destined to be transformed from their present to multifunctional, adaptive and responsive systems. The textiles can be classified into four categories, based on the performance and function which are; Apparel textiles. Home textiles. Interior textiles and Technical textiles. It is concluded that every new step is paving the way to further expansions. At the present time, these kinds of textiles are making a noteworthy contribution to the increasing market of textiles. Hence, with the succeeding steps and promising trends in the textile industry, greater attention will be drawn from every nook and corner of the world, which eventually get better the economic strategy of the world to a larger
extent, proving that textiles are not only linked to the usual use of protection and safety but also to technological progress satisfying the wants of mankind globally.

(Singh and Kathuria, 2006) discussed the problems faced by Indian garment exporters in the post and also identified the problems of garment exporters located in Ludhiana and Delhi.

(Uglene, 2010) authored a paper on "Recent advances in protective clothing technology" which details the modem development and their reasons in protective clothing technology made by Mustang survival, privately owned Canadian corporation. It is clothing industry but has made number of remarkable advancements in the field of protective clothing technology namely life preserver/ survival vest, National aeronautics and space administration (NASA) life preserver unit (LPU), NASA enhanced life preserver unit (ELPU), advanced life preservers, wind blast- life preserver/ survival vest, thermal protection, immersion suits, thermal under garments and integration. The details have supported the view that the Mustang survival corporation has good research and development capabilities.

(Vengsarker, 2009) writes a paper on "Polypropylene staple fiber for specialized Technical textiles application" which examines the wide range application of polypropylene fiber in Technical textiles. For testing the proficiency of polypropylene fiber in technical textile application, the author has compared the PP fiber with polyester, nylon, acrylic and viscose which results that polypropylene fiber is more resistant to chemicals, regains very low moisture, lowest specific gravity of all fibers, low thermal conductivity, has color fastness and good resiliency than other synthetic fibers. These properties are made capable the PP fiber to be applied in various
segments of technical textiles i.e. geo textiles, media textiles, filtration fabric and flame retardant non-woven.

4.4 Studies related to Literature Growth

(Balakrishnan and Parameswaran, 2007)\(^6\) studied the economic growth in India and by testing multiple structural breaks to identify phases of growth in India since 1950. The results revealed that there were two growth regimes in India since 1950. Further, the study decomposed economic growth by sectors and the contributions to the were estimated. The results of the study indicated the little role for a liberalized trade and industrial policy has been the trigger of a new growth dynamic in India via faster manufacturing growth, at least up to the mid-1990s.

(Dhiman, 2000)\(^25\) examined a ten years bibliometric study on Ethnobotany journal. The year wise, Institution wise, and country wise distribution, authorship pattern, a range of performance cited and length of articles were also analyzed by him.

(Ganesh, 2002)\(^30\) commented that the Indian textile industry was in a state of decay if seen from the perspective of preparedness for the opening of the world textile market in 2005. Those not so concerned with the importance of loss in exports would still need to consider the serious implications for local industry and employment when textile imports opened up further and import duties came down. For almost fifty years, government policy weighted scales against the organized sector including the state sector, first by limiting the growth of composite mills, and then by encouraging excise duty avoidance and evasion as the basis of building competitive advantage in the Indian market.
Karam Pal Singh Surinder Kundu, 2004) studied on the Indian cotton textile industry to analyze the evolution of growth and foreign government policies regarding textile industry of India. Indian five-year plans proved a boom to cotton textile industry, the industry not only made remarkable development but also established milestones in the international market. Foreign trade of Indian cotton textile industry showed an increasing trend. The National Textile Policy announced on November 2, 2002, aimed to give attention to the challenges and opportunities to the domestic textile industry. Indian Cotton Mills Federation (ICMF) during the period 1980-2001.

Karki et al., 2000 have studied the growth of organic chemistry research in India during the years of 1971 – 1989 by using Chemical Abstract as the source database. The study reveals that the activity index of India is quite lower. However, the activity picked up speed and matched with the world during the 1980s. The growth trend of world and India follow the same pattern which shows that the output in three subfields such as amino acids, alkaloids. For the data exponential model has been found to be best fitted.

Kumar and Gopalakrishnan, 2013 carried out a bibliometric study of textile research. Their study reported an indexing of 96360 articles in SCOPUS database during the period of 1983-2012. They reported a linear growth of literature on textile during the period of study. Again, Kumar and Gopalakrishnan analyses the Indian textile research and reported a contribution of 5006 articles from India.

Meadows, 1974 was of the opinion that the total growth curve passes through an S-shaped path consisting of three positions, an initial exponential growth, then a central linear section and finally an exponential decrease towards saturation.
According to a study by (Nair, 2004)\textsuperscript{86} the emerging scenario was that EU (European Union) and USA (United State of America), who together accounted for over sixty percent of world imports of textile and clothing and for most of the textile quotas, fortified their market with preferential arrangements, mostly providing for production sharing by their own industries or for offshore processing of their raw materials. Both had kept their MFN (Most Favoured Nation) import duties on textile products several times higher than their average industrial tariff, in order to make imports from non-preferential sources even more difficult. All this gave a clear message that abolition of quotas should be expected to accelerate all other forms of Non-Tariff Barriers (NTB) and trade defense measures.

(Prince Dhanaraj, 2002)\textsuperscript{104} The study had used three types of statistics published by the Annual Survey of Industries (ASI) from the central and Tamilnadu governments. Secondly, ASI format for the Annual Reports and the spinning mills had been used. Thirdly, data and information had been collected from the sample mills. The major findings of the study include that the gap between them had widened. Moreover, the dependence on plant and machinery made the cotton textile industry a capital-intensive one. The very objective of these mills to reduce the cost of production, especially wage costs, was fulfilled with a reduction in employment. Finally, the conflicting expectations of employees and workers often resulted in industrial unrest.

(Rajendran et al., 2005)\textsuperscript{107} The study of analyzed the global output of Fiber Optics research. They studied the papers covering the period 1999 – 2003 from hi – tech Index database. They also analyzed the growth of literature year wise, country wise, authorship pattern, bibliographic form, the ranking of journals and nature of research.
(Rana, 2004) studies the field of wildlife science. The author found that the growth rate is 37.85 articles per year, and the growth rate of authors varied from 28.80 to 46.70 per year. The 65% of the total authors have contributed an only single article, upholding the applicability of Lotka’s law and 50% of the total literature is contributed by 10% of the total authors. The highest number 48 of contributions (papers) is 456 in 41 years with an average of 3.8 articles per year. Average of all productive authors are 156 articles per year.

(Subramanian, 1992) analyzed the productivity growth in the cotton textile industry in Tamil Nadu for the period 1975-76 to 1985-86. The main objectives of the study were the partial and total factor productivity of factor inputs, to estimate returns to scale and elasticity of substitution between labor and capital, and to find whether any technical progress had taken place in cotton textile industry during 1975-76 to 1985-86. The study utilized the concepts of partial productivity ratios, total factor productivity indices and production functions. The reports of Annual Survey of Industries Economic appraisal (Under the Code Number 23 for Cotton Textile Industry in Tamil Nadu) published by Evaluation and Applied Research Department of Government of Tamil Nadu had been the sources of data for the study. The study had used Kendrick and Solow's indices of total factor productivity. The findings clearly ruled out the possibility of a variable elasticity of factor substitution in the cotton textile industry in Tamil Nadu. The study concluded that partial labor productivity had increased at an annual average rate of 2.42 per cent. The real wage of labor had also increased at the rate of 1.36 per cent per annum.
(Sahnmugam and Bhaduri, 2002)\textsuperscript{123} analyzed size and age growth in the Indian manufacturing sector using a balanced panel of 392 manufacturing firms during the period from 1989-1990 to 1992-1993 to explore. The result of their study indicated that the age positively influences growth, which was in contradiction to the result obtained in previous studies. The findings of the study also indicated that the smaller and older firms grew faster than their counterparts.

(Thirthan\textsuperscript{kar} Ray, 1999)\textsuperscript{141} studied the growth with special reference to Tamil Nadu power looms, examples of an export oriented weaving region. This study described the conditions of the power loom units, its major handicaps, how it tried to address its handicaps. An export recession in 1996-98 showed that the growth had happened without basic changes in the technological and organizational capability of the industry.

(Vanitha and Mohanasundari, 2012)\textsuperscript{145} This study period from 1990-91 to 2005-06. A determinant of labor productivity was measured using regression analysis. The study found that in the cotton textile industry of Tamil Nadu the capital intensity and managerial skill seem to have a positive influence on labour productivity, factory size and wage rate exhibited a negative influence of labour productivity and managerial skill emerged as the major determinant of labour productivity. The study also suggested that, as capital intensity otherwise known as technology factor has emerged as an important determinant of labour productivity in cotton textile industry, the systematic training of workers and managers on efficient production methods and capital deepening in improving technology would enhance levels of labour productivity in the cotton textile industry.
4.5 Studies Related to Liberalization and Productivity

(Ahluwalia, 1991)\(^1\) made a detailed study of the trends in productivity growth in the Indian manufacturing sector. Her study covers the period from 1959-60 till 1985-86. She computed the Chenery measures of the contribution of import substitution to the growth for 62 industry groups of manufacturing. Using this measure as an explanatory variable in an equation explaining growth in productivity, she addresses the question of whether total factor productivity growth across the industry groups is systematically related to the degree of import substitution of these industries.

(Deb Kusum Das, 1998)\(^2\) made an attempt to examine the view, whether changes in trade policy orientation enhanced TFP growth for 76- three digit industries in Indian manufacturing covering the period from 1980-81 to 1993-94. The study has dealt with two aspects- first, what was the position regarding TFP growth in the two trade reform regimes and second, did the trade policy reforms captured in terms of the import penetration rate and export-output ratios, contribute to TFP improvements. To measure the productivity growth at the industry level, the study used a methodology proposed by Jorgenson et al (1987). The study found that a number of industries recording positive growth in both periods. In terms of improvements or decline over the phases, the study found that around 35 industries have a beneficial impact and in other 27 industries the performance has worsened. It is evident that the impact of trade liberalization was mixed.

(Deepak Gupta, 1985)\(^3\) “Productivity Trends and Factor Substitutability in manufacturing Sector in Maharashtra”, Margin, Vol.17, No.4, P.555-567. (1985) made an attempt to study the productivity trends and manufacturing sector in
Maharashtra during the period from 1968-69 to 1977-78 with reference to ASI data. He used Kendrick’s measure of total factor productivity as well as the Cobb-Douglas production function. He concluded that the wage rate has fallen, though the rate of return has increased that is the price of labor has fallen relative to that of capital.

4.6 Studies related to Research Collaboration

(Cholin, 2005) conducted a comprehensive collaborative analysis of the sociology literature. The study has been done for the 15 major fields of sociology using the three collaborative measures as Collaborative Index (CI) Collaborative Coefficient (CC) and Degree of Collaboration (DC) and found that there is an increasing trend towards collaboration in these fields.

(Kundra & Srinivasan, 2004) reveals the productivity pattern and collaboration pattern of Indian institutions, which shows that there is a steady growth in publication and in collaborative output. The degree of collaboration is observed to be between 94.98%, which reflects the high professionalism in the field of chemistry for the period 1993-2003. (Mc Alisler et al., 1980) ascertained the extent of agreement between expert’s subjective assessment of scientific journals and citation ratings of the same journals.

(Maheswarappa, Nagappa and Mathias, 1984) examined the collaborative research in Indian Science and Technology based on authorship data collected from the Indian Science Abstracts covering the periods 1965-70, 1975-80 and 1980-83. The findings revealed that two-authored papers were maximum in Science and Technology as a whole. The single authored papers constitute more than one fourth of the publications.
(Munshi, 1993)\textsuperscript{83} studied research collaboration in agricultural sciences amongst the scientists working in six agricultural universities of India. The findings revealed that only 15.36\% of the total publications constituted single author research output while 84.63\% is collaborative. Interestingly, the collaboration of 2 and 3 authors was more prevalent.

(Sangam, 1986)\textsuperscript{118} applied citation analysis techniques to draw the ranking list of journals in social science based on the citation data collected from the doctoral theses submitted to Karnataka University, Dharwad.

(Sangam & Bagalkoti, 2012)\textsuperscript{119} undertook a study of research output of top eight Asian countries under various indicators. To determine the ranks, the total articles, citations, subject areas, authors, international collaboration, institutional collaborations and H-index are taken into account. In this article, all the indicators which measure quantifiable aspects of the application of science and technology. For this, data has been collected from the SCOPUS database.

(Smith, 1981)\textsuperscript{129} explained two kinds of citation. According to him “reference was the acknowledgment that one document gives to another; a citation was acknowledgment that one document gives to receives from another”. The relationship is implied between the cited document and citing document of all or part. Among 22565 citations, journal citations were considered for the study. A total of 14374 journals were utilized for their study. He identified that there was a predominance of multi authored papers over single authored papers.

(Subramanyan, 1983)\textsuperscript{133} studied the degree of collaboration in a discipline. The total no. of the ratio of multi authored published during the study.
4.7 Studies related to Citation Analysis

(Bonn, 2012)⁹ wrote another trend book entitled "Technical Textiles 2012/13" which covers significant segments such as Protech, Indutech, Agrotech and Mobiltech along with expert reports regarding the mega trends of urbanization and bionic. It also covers European market overview with detailed business data which is divided into the areas such as fibers, chemicals, textile auxiliaries, textile machinery and technical textile. It highlights the solutions and strategies for a "sustainable" future and also carries the Chinese market into the foreground. It is concluded that the market for technical textiles in China will increase in near future but it needs foreign investors who want to realize investments in China because it is not possible for the Chinese textile industry to meet the increasing demand, especially for highly advanced and higher quality technical textile.

(Carrera-Gallissa and Capdevila, 2011)¹³ conducted a study on Textile-related research in Spain: a case study applying micro bibliometric indicators. Their analysis focused on citation study and h-index dependencies of 74 researchers at 6 institutions of Spain. The results of the study show a significance relationship between citation and h-index value.

(Chakrabarty, 2008)¹⁴ in the paper entitled "Indian Technical Textiles prospects" the describe the technical textile growth in India. The author suggested the basic consideration for the Technical Textiles production and presented the various techniques that convert the textiles into products i.e. nano technology, knitting, the braided structure, coating and laminating etc.
(Chaudhary and Shahid, 2012) in their paper entitled "Growing importance of Hometech Textiles in India" endeavored to show the Hometech Textiles as an essential segment of Technical Textiles Industry in India. The purpose of the study is to verify that the demand for Hometech textiles is large enough and is going up in India in the near future. It put special emphasis on market size, exports and imports of Hometech products in order to show the magnitude of the industry in India and offers suitable suggestions for improving the growth and development of the sector.

(Chi, T., 2010) on "A study of Trade competitiveness in the US Technical textile industry" identifies the impacts of major political and economic factors on the US technical textile export to its 15 major trading partners and examines the trade performance of US technical textiles with these trading partners over the period. The author employed ordinary-least-square (OLS) regression under a gravity model framework to construct the analysis. The result shows the increasing trend of US technical textile export with greater production which enables large supply for export. The outcome of the study reveals the competitive position and dominating trade performance of US in Technical textiles with its major trading partners.

(Chi, Kilduff, and Dyer, 2005) in their paper "An assessment of US comparative advantage in Technical textiles from a trade perspective" evaluate the changes in international competitiveness of the US technical and industrial textile sector with time. The authors used the method of Balassa's Revealed Comparative Advantage (RCA) for the detailed examination. They compared the US trading with nine leading textile partners (1992-2002), with the result that high-income countries have a strong trade position in high-tech products whereas medium and low-income countries are
enjoying a strong position in low-tech products. The finding shows the leading position of US in sophisticated technical and industrial textile products.

A scientometric study of laser research in India is done by (Garg & Padhi, 2002)\(^{32}\) for the year 1970-1999. The findings show that research in this area has improved a lot during 1985-1994. This is because of impact indicators such as citation per paper proportion of high-quality papers and publication effective index. India citation rate per paper for highly productive authors is at par with the world citation rate per paper. It indicates that international collaboration mainly with the USA and activity index and attractive profile of the prolific institutions are quite similar.

(Gupta, 2012)\(^{40}\) in the presentation on "Standardization of Technical Textiles- An Overview" states that the presence of developed countries in Technical Textiles is very significant but in case of developing countries like India, its production requires huge investment, technology know-how, better production facilities and standardization in order to take benefit of the new opportunity in this sector.

(Gupta, Bala & Kaur, 2011)\(^{39}\) have made an attempt to study the research publication on AIDS/HIV during 1999-08 by referring to Scopus database. The data was analyzed on the aspects such as the growth rank, global publication share, citation impact, share of international collaborative papers, the contribution of major collaborative partner countries, the contribution of various subject fields and by type of tuberculosis and patterns of research communication in most productive journals.

(Hall, 2010)\(^{13}\) in the paper entitled "Coating of Technical textiles" discusses the different types and techniques of coating for the application in Technical textiles. The article reports the detailed description of individual items which are used during the
coating process. The background and developments of different coated materials namely fusible interlinings, adhesives and laminating have also been covered so as to present their performances and application in coated Technical textiles. 

(Johnson, 2003)\textsuperscript{53} in the paper entitled "High-tech fibers for Technical textiles" throws light on the increasing use of high-tech fibers in technical textiles. The author cites the background of fibers when the concept of long-chain molecules passing through both crystalline and disordered regions of the structure was introduced and also reveals the present picture of high-tech fibers that shows the improved relationships between tensile properties and structure.

(Kaliyaperumal & Natarajan, 2009)\textsuperscript{55} study the growth pattern as well as the overall trend in literature output on the retina during 2002-2007. The results indicate variability in the authorship pattern, and English language as the major medium in literature output for retina. The contribution of the USA is higher compared to that of other countries. The study emphasizes the need for more research in the retina and its allied subjects.

(Kumar, 2008)\textsuperscript{65} authored a paper entitled "Technical Textiles" which discusses the importance of High-performance textile in the era of innovation, modernization, infrastructure etc. It is found out that the Indian Textile industry has a strong base in terms of manpower, resources, machinery, equipment, testing and processing despite it is lagging behind in updating research and development which is the major reason for trivial consumption of Technical Textiles in India. The study gave the conclusion that India will grow rapidly and will have the advantage of manufacturing technical
textiles than other countries due to the low cost of production but need is to the proper selection of raw material, process, machines and implementation of successful innovation and design.

(Marimuthu, 2008)\textsuperscript{73} in the presentation entitled "Business Opportunity for Nonwovens & Technical Textiles in India" describes the growth of factor in India to a big market for Technical textiles and nonwovens. The given status of Technical textile and nonwoven industry in India concluded that Indian market for these industries are at infancy stage but the market size in the past year shows that it has huge growth potential. The demand for Technical textiles and nonwoven products are rising rapidly due to the growth of organized retail market or mall culture and domestic housing boom. The author expected that India will be from Italy in 2012 and will be better than Europe by 2022 and US by 2042. The presentation also offered some suggestions for the entrepreneurs in order to develop its business in Technical textile and nonwovens.

(Marmarali, 2010)\textsuperscript{75} in the presentation on "Technical Textile - The research and innovation challenge in the Mediterranean countries - The case study of Turkey" endeavored to show the status of the technical textile sector in Turkey. It reveals that Turkey is increasing rapidly in terms of Technical textile production similar to developed countries because of its various competitive advantages. It is a big technical textile supplier, importer as well as its investment is continuously rising but the amount of R & D is low in comparison with other OECD countries.

(Mulla & Chandrashekara, 2011)\textsuperscript{82} carried out an analytical study of citation pattern and identified few prominent bibliometrics indicators of 2253 articles published in the
industry and trade literature for the period 2002-2006. The research data has clearly shown the keen inclination of the Corporates with the contribution as high as 42.96%, around 968 research articles. Percentages from Indian Literature contribution (69.86%) revealed the growing interest in the subject.

(Nemoz, 2001)\textsuperscript{90} in a presentation on "Applications and markets of Technical Textiles: Actual situation and Trends" discussed the author is of the opinion that distribution of the Technical Textile knowledge entails a multidisciplinary approach for all future engineers, textile technicians, engineers or managers. The paper also suggests some keys for driving forces, building the most powerful supply chain and transferring the knowledge at all levels in order to make future bright in Technical Textiles.

(Panda, 1997)\textsuperscript{98} analyzed the definitions and facets of bibliometrics. He explained bibliometric studies into descriptive studies and behavioural studies which are important areas in bibliometric studies. He applied Bradford’s law in age relations, Zipf distribution and Lokta’s inverse square law. Citation analysis, bibliometric doubling, journals clustering and obsolescence were also dealt in his analysis.

(Patel, 2010)\textsuperscript{100} in the paper entitled "Technical Textile in India- A dormant volcano prepares to erupt" focused on factors which are responsible for the slow growth rate of Indian Technical Textile Industry. The author throws light on the supply side and demand side factors and gives suitable strategies for stimulating domestic demand for Technical Textiles. The paper covers the global scenario and market size of Indian Technical Textile industry and gave the conclusion that the current consumption of technical textile is 3% which is expected to be 11% which will lead to several benefits
such as the increase in export, increase in job opportunities, entry of large manufacturers and increase in investment.

(Ramkumar, 2009)\textsuperscript{109} in the paper entitled "Compelling case for the Technical textile sector in India" explains that Indian textile industry needs a new IT (Indian textile industry) growth. The technical textile sector in India which are: (a) technical textile sector helps to increase the economic and GDP growth, (b) due to the lack of availability of raw cotton for the textile industry entrepreneurs need to focus on technical textile products and (c) technical textile fulfils the needs of growing domestic and export markets. These reasons support to conclude that scarcity of availability of raw material and skilled labors are the two big reasons, which divert the attention towards the technical textile sector.

(Ramkumar, 2010)\textsuperscript{110} in the paper "Technical Textiles in the changing economic landscape" focused on the Technical textile industry which is an essential textile item and source of connecting emerging economies with the developed world. The author is of the opinion that India needs to enhance the technical textiles sector and requires to have a public-private partnership to create a dynamic converting sector for the technical textile sector in India which will help in creating job avenues for the Indian textile industry.

(Ramkumar, 2011)\textsuperscript{111} writes a paper on "Technical textiles: A growing necessity for the Indian Textile industry" that reveals the need for the Technical textiles sector for its expansion in India. The author has proposed a classification of Technical textiles sector into three segments i.e. consumer products, institutional products and
government products. He also points out the two reasons for the lack of growth i.e. lack of practical knowledge and lack of market know-how.

(Reliance Industries Limited, 2010) presented a paper entitled "Technical Textiles - Growth potential and prospects in India" which shows the Indian scenario of Technical Textiles. It emphasized on constraints for the growth of Indian Technical textile industry and gave reasons for the low consumption of Technical Textiles in India. It suggests various strategies for the promotion of this sector in India in terms of application areas, raw materials, specialty fibers, manufacturing facilities, R&D and quality assurance, domestic and export market development and fiscal measures.

The h-b-index developed by Michael Banks, 2005 is an extension of the h-index. Single h-index could not reflect the difference of time spans for scientists (Liang, 2006). The g-index was introduced as an improvement of the h-index (Egghe, 2006). A significant correlation was found between the journals' h-indices and their citation impact scores (Saad, 2006). In a presentation on "Emerging Indian market trends in Technical Textiles and nonwovens" states the segment wise present status of Technical Textile and Non-woven Industry in India. The included the production and consumption of technical textile and non-woven items in India is increasing very speedily due to the growth in the economy and government's initiatives. The disorganized changes in the conventional textile industry have also encouraged diversification in technical textiles.

(Singh, 2008) in a paper "India to grow faster in Technical Textiles" states that fast growth of the Indian economy will be favorable for the Technical Textiles. The paper covers the market size and consumption of Technical textiles in India which shows
that the Packtech, cloth-tech, Home-tech and Sport-tech products of Technical textiles are largely produced in India.

(Teli and Kumar, 2007)\(^{139}\) in the paper entitled "Technical textile- Functional textiles and apparels" discuss the significant importance of functional textiles and apparels which indicate Meditech and Protech as the two main branches of the Technical textile segment for the growth in fast developing countries like India and China. The applications of nano-technology based functional textiles are also covered in this paper. As per the given market size of Indian Technical textiles during the years 2003-04, 2007-08 and the forecast of world Technical textiles consumption during 1995-2010, we concluded that India and China being developing countries have 19% and 5% of the textile industrial production in terms of Technical textiles respectively.

4.8 Collaboration Studies

(Godin and Ippersial, 1996)\(^ {36}\) analyzed the collaboration pattern at a regional level by looking at the scientific production of Quebec (Canada) during 1980-1992 and found that international collaborated papers rose from 4% in 1973 to 11% in 1984.

(Vogel, E.E, 1997)\(^ {148}\) found that international collaboration is playing an important role in the growth of physics literature in Chile and more than 40% of the papers on physics originated from Chile have international collaboration and the impact associated with these papers is higher than average.

Collaboration among group of authors

(Bordons, M., et al., 1996)\(^ {10}\) studied the pattern of local, domestic international collaboration of Spanish authors in three biomedical sub-specialties and found that the pattern of collaboration varies among different sub-specialties.
(Haiqi and Hong, 1997)\textsuperscript{41} analyzed the characteristics of scientific research collaboration in China and found that the number of internationally co-authored articles was steadily increasing.

(Russel, J.M. 1995)\textsuperscript{117} has observed an increasing trend of internationally co-authored papers for Mexico between 1980 and 1990.

(Stefaniak, B. 1998)\textsuperscript{130} also observed increasing activity of the Polish researchers in international teams.

**Collaboration among group of Institutions**

(Melin, G., 1999)\textsuperscript{76} found that American universities have more national and less international collaboration than the European counterparts.

(Melin and Persson, 1996)\textsuperscript{79} have reported similar results for the co-authorship pattern of the Umea University (Sweden) with different countries in different discipline of science.

(Persson, O., et al., 1997)\textsuperscript{101} points out that research collaboration is of prime importance for all Nordic universities, regarding of their size and nationality as reflected by the papers indexes in SCI (CD ROM) 1993.