CHAPTER I
INTRODUCTION AND DESIGN OF THE STUDY

INTRODUCTION
The word paper is derived from the “Latin” word “Papyrus” and from French “Papier”, Paper is basically composed of vegetable fibers mattered together to form into sheets. “Payprus” is a kind of grass material. Papyrus is an aquatic plant which grew in abundance in the delta of the Nile in Egypt. In an understandable language it means a sheet formed by the composition of vegetable, mineral, animal or synthetic fibers or mixtures with or without the addition of other substances into liquid vapour, or gas so that the fibers are intermeshed together. Paper consumption is used as basic measure of civilization. Initially writings and carvings were made on stones, clay, copper, bras and palm trees, etc. The art of paper making was first developed in China where it was made from the bark and leaves of the mulberry tree. In 751 A.D. the Arabs took the Chinese as prisoners and from them the art of paper making reached to the Middle East and Europe.

The art of paper making reached India through Arabs who initially learnt from Chinese prisoners. Earlier Aryans used “copper plates” (Tammrapatra), Loha Patra (Iron sheets), Tadapatra (Palm leaves), Bhuajpatra (Beech palm) and like material, in order to memorize the huge amount of information. The usage of metals for information sharing and storing has eroded with certain problems, and resulted in invention of paper to ease the human’s everlasting endeavour of information sharing and storing. The usage of lead, copper and bronze as means of communication drastically reduced with the introduction of fiber sheets. In olden days, from Kashmir to Kanyakumari, there were evidences of existence of hand-made paper industries. The paper industry gained its momentum during Moghal Empire. It was observed as the most common use material throughout India at the close of Akbar’s reign.
As per history, the efforts to mechanize the Indian paper industry were first made by William Carey. Then the British Government in India had given a preferential treatment to the indigenous paper production in 1880 to encourage and establishment paper mills. During the course of time the paper industry had been transformed into one of the major and key industry for independent India.

In spite of its growth Paper Industry is one of the high consumed societal resources industries. The running of this industry has a huge impact on eco-and other subsystems of the environment. There is a thrust to find an appropriate substitute for this industry. Accordingly, one substitute came up before the society and market is e-paper. In a research it came to know that more than 90% percent of the world’s data is in electronic format and majority of these electronic documents are never printed. However, the usage and adoptability of e-paper as a right substitute is doubtful due to varied reasons1.

TRANSFORMATION PROCESS OF INFORMATION (PAPER) REVOLUTION

Paper is a symbol of Information processing element. As per the literature on history of paper, in ancient times especially in India, people used for scribing copper, bronze and iron sheets and there were evidences of using taddy sheets as well. Much of the literature, which is very important, is preserved in terms of engraving on stones and other rock forms. Knowledge or information is stored according to its importance. However, the present day information era has gone several revolutionary stages or ages before getting stabilized in present day form.
Transformation process of Paper has submitted one thing to the world that discovery one element outweighs the usage of the other element or product. Accordingly, the usage of present form of paper disappears completely and E-form occupies its place is a debatable and research oriented issue.

Worldwide the Indian paper industry is ranked among the top 15 paper industries. The paper industry employs 1.5 million people and contributes ₹30,000 million to the government of India. The paper industry is ranked among country’s 35 high priority economic sectors.

Paper industry is primarily dependent upon forest-based raw materials. The first paper mill in India was set up at Srirampur, West Bengal, in the year 1832. It was based on grasses and jute as raw material. Large scale mechanized technology of papermaking was introduced in India in early 1905. Since then the raw material for the paper industry underwent a number of changes and over a period of time, besides wood and bamboo, other non-conventional raw materials have been developed for use in the papermaking. The Indian pulp and paper industry at present is very well developed and established. Now, the paper industry is categorized as forest-based, agro-based and others (waste paper, secondary fibre, bast fibers and market pulp).
In 1951, there were 17 paper mills, and today there are about 515 units engaged in the manufacture of paper and paperboards and newsprint in India. The pulp and paper industries in India have been categorized into large-scale and small-scale. Those paper industries, which have capacity above 24,000 tonnes per annum, are designated as large-scale paper industries. India is self-sufficient in manufacture of most varieties of paper and paperboards. Import is confined only to certain speciality papers. To meet part of its raw material needs the industry has to rely on imported wood pulp and waste paper.

Indian paper industry has been de-licensed under the Industries (Development & Regulation) Act, 1951 with effect from 17th July, 1997. The interested entrepreneurs are now required to file an Industrial Entrepreneurs' Memorandum (IEM) with the Secretariat for Industrial Assistance (SIA) for setting up a new paper unit or substantial expansion of the existing unit in permissible locations. Foreign Direct Investment (FDI) up to 100% is allowed on automatic route on all activities except those requiring industrial licenses where prior governmental approval is required.

The paper industry has a vital role to play in socio-economic development of a country. The per capita consumption of paper is generally considered as a benchmark of a country’s modernization. The Indian paper industry, which is century old, has made steady progress and presently has an installed capacity of 9.18 million tonnes, generating 286 billion rupees in 2007. The paper industry employs 1.5 million people and contributes `30,000 million to the Government of India. The paper industry is ranked among country’s 35 high priority economic sectors. However, the sector has not emerged as a hi-tech industry similar to that in developed countries. It is still at the crossroad facing a number of challenges from availability of raw materials through the quality of end products. The Indian paper industry has not grown in an organized scientific way and always had a short term planning. Today the industry continues to face import challenges, particularly in coping with the strong competition from import
while trying to improve the profitability and productivity. Worldwide, the Indian paper industry is ranked among the top 15 global paper industries. The industry is fragmented with a capacity ranging from 10 tonnes to 800 tonnes per day. The per capita consumption of paper in India is still at about 7.0 kg which is far below the global benchmarks. Analysts and economists agree that the economic growth is linked to paper consumption and a modest increase of one kilogram per capita translates into 1.15 million tonnes of additional paper demand.

Growth of paper industry in India has been constrained due to high cost of production caused by inadequate availability and high cost of raw materials, power cost and concentration of mills in one particular area. Government has taken several policy measures to remove the bottlenecks of availability of raw materials and infrastructure development. For example, to overcome short supply of raw materials, duty on pulp and waste paper and wood logs/chips has been reduced.

**Outlook**

Outlook for paper industry in India looks extremely positive as the demand for upstream market of paper products, like, tissue paper, tea bags, filter paper, light weight online coated paper, medical grade coated paper, etc., is growing up.

Paper is often characterized by weight. The weight assigned to a paper is the weight of a ream (500 sheets) of varying "basic sizes", before the paper is cut into the size it is sold to end customers.

**Density of Paper:**

The density of paper ranges from 250 kg/m³ (16 lb/ft³) for tissue paper to 1500 kg/m³ (94 lb/ft³) for some speciality paper. Printing paper is about 800 kg/m³ (50 lb/ft³).
Paper stability:

Much of the early paper made from wood pulp contained significant amounts of alum, a variety of aluminium sulphate salts that are significantly acidic. Alum was added to paper to assist in sizing the paper, making it somewhat water resistant so that inks did not "run" or spread uncontrollably. The early papermakers did not realize that the alum they added liberally to cure almost every problem encountered in making their product would eventually be detrimental. The cellulose fibres which make up paper are hydrolysed by acid, and the presence of alum would eventually degrade the fibres until the paper disintegrated in a process which has come to be known as "slow fire". Documents written on rag paper were significantly more stable. The use of non-acidic additives to make paper is becoming more prevalent and the stability of these papers is less of an issue.
Paper made from mechanical pulp contains significant amounts of lignin, a major component in wood. In the presence of light and oxygen lignin reacts to give yellow materials, which is why newsprint and other mechanical paper yellows with age. Paper made from bleached Kraft or sulphite pulps does not contain significant amounts of lignin and is therefore better suited for books, documents and other applications where whiteness of the paper is essential.

It is important to note that just because a paper is made of wood pulp, does not necessarily mean it is any less durable than a rag paper. The factor that determines the ageing behaviour of a paper is how it was manufactured, not the original source of the fibres. Furthermore, tests sponsored by the Library of Congress prove that all paper is at risk of acid decay, because cellulose itself produces formic, acetic, lactic and oxalic acids.

Mechanical pulping yields almost a tonne of pulp per tonne of dry wood used (which is why mechanical pulps are sometimes referred to as "high yield" pulps), which is about twice as much as chemical pulping. Consequently, paper made with mechanical pulps is often cheaper than that made with bleached chemical pulps. Mass-market paperback books and newspapers use these mechanical papers. Book publishers tend to use acid-free paper, made from fully bleached chemical pulps for hardback and trade paperback books.

**Environmental impact of paper**

The production and use of paper has a number of adverse effects on the environment.

Worldwide consumption of paper has risen by 40% in the past 40 years leading to increase in deforestation, with 35% of harvested trees being used for paper manufacture. Logging of old growth forests accounts for less than 10% of wood pulp, but is one of the most controversial issues.
Paper waste accounts for up to 40% of total waste produced in the United States each year, which adds up to 71.6 million tons of paper waste per year in the United States alone.

Conventional bleaching of wood pulp using elemental chlorine produces and releases into the environment large amounts of chlorinated organic compounds, including chlorinated dioxins. Dioxins are recognized as a persistent environmental pollutant, regulated internationally by the Stockholm Convention on Persistent Organic Pollutants. Dioxins are highly toxic, and health effects on humans include reproductive, developmental, immune and hormonal problems. They are known to be carcinogenic. Over 90% of human exposure is through food, primarily meat, dairy, fish and shellfish, as dioxins accumulate in the food chain in the fatty tissue of animals.

**TYPES OF PAPER**

**Bank Paper**

Bank paper is a thin strong writing paper of less than 50g/m2 commonly used for typewriting and correspondence.

**Bond Paper**

Bond paper is a high quality durable writing paper similar to bank paper but having a weight greater than 50 g/m2. It is used for letterheads and other stationery and as paper for electronic printers. Widely employed for graphic work involving pencil, pen and felt-tip marker. It is largely made from rag pulp which produces a stronger paper than wood pulp.

**Book Paper**

A book paper (or publishing paper) is a paper which is designed specifically for the publication of printed books. Traditionally, book papers are off white or low white papers (easier to read), are opaque to minimize the show through of text from one side of the page to the other and are
(usually) made to tighter caliper or thickness specifications, particularly for case bound books. Typically, books papers are light weight papers 60 - 90gsm and often specified by their calipers/substance ratios (volume basis).

**Construction Paper / Sugar Paper**

Construction paper or sugar paper is a type of coarse coloured paper typically available in large sheets. The texture is slightly rough, and the surface is unfinished. Due to the nature of the source material from which the paper is manufactured, small particles are visible on the paper's surface.

**Cotton Paper**

Cotton paper is made from 100% cotton fibers. Cotton paper is superior in both strength and durability to wood pulp-based papers, which may contain high concentrations of acids. May also be known as cotton rag or ragged paper.

Cotton fiber papers is known to last several hundred years without fading, discolouring, or deteriorating; so is often used for important documents such as the archival copies of dissertation or thesis. As a rule of thumb, each percentage point of cotton fiber, a user may expect one year of resisting deterioration by use (the handling to which paper may be subjected - reference - Southwest Paper Co). Legal document paper typically may contain 25% cotton. Cotton paper is also used in banknotes.

**Electronic Paper/ E- Paper**

Electronic Paper is a display technology designed to mimic the appearance of ordinary ink on paper. Electronic paper reflects light like ordinary paper and is capable of holding text and images indefinitely without drawing electricity, while allowing the image to be changed later. E-paper can be crumpled or bent like traditional paper. Pixels on e-paper are image stable, or bi-stable, so that the state of each pixel can be maintained without a constant supply of power.
Inkjet Paper

Inkjet paper is paper designed for inkjet printers, typically classified by its weight, brightness and smoothness, and sometimes by its opacity.

Photo Paper

Photo paper is a category of inkjet paper designed specifically for reproduction of photographs. The best of these papers, with suitable pigment-based ink systems, can match or exceed the image quality and longevity of traditional materials used for printing colour photographs, such as Fuji Crystal Archive (for colour prints from negatives) and Cibachrome / Ilfochrome (for colour prints from positive transparencies). For printing monochrome photographs, traditional silver-based papers are widely felt to retain some advantage over inkjet prints.

Kraft Paper

Kraft paper is paper produced by the Kraft process from wood pulp. It is strong and relatively coarse. Kraft paper is usually a brown colour but can be bleached to produce white paper. It is used for paper grocery bags, multiwall sacks, envelopes and other packaging.

Laid Paper

Laid paper is a type of paper having a ribbed texture imparted by the manufacturing process. Laid paper is still commonly used by artists as a support for charcoal drawings.

Tyvek / Tyvex

Tyvek is a brand of flash spun high-density polyethylene fibers, a synthetic material; the name is a registered trademark of the DuPont Company. The material is very strong; it is difficult to tear but can easily be cut with scissors or any other sharp object. Water vapour can pass through Tyvek, but not liquid water, so the material lends itself to a variety of applications: medical packaging, envelopes, car covers, air and water intrusion barriers (house wrap) under house siding, labels, wristbands,
mycology, and graphics. Tyvek is sometimes erroneously referred to as "Tyvex."

Paper Towel
A paper towel is a disposable product made of paper. It serves the same general purposes as conventional towels, such as drying hands, wiping windows and dusting. Because paper towels are disposable, they are often chosen to avoid the contamination of germs.

Wall Paper
Wallpaper is material which is used to cover and decorate the interior walls of homes, offices, and other buildings; it is one aspect of interior decoration. Wallpapers are usually sold in rolls and are put onto a wall using wallpaper paste. Wallpapers can come either plain so it can be painted or with patterned graphics. Wallpaper printing techniques include surface printing, gravure printing, silk screen-printing, and rotary printing. "Wallpaper" is also a term for computer wallpaper.

Washi
Washi or Wagami is a type of paper made in Japan. Washi is commonly made using fibers from the bark of the gampi tree, the mitsumata shrub (Edgeworthia papyrifera), or the paper mulberry, but also can be made using bamboo, hemp, rice, and wheat. Washi comes from wa meaning Japanese and shi meaning paper, and the term is used to describe paper made by hand in the traditional manner. Washi is generally tougher than ordinary paper made from wood pulp, and is used in many traditional arts.

Wax Paper
Wax paper (also called waxed paper) is a kind of paper that is made moisture proof through the application of wax. The practice of oiling parchment or paper in order to make it semi-translucent or moisture-proof goes back at least to medieval times. Thomas Edison claimed to have invented wax paper in 1872, but what he really invented was a cheap and
efficient means to manufacture such paper. Wax paper is commonly used in cooking, for its non-stick properties, and wrapping food for storage, as it keeps water out or in. It is also used in arts and crafts.

**Wove Paper**

Wove paper is a writing paper with a uniform surface, not ribbed or watermarked.

**Coated Paper**

Coated paper is paper which has been coated by an inorganic compound to impart certain qualities to the paper, including weight and surface gloss, smoothness or ink absorbency. Kaolinite is the compound most often used for coating papers used in commercial printing. One function of coating is to protect against ultraviolet radiation.

**Future of paper**

Some manufacturers have started using a new, significantly more eco-friendly alternative to expanded plastic packaging made out of paper, known commercially as paper foam. The packaging has very similar mechanical properties to some expanded plastic packaging, but is biodegradable and can also be recycled with ordinary paper.

With increasing environmental concerns about synthetic coatings (such as PFOA) and the higher prices of hydrocarbon based petrochemicals, there is a focus on zein (corn protein) as a coating for paper in high grease applications such as popcorn bags.

Also, synthetics such as Tyvek and Teslin have been introduced as printing media as a more durable material than paper.
OPERATIONAL EFFICIENCY - CONCEPTUAL ASPECTS

Operational efficiency is percentage measure of a management’s ability to generate sales revenue and to controls costs. Operational efficiency deals with minimization of waste and maximization of resource capabilities, in order to deliver quality products and services to customers. Operational efficiency is concerned with identifying wasteful processes and resources, which drain the organisation’s profits. Operational efficiency is also concerned with designing new work processes, which improve quality and productivity, improving operational efficiency has a direct impact on the company’s profit margin.

In a business context, operational efficiency can be defined as the ratio between the input to run a business operation and the output gained from the business. When improving operational efficiency, the output to input ratio improves.

Inputs would typically be money (cost), people (headcount) or time/effort. Outputs would typically be money (revenue, margin, and cash),
new customers, customer loyalty, market differentiation, headcount productivity, innovation, quality, speed & agility, complexity or opportunities.

The terms "operational efficiency", "efficiency" and "productivity" are often used interchangeably. Productivity and efficiency analysis gives an explanation to the difference between efficiency and (total factor) productivity. To complicate, "operational excellence" which is about continuous improvement - not limited to efficiency - is occasionally used when meaning operational efficiency. From time to time "operating efficiency" is also used with the same meaning as "operational efficiency".

### Measuring operational efficiency

In order to improve operational efficiency, one has to start by measuring it. Since operational efficiency is about the output to input ratio, it should be measured both on the input and the output side. Quite often, company management is measuring primarily on the input side, e.g. the unit production cost or the man hours required to produce one unit. Even though important, input indicators like the unit production cost should not be seen as sole indicators of operational efficiency. When measuring operational efficiency, a company should define measure and track a number of performance indicators on both the input and output side. The exact definition of these performance indicators will vary from industry to industry, but typically these categories are covered:

- **Input**: Operational Expenditure (OPEX), Capital Expenditure (CAPEX), headcount (including headcount of partners)
- **Output**: Revenue, customer numbers/distribution between segments, quality, growth, customer satisfaction.
Comparing operational efficiency

If the intention is to compare numbers with others through benchmarking it is important to define, measure and track performance indicators for load and complexity as well. Even within the same industry, customer behaviour might e.g. be significantly different between two markets (or two countries) leading to one company having to assign more resources and cost to handling of customers. Not measuring such load and complexity factors might lead to incorrect conclusions on operational efficiency.

When interpreting the quantitative results of the benchmarking, it is important to consider the strategic differentiation:

Cost is generated by performing activities, and cost advantage arises from performing particular activities more efficiently than competitors. Similarly, differentiation arises from both the choice of activities and how they are performed.

When qualitatively interpreting the quantitative results of the benchmarking, one has to take the company strategy into consideration - as well as the individual strategies of the other members of the peer group. If not done, quantitative results that are a consequence of strategy, not of inefficiency, can't be eliminated.

One company might have a strategy to differentiate with low price. For that company, it is critical to have low unit production costs and high efficiency in distribution. For another company, differentiating with premium quality, the unit production cost is not that critical (but still important to know, of course). Instead, it will be critical to have satisfied and loyal customers and a high absolute revenue per customer. Actual quality levels will also be key to understand5.
Improving operational efficiency

When improving operational efficiency, companies have a few alternatives. The most common are:

- **Same for less**, i.e. same output for less input
- **More for same**, i.e. more output for same input
- **Much more for more**, i.e. much more output for more input

It is a common misconception that costs, in absolute terms, are always cut when improving operational efficiency. It is true for the "same for less" alternative, but not for the two other alternatives. It can be operationally efficient to increase cost - as long as the output is increasing more.

One example of a same for less alternative is when a manufacturing company reduces its total personnel (and thereby personnel cost) while still producing the same volume of goods. This can e.g. be achieved through centralisation, automation or optimisation of working processes.

An example of a more for same alternative is a manufacturing company reducing its output of faulty products (and thereby reducing after sales cost) without using more money or resources. This can e.g. be achieved through use of quality management systems, addressing quality in existing training programs for personnel or introduction of higher quality requirements when prolonging subcontractor agreements.

An example of a much more for more alternatives is when a manufacturing company invests in a new production plant which will enable them to produce products with a higher level of refinement than what could be produced in the old production plants. These products can be sold with a premium that more than compensates for the additional cost. Another example of "much more for more" is when a service company invests in expanding its customer service in order to increase customer satisfaction and customer loyalty.
STATEMENT OF THE PROBLEM

The Indian paper industry, which is century old, has made steady progress and presently has an installed capacity of 9.18 million tonnes. The paper industry employs 1.5 million people and contributes ₹30,000 million to the Government of India. The paper industry is ranked among country's 35 high priority economic sectors. However, the sector has not emerged as a hi-tech industry similar to that in developed countries. It is still at the crossroad facing a number of challenges from availability of raw materials through the quality of end products. The Indian paper industry has not grown in an organized scientific way and always had a short term planning. Today the industry continues to face import challenges, particularly in coping with the strong competition from import while trying to improve the profitability and productivity. Worldwide, the Indian paper industry is ranked among the top 15 global paper industries. The industry is fragmented with a capacity ranging from 10 tonnes to 800 tonnes per day. The per capita consumption of paper in India is still at about 7.0 kg which is far below the global benchmarks. Analysts and economists agree that the economic growth is linked to paper consumption and a modest increase of one kilogram per capita translates into 1.15 million tonnes of additional paper demand.

Therefore it is need of the time to take a complete review of the cost structure of paper industry so as to see what cost component is more responsible for higher cost of paper production and to see that how it can be controlled, so as to keep it as minimum as possible. The major cost centre in the paper industry is as follows.

- Raw material cost
- Employee cost
- Manufacturing cost
- Depreciation on plant and machinery

The study of these components will certainly help to know which factors are adversely affecting for the higher cost of paper production.
Hence the study aims at in the absence of cost data to find out the cost trends of paper production with the help of prevailing financial accounting system as well as to identify the most casual factors which are responsible for unsatisfactory results in the paper industry. While judging the profitability of paper industry it also shows that the incidence of administrative overheads, interest and bank charges are too heavy, this led the mills in higher cost of paper production. Therefore it is equally important to analyse the magnitude of each overhead carefully and how it is affected to the cost of production over a period of time.

IMPORTANCE OF THE STUDY

India is the fastest growing paper market in the world, growing at a CAGR of 6.7%. Indian paper industry demand is closely linked to economic activity. Indian Paper industry demand recovered strongly in financial year 2011.

India paper industry is broadly classified into three segments – namely

- Printing & Writing (P&W) – 35% of total domestic paper demand.
- Newsprint – 20% of total domestic paper demand.
- Paperboard & Industrial Packaging (Paperboard) – 45% of total domestic paper demand.

The industry is further categorized on the basis of raw-material used for manufacturing paper into

- Forest-based (21%),
- Agro-based (23%) and
- Recycled fibre-based paper (56%).

Cost efficiency of domestic producers vis-a-vis major paper exporting countries plays an important factor in determining sustainable profitable operations, given raw-material cost forms about 75-85% of the total manufacturing cost. To compete with large efficient international players, the
The foremost factor to be considered is the cost. Each and every cost in paper production is analysed and necessary steps are to be taken to reduce the cost. There should be a keen watching whether each and every rupee spent gives maximum utilisation. The technical factors all the cost items, capacity utilised, interest paid, overhead cost all have to be analysed and find out which is the pulling factor that brings down the profit of the industry.

**SCOPE OF THE STUDY**

The paper industry has an important role to play in the Indian economy. There are 8 industries in south India including Tamil Nadu. Majority of industry are private sectors and TNPL is the only public sector industry. To draw a logical and meaningful conclusion five industry is taken for the present study.

**REVIEW OF LITERATURE**

Ankur Gupta & Ken⁷ stated that the lead players dominating the Indian paper industry include Ballarpur Industries Ltd., ITC Ltd., Tamil Nadu Newsprint and Papers Ltd., JK. Papers Ltd., West Coast Paper Mills Ltd. and International Paper APPM Ltd. In addition to these companies, many other players in the industry are making constant efforts towards sourcing their wood requirement from their respective farm forestry initiatives. Having realized the advantages of farm forestry by all the stakeholders involved in the initiative, it is being predominantly followed by many paper manufacturers in India.

The Indian paper industry is projected to grow tremendously on account of increasing literacy levels, higher government spending on education, booming retail sector, increasing industrial activities, growth in print media, packaging of FMCGs, pharmaceuticals and apparels, and changing urban lifestyles.
Yogesh Agarwal\textsuperscript{8}, had stated India's paper consumption compares poorly with global standards. While the per capita consumption of paper in India is only 10 kg, the world average is much higher at 54 kg. This indicates that there is lot of headroom for growth in India. From a demand point of view, every 1 kg incremental per capita consumption results in additional demand of more than 1 million tonnes per annum.

Besides this, the government's sustained focus on literacy, increased consumerism and expansion in organised retail are all factors which are expected to positively affect paper consumption and demand in India. So the Indian paper market is poised for growth but how much of that will actually benefit Indian paper companies will be decided to a large extent by the enabling policies provided by the state, apart from the individual competitiveness of the companies themselves.

He would not like to term it as "drying up of new investments" because even now there are projects which are under progress. At an Industry level, over the last five years the Indian paper industry has invested around `20,000 crore towards capacity enhancement, technology upgradation and various acquisitions. Now, the industry is in balance sheet improvement mode. The future investment cycle, however, would depend on how soon the companies in this sector are able to improve their balance sheets.

Forest Policy and Economics\textsuperscript{9}, stated that the objectives of this paper are to: (a) provide a critical survey of existing econometric analyses of supply and demand elasticity's in recycled paper markets and (b) discuss a number of implications of the results from this work. Specifically, the survey adds to our understanding of the functioning of recycled paper markets, points towards some important policy lessons, and identifies gaps in the economic literature on recycled paper market behaviour. The analysis builds on the scope, methodology and data used by 21 previous studies, which all estimate the own-price elasticity’s of recycled paper demand and/or supply.
One key finding is that the own-price elasticity of recycled paper supply is positive but low (around 0.20–0.30). This helps explain the often high price volatility in recycled paper markets, and carries important implications for the impacts of, and the choice between, price- and quantity-based waste management policies. Finally, the analysis also suggests that future research should devote increased attention to different non-environmental market imperfections (e.g., market power, information asymmetries) that could discourage the uptake of recycled materials in the market place. A stronger research focus on recycled paper use in developing countries, not the least China, is also needed.

Direct and indirect generation of waste in the Spanish paper industry waste Management\textsuperscript{10}, Economic Input Output Life Cycle Assessment Models (IO-LCA) that combine LCA with Input-Output analysis (IO) are more accurate and less expensive, as they employ publicly available data. This paper represents one of the first Spanish studies aimed at estimating the waste generated in the production of paper by applying IO-LCA. One of the major benefits is the derivation of the contribution of direct and indirect suppliers to the paper industry. The results obtained show that there was no direct relationship between the impact on output and the impact on waste generation exerted by the paper industry. The major contributors to waste generation were the mining industry and the forestry industry.

Sarbapriya Ray, Shyampur Siddheswari Mahavidyalaya\textsuperscript{11}, stated that the analysis of the financial performance of Indian paper and paper product companies using data from CMIE over the period, 2000-01 to 2008-09. The analysis has been conducted from seven key financial dimensions, namely, financial profitability, capital structure, operational efficiency, fixed asset age, current asset efficiency and liquidity position. The financial performance analysis identifies financial strength and weakness of the firms within paper industry. The study suggests that liquidity position and profitability of the industry as a whole are sound and strong ensuring good liquidity management and better profitability to both investors as well as
entrepreneurs. The study reveals that high and gradually increasing current asset turnover has been a contributing factor responsible for ensuring current asset efficiency which means that resources like current assets of the firms of the industry are getting utilized more efficiently. But, dividend payment being lower, the companies need to improve the quantum of dividend payment in order to satisfy the investors without affecting the future expansion and modernization programmes of the sector. Moreover, companies should make a concerted effort in maximizing assets and minimizing liabilities so that overall financial position could be improved.

Jordi-Roger Riba, Member, IEEE, Trini Canals, Rosa Cantero12, Recycled paper is extensively used worldwide. In the last decades its market has expanded considerably. The increasing use of recycled paper in papermaking has led to the production of paper containing several types of impurities. Consequently, wastepaper mills are forced to implement quality control schemes for evaluating the incoming wastepaper stock, thus guarantying the specifications of the final product. The main objective of this work is to present a fast and reliable system for identifying different paper types. Therefore, undesirable paper types can be refused, improving the performance of the paper machine and the final quality of the paper manufactured. For this purpose two fast techniques, i.e., Fourier transform mid-infrared (FTIR) and reflectance near-infrared were applied to acquire the infrared spectra of the paper samples. Four processing multivariate methods, i.e., principal component analysis (PCA), canonical variate analysis (CVA), extended canonical variate analysis (ECVA) and support vector machines (SVM) were employed in the feature extraction –or dimension reduction– stage. Afterwards, the k nearest neighbours algorithm was used in the classification phase. Experimental results show the usefulness of the proposed methodology and the potential of both FTIR and spectroscopic methods. Using the FTIR spectrum in association with SVM and the system achieved maximum classification accuracy of 100%, whereas using the spectrum in association with ECVA or SVM and the system achieved maximum classification accuracy of 96.4%.
Nadeem, Fatima, Nawab Ali Khan\textsuperscript{13}, stated that the present study entitled Performance Appraisal of Paper Industry in India- a case study of Some Selected Paper Mills has been undertaken with the object of analyzing and evaluating the financial performance of the paper industry in India. The study obtains an insight into the financial position of the four companies of paper industry, namely, Ballarpur Industries Limited, Tamil Nadu Newsprint and Papers Limited, Andhra Pradesh Paper Mills Limited, and West Coast Paper Mills Limited. The financial performance of these companies during the years from 2000-2001 to 2009-2010 has been thoroughly examined. The main objective of the study is to know the position of paper industry, profitability position, liquidity position, activity position and cash flow position of selected paper mills. The study is based primarily on the secondary data published by selected Indian paper. The various tools have been used to analyze financial performance in terms of liquidity, solvency, profitability, and financial efficiency, various accounting ratios have been calculated to make a comparison of the performance of different mills.

Sandeep Kumar Kujur\textsuperscript{14}, India’s Pulp and Paper industry, as one of the old and core industrial manufacturing sector with a bearing on socio-economic development has undergone a significant change during the last three decades, especially after liberalisation. This paper examines in detail about the globalisation and its impact on the growth performances of major indicators of structure and nature of the industry. It then identifies the probable causes for changing pattern of growth. The changing policy of government propelled this sector to integrated international market. Further analysis reveals that, apart from rising production and consumption, erstwhile import dependent India, has achieved self-sufficiency and also witnessed tremendous increase in exports since liberalisation. During the same time, the energy efficiency of the sector has improved while the raw-material consumption has seen drastic shift from conventional type to energy-efficient carbon-neutral non-conventional one.
PTI DUBAI\textsuperscript{15}, India ranks among the top four suppliers of paper to the UAE alongside China, Indonesia and Germany. China and Indonesia are the key source of import to the UAE, accounting for a quarter of paper brought into the UAE. Germany comes third, accounting for 8.1 per cent of Dubai’s imports, followed by India (6.9 per cent) and United States of America (6.9 per cent), Italy (4.4 per cent) and Finland (3.6 per cent).

T.N. Subramanian and Arun Kumar\textsuperscript{16}, stated that the Indian paper and board industry offers many opportunities for the innovative use of limited resources. For a developing country like India, faced with increasing shortages of raw, materials, energy sources and capital, the development of the handmade paper industry offers considerable potential to meet the increasing demand for paper products in an environment-friendly way. Handmade paper production uses exclusively non-forest raw materials; it is particularly well suited to internal recycling; and it is not centralized in large scale units. A case study is presented of the TARA handmade paper production unit in Delhi. The importance of both technology development and marketing initiatives is emphasized.

Indian Paper Industry, Economy Watch\textsuperscript{17}, stated that the Indian paper industry is booming industry and is expected to grow in the years to come. The usage of paper cannot be ignored and this awareness is bound to bring about changes in the paper industry for the best. It is a well-known fact that the use of plastic is being objected to these days. The reason being there are few plastic which don’t possess the property of being degradable as such uses of plastic is being discouraged. Excessive use of nondegradable plastics upsets the ecological problem.

The paper industry is a priority sector for foreign collaboration and foreign equity participation up to 100% receives automatic approval by RBI. Several fiscal incentives have also been provided to the paper industry. Particularly to those mills which are based on non-conventional raw material.
K. Narayanan & Santosh Kumar Sahu\textsuperscript{18}, An attempt has been made to understand the relationship between the labour and energy intensity for firms drawn from pulp and paper industries in Indian manufacturing. Energy and labour intensity is higher for the domestic when compared to foreign firms. The econometric analysis of the energy intensity and other firm specific characteristic suggests that labour intensity has a negative relationship with energy intensity, suggesting and substitution possibility between energy and labour for the pulp and paper industries in India. Further added that higher labour intensive firms are more energy intensive. Profitability of the firm emerged negatively related to energy intensity. More importantly, technology import is found negatively related to the energy intensity of the firms, suggesting that firms in these industries could be using technology import and knowledge sharing from their foreign collaborators for savings on energy and improve productivity.

\textbf{Journal of Forest Economics\textsuperscript{19}}, A common expectation in evolutionary cluster studies is that national clusters engage in competitive interactions that lead to a continuous stream of changes in global dominance. The fuzzy-set analysis on the evolution of the paper and pulp industry demonstrates that globalization has dramatically changed this situation. National clusters have largely faded away; the value chain dominance is now held by technology suppliers who are global hubs in majority of identifiable business activities in the focal industry. Our results imply that when industrial decline is accentuated by industrial concentration in some part of the value chain the national clusters may lose their importance.

\textbf{Prakash Gaba\textsuperscript{20}}, stated that looks like today is a paper day because West Coast Paper has done beautifully well. It is around 16\% up and so is the case with Andhra Paper. Rama Newsprint is actually on the upper circuit. So, when you look at paper stocks it looks like there is some activity in the paper stocks.
Business Standard Reporter\textsuperscript{21}, Paper industry in India is expected to see an average growth of 7 per cent during the next one year according to prediction by the Indian Pulp and Paper Technical Association (IPPTA).

“The sector is expected to grow 7 per cent per annum. From the current about `30,000 crore size, the turnover of the industry is likely to touch 60,000 mark by 2025,” said M B S Nair, president, IPPTA. Currently, the Indian industry is accounts to about 2.5 per cent of the global production of paper.

“Though domestic consumption is growing, the per capita consumption is only about 10 kilo gram against the global average of 57 kilo gram,” Nair said. As per the association, about 31 per cent of the country’s total production is met through raw materials like wood and bamboo, while 47 per cent comes from recycled wastes and the rest from agro products.

\textit{Journal of Forest Economics}\textsuperscript{22}, this paper uses three different approaches for measuring the tightness of competition in the global pulp and paper markets. First, evaluate the market shares of the world's largest pulp and paper companies. Second, estimate the price elasticity of the export demand for pulp and paper. Third, test the Law of One Price. All three approaches suggest that the pulp and paper markets are competitive in the sense that a single firm, no matter how large, cannot increase the price of its products without losing market shares and experiencing a fall in total revenues.

Kiran Kabtta Somvanshi\textsuperscript{23}, stated that Mumbai-based Paper Products is the country's leading consumer packaging company. Strong fundamentals, growth-oriented business and high dividend yield make it an attractive stock. At annual revenues of `700 crore, Paper Products is a leading player in the Indian packaging industry. It offers total packaging solution to the consumer industry with technologies such as flexible packaging, labelling and specialised cartons. It meets the packaging needs of various consumer product categories like personal products, personal wash, laundry, foods,
sauces, beverages, bakery products, spices, confectionery, dairy and other product segments like seeds, specialised chemicals, electronics, healthcare as well as anti-spurious packaging.

**Valinda Rutledge, David Huber, MD. Fache and Jan Mathews**\(^2^4\), told that strategies used by Caro Mont Health to improve quality, decrease cost, and increase operational efficiency have ultimately aligned their system to address the present and future challenges confronting healthcare. Their strategies reinforce the fact, that improved quality and patient outcomes will ultimately reduce overall healthcare costs.

**Haritha Saranga and B. V. Phani**\(^2^5\), revealed that operational efficiencies of a firm play a crucial role, in determining the survival and growth of a firm, especially, when the industry is going through a dynamic structural transformation, owing to external changes. In this paper, they explored the effect of managerial and strategic parameters on the degree of operational efficiency achieved by a firm in the Indian pharmaceutical industry, using data envelopment analysis (DEA). They used non-parametric DEA models and parametric methods, such as regression analysis to determine the factors, which have contributed to the internal operational efficiencies of these firms. The findings indicate, that domestic firms, most of which are controlled by family based governance structures, enjoy higher efficiencies than affiliates of multinational pharmaceutical majors. Operational efficiencies add to the bottom line thus providing the firm with additional resources to take advantage of any growth opportunities that may arise due to the dynamic nature of the external environment.

**R.M. Mathur, B.P. Thapliyal and K. Singh**\(^2^6\), stated that the production growth rate at the beginning of the millennium have generally shows a down word trend. This is however more a case of capacity constraints from 2004-2006 where after the industry announced many capacity expansions and up gradation. The sharp fall again in the year 2007-2008 is in all probabilities due to recessionary trends coupled with capacity constraints. This bottle
neck is likely to case out in the coming time as about 58 projects worth `20,907 crores are outstanding in the sector. Even in the face of recession as many as `5,124 crores are under implementation.

Forest Policy and Economics\textsuperscript{27}, This paper presents an alternative approach in estimating the effect that technological knowledge has on the cost structure facing individual firms. The suggested method is applied to the Swedish kraft paper industry and relies on a comprehensive dataset for eight individual integrated kraft paper mills. The developed model is based on a two-step process. Step one, the estimation of a pure cost reduction index is derived using a flexible variable cost function which is utilising mill-specific dummy variables. In addition, this approach allows for an estimation of the pure unit cost reduction index that is devoid of scale and price effects which, if not dealt with can produce spurious results when estimating learning effects. Step two, is the estimation of a two factor dynamic learning curve model (2FDLC) using the estimated pure unit cost reduction index as dependent variable. The results suggest that the Swedish kraft paper industry has relatively little to gain in terms of cost reduction through a further technological learning.

Forest Policy and Economics\textsuperscript{28}, Timber scarcity relates to the evolution of stocks in both natural forests and tree plantations, relative to the demand from timber processing industries. Several economic indicators are used to evaluate timber scarcity. In particular, the market price of timber stumpage is believed to send a signal to investors in timber growing and to further regulate mill investments, thus preventing industrial overcapacities from emerging relative to future available wood supply. Our analysis of the Indonesian Pulp and Paper industry, one that expanded impressively in the 1990's and installed large overcapacities, gives us the elements to discuss the applicability of market price as a scarcity signal. Specific conditions, usually found in the developing world, most importantly weak or compromised public governance, flawed corporate governance, and the monopsony character of wood supply mechanisms, prevent the
development of a market price scarcity signal. In this paper, special attention is paid to the complexity of the wood supply chain and the nature of the actors involved. This, together with the absence of pricing transparency, allows industrial overcapacities to occur, leading to the depletion of the natural forest. A key unresolved mystery here is why the private capital providers made no effort to detect this obvious and critical risk to the repayment capacity of their investments. The apparent absence of any government role in enforcing sustainable harvest or capacity levels results from state capture and governance failure, topics fully discussed elsewhere in the Indonesian case. The situation has implications for supply modelling as well as for public and private policies.

China Economic Review\textsuperscript{29}, in this study, the authors investigate the demand pattern and structural changes during the economic transformation using data from the paper and paperboard industry in China. Instrumental variable estimations as well as co-integration analysis and error correction models are applied to the analysis. Our results show that in the early stages of economic reform before 1993, the demand did not respond to price changes; while in the later stages, the demand shows significant responses to its own-price and the price of international markets. In particular, since 1992, the own and cross-price elasticity of demand for domestically made paper and paperboard products becomes, respectively, $-0.69$ and $0.59$, in the range found in some market economies. We also find that imports are substitutes for domestically made paper and paperboard products, but the reverse is not true; and in the later stage of economic transition, the reliance on international market has increased, as reflected by the lower price elasticity of imports.

Tapper, Anne-Maria\textsuperscript{30}, the pulp and paper industry is going through a structural change that can be seen in financial ratios. South American companies that profit from the new cost-effective raw material have moved toward being value creators, whereas most of the North American companies that were the leading value creators in the industry are now value
destroyers. The industry also suffers from low profitability, which affects mostly the North American companies. At the same time, South American companies have, however, been able to increase their profitability, which underlines the ongoing transformation.

Forest Policy and Economics\textsuperscript{31}, the objective was to measure the productivity of pulp and paper industry in OECD countries over the period of 1991–2000. We calculated the Malmquist productivity index by using the nonparametric-frontier approach, and decomposed the index into two components: technical change and efficiency change. Empirical results showed that the productivity change of pulp and paper industry in OECD countries ranged from Switzerland's −0.9% to Japan's 2.4% over the sampled period. The Nordic nations (Finland, Norway and Sweden) recorded 1.2–1.5% improvement in their performance. The productivity of the Canadian pulp and paper industry increased by 2%, while that of its United States counterpart increased only by 0.8%. The results also showed that the last decade's productivity growth was attributed more to the technical change than efficiency change.

International Journal of Production Economics\textsuperscript{32}, analysis of the rate and the impacts of technical change in the Swedish pulp and paper industry. In contrast to earlier research on this industry replacement the standard time trend with time-specific dummy variables enabling the estimation and decomposing of a general index of technical change. The analysis is made within a Translog cost function model, which is estimated using a panel data set with observations across individual paper and board mills over the time period 1974–1994. Our results indicate that the highest rates of technical change have generally occurred during the latter part of this period. Pure technical change is the primary component that has directed technical change over the entire time period. We also find evidence of non-neutral technical change. Energy use has been stimulated by technical improvements while labour use has been discouraged. Also, technical change has had waste paper and wood pulp using impacts. However, the
magnitudes of these latter impacts are relatively small, implying that the increase in waste paper use during the last decades has mainly been stimulated by relative price changes.

Stephen A. Magnus, John R.C. Wheeler, and Dean G. Smith\(^3\), had said that operational efficiency implies lower day-to-day operating costs (such as staffing, supplies, business travels, and routine promotional expenses), as well as reduced managerial perquisites.

Central Pulp & Paper Research Institute\(^4\), there is a growing need to invest - capital is needed for mill modernization, productivity improvements and building of new capacity. If adequate measures are taken, India’s competitiveness could substantially be improved and the industry be prepared for global competition. Looking at the future, the Indian Pulp and Paper Research Institute is carrying out a survey of the global competitiveness of the Indian pulp and paper industry. The key objective is to analyse and give recommendations for the Government and the paper companies on how to improve productivity & international competitiveness.

Journal of Forest Economics\(^5\), This paper analyses the effects of price and market size variables on the investment propensities in the pulp and paper industry. A panel of 15 European countries in the time period 1988-1997 is used in the regression analysis. We find the wages, the USD/ECU exchange rate, the price of paper and the installed production capacity to be the main determinants of large investments in this industry. Our measure of market size has no - or only very small - effects.

Scandinavian Journal of Management\(^6\), The traditional production management strategy in paper manufacturing is based on a volume-intensive approach. This involves the measurement of overall performance or productivity, while aiming at a high level of capacity utilisation and minimum waste levels. This approach has proved successful in mills producing high volumes with a limited and standardised product range. This
paper presents five empirical examples to illustrate the use of the two strategies. The detailed analyses of production cycles, the logistical solutions applied and the inventory levels at various stages of the supply chain, show that the Nordic paper industry is slow, with average lead times of 79 days to market. When production cycles are reduced and logistical alternatives are fully exploited, it can be seen that 30% of the inventories can be regarded as slack. The summary of the cases shows that speedier operations easily generate direct cost savings amounting to 2–5% of annual turnover. All these results can be achieved without additional investment; all that is required is a change in production planning principles and logistical control procedures. The paper concludes with a challenge to the Nordic paper industry to be the first in its field to achieve the higher level of productivity that faster operations can generate.

The Japanese pulp and paper industry: an analyse\(^{37}\), the study discusses the determinants of profitability expressed as return on capital among Japanese pulp and paper companies. Return on capital is measured as income before tax related to stockholders’ equity. Return on capital has been divided into profit margin and asset utilization rate. The hypothesis is that return on capital can be explained by mill size, productivity, product line, financial situation, and use of wood resources. The dataset consists of 13 larger Japanese pulp and paper companies listed in Pulp & Paper Statistics. Data on financial performance, production, and use of wood fibers were collected for the period 1991–2001. The average return on equity for the studied companies is 4.2%. Labour productivity has increased quite significantly, from about 600 to 1,000 kg/employee and year. An econometric analysis indicates that the best model fit is found when the asset utilization rate is used as the dependent variable. Significant variables are, among others, asset utilization rate lagged one time period (−), labour productivity (+), capital productivity (−), paper production as a share of total paper and board production (−), total value of assets on the books (−) and solidity (+). This may indicate that the total value of assets on the books is large in relation to the total production of paper, paperboard and pulp.
Patrick McCarthy\textsuperscript{38}, stated that the United States paper and paperboard industry has experienced significant structural changes over the past twenty-five years, including reductions in the number of mills, lower rates of capacity growth, employment cutbacks, and a loss of market share to foreign competitors. These structural shifts portray an industry that increasingly has difficulty adapting to a more competitive global environment. Based on aggregate data from 1965-1996, this paper estimates a short run translog cost function for the industry. The estimated model fits the data well and all sample points satisfy monotonicity and concavity conditions at all points. Among the findings, the industry operates at slightly increasing returns to capital utilization and labour and energy are Allen-Uzawa complements but Morishima substitutes in production. Technological progress generated 0.02% reduction in annual operating costs and consistent with an ailing U.S. industry, estimated marginal costs approximated average operating costs until 1982 after which marginal costs significantly diverged from average operating costs.

Rajiv D. Banker, Robert J. Kauffman, and Richard C. Morey\textsuperscript{39}, have stated that operational efficiency measures, such as the ones they have developed provide managers with the opportunity to implement deployment strategies for new ITs, in order to maximize value.

Tzong –Ru Lee and Jui –Sheng Kao\textsuperscript{40}, had stated that improving operational efficiency reduces block percentage to a minimum and automation and computerization coupled with good management and experienced staff are all essential for the fish market to operate efficiently.
OBJECTIVES OF THE STUDY

1. To examine the composition of various cost components and its pattern.
   - Raw material cost.
   - Employee cost.
   - Manufacturing cost.
   - Selling and Administration cost.

2. To assess the impact of cost on profit.

3. To judge the operational efficiency of the paper mills.

4. To offer suggestions based on findings for the improvement of paper mills.

METHODOLOGY

In this study the research work is based mainly on primary as well as secondary sources of information. As a part of primary source the researcher has visited personally to some of the sample paper mills. The interviews with the officials and executives were organised to understand the financial and technical problems of paper mills.

Secondary sources

Secondary data are collected from PROWESS which is the most reliable and empowered corporate database of Centre for Monitoring Indian Economy (CMIE). The data required for the study were collected from the annual reports of the industry. The annual reports of the sample industry are downloaded from the database called prowess.

Sample size

The study is exploratory in nature attempting to evaluate the operational efficiency of paper industry in south India.
## Table 1.1

**LIST OF LEADING PAPER MILLS IN INDIA**

*(Production in Tonnes)*

<table>
<thead>
<tr>
<th>S.NO</th>
<th>COMPANY NAME</th>
<th>2011-12</th>
<th>2012-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ballarpur Industries Ltd.,</td>
<td>846,244</td>
<td>834,050</td>
</tr>
<tr>
<td>2.</td>
<td>ITC Ltd.,</td>
<td>284,000</td>
<td>298,000</td>
</tr>
<tr>
<td>3.</td>
<td>Tamil Nadu Newsprint and Papers Ltd.,</td>
<td>343,306</td>
<td>371,637</td>
</tr>
<tr>
<td>4.</td>
<td>J K Papers Ltd.,</td>
<td>283,038</td>
<td>292,582</td>
</tr>
<tr>
<td>5.</td>
<td>West Coast Paper Mills Ltd.,</td>
<td>308,230</td>
<td>317,808</td>
</tr>
<tr>
<td>7.</td>
<td>Century Pulp and Paper Ltd.,</td>
<td>154,252</td>
<td>242,906</td>
</tr>
<tr>
<td>8.</td>
<td>Seshasayee Paper and Board Ltd.,</td>
<td>118,282</td>
<td>169,438</td>
</tr>
<tr>
<td>9.</td>
<td>Rainbow Paper Ltd.,</td>
<td>139,596</td>
<td>149,251</td>
</tr>
<tr>
<td>10.</td>
<td>Orient Paper Industries Ltd.,</td>
<td>64,194</td>
<td>64,798</td>
</tr>
<tr>
<td>11.</td>
<td>Abishek Industries</td>
<td>146,416</td>
<td>152,719</td>
</tr>
<tr>
<td>12.</td>
<td>Star Paper Mills Ltd.,</td>
<td>56,147</td>
<td>63,000</td>
</tr>
<tr>
<td>14.</td>
<td>Emami Papers Mills Ltd.,</td>
<td>144,883</td>
<td>145,862</td>
</tr>
<tr>
<td>17.</td>
<td>Murli Industries Ltd.,</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>18.</td>
<td>Mysore Paper Mills Ltd.,</td>
<td>84,282</td>
<td>86,410</td>
</tr>
<tr>
<td>20.</td>
<td>Selvalakshmi Paper Ltd.,</td>
<td>27,091</td>
<td>52,838</td>
</tr>
<tr>
<td>21.</td>
<td>N R Agarwal Industries Ltd.,</td>
<td>131,426</td>
<td>140,494</td>
</tr>
<tr>
<td>22.</td>
<td>Kuantam Paper Ltd.,</td>
<td>95,382</td>
<td>100,218</td>
</tr>
<tr>
<td>23.</td>
<td>Naini Group</td>
<td>78,181</td>
<td>70,185</td>
</tr>
</tbody>
</table>

Source: indiainfoline.com

There are 23 leading paper mills in India. Out of 23 mills, 15 leading paper mills are the members of IPMA (Indian Paper Manufacturer Association). Of the 15 paper mills 6 of them are located in South India.

In selecting the sample mills, the mills which have financial data available for a period of ten years 2003-2004 to 2012-2013 have been
considered for the study. The mills for which the data are not available for one or more than one year in between the study period of ten years or in the beginning or end of the study period have been deleted. Five mills which have satisfied the above said condition have been selected based on earnings as samples of the study.

The five mills are
- West Coast Paper Mills Ltd.,
- Seshasayee Paper & Boards Ltd.,
- Tamil Nadu Newsprint & Papers Ltd.,
- The Sirpur Paper Mills Ltd.,
- Andhra Pradesh Paper Mills Ltd.,

**Period of Study**

The present study covers a period of 10 years from 2003-04 to 2012-13 in order to evaluate the operational efficiency of paper industry in South India.

**STATISTICAL TOOLS USED**

**The following tools are used for analysing the data:**

1) **ONE-WAY ANOVA:**

   ANOVA is a statistical technique for determining the degree of difference or similarity between two or more groups of data. It is helpful in making comparison of two or more means which enables a researcher to draw various results and predictions about two or more sets of data. Anova test includes one-way anova, two-way anova or multiple anova depending upon the type and arrangement of the data.

   One-way anova has the following test statistics:

   \[ F = \frac{\text{MST}}{\text{MSE}} \]

   Where \( F \) = Anova Co-efficient

   \( \text{MST} \) = Mean sum of squares due to treatment

   \( \text{MSE} \) = Mean sum of squares due to error.
The ANOVA tests the hypothesis that samples in two or more groups are drawn from populations with the same mean values. To do this, two estimates are made of the population variance. The ANOVA produces an F-statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from populations with the same mean values, the variance between the group means should be lower than the variance of the samples, following the central limit theorem. A higher ratio therefore implies that the samples were drawn from populations with different mean values.

2) KRUSKAL-WALLIS TEST:

The Kruskal-Wallis test evaluates whether the population medians on a dependent variable are the same across all levels of a factor. To conduct the Kruskal-Wallis test, using the K independent samples procedure, cases must have scores on an independent or grouping variable and on a dependent variable. The independent or grouping variable divides individuals into two or more groups, and the dependent variable assesses individuals on at least an ordinal scale.

3) PROBABILISTIC NEURAL NETWORK CLASSIFIER (PNN):

It is a tool used to classify the observations into one of g groups based on p observed quantitative variables. The Probabilistic Neural Network Classifier (PNN) implements a non-parametric method for classifying the observations. Rather than making any assumption about the nature of the distribution of the variables within each group, it constructs a nonparametric estimate of each group’s density function at a desired location based on neighbouring observations from that group. The estimate is constructed using a Parzen window that weights observations from each group according to their distance from the specified location. The approaches to classifying cases are formulated as a neural network is in the form of four layers. Input layer, Pattern layer, Summation layer and output layer. From the Trained neural network observations-Scores we can find the classified groups.
4) DATA ENVELOPMENT ANALYSIS:

Data Envelopment Analysis (DEA) technique is used for estimation of resource use efficiency and ranking production units on the basis of their performances. Production units are termed decision-making units (DMU). Data Envelopment Analysis (DEA) is a powerful method widely used in the evaluation of performance of Decision Making Units (DMUs). The efficiency of each DMU is the ratio (sum of weighted outputs)/(sum of weighted inputs), adjusted to be a number between 0 and 1. This is a very common definition of productivity. Those DMUs which do attain an efficiency of 1 form a mathematical space (the "efficient frontier") which "envelops" all the other DMU points, hence the name Data Envelopment Analysis. This frontier is very precisely defined and allows the calculation of potential improvements for the inefficient DMUs. Apart from the efficiency scores, it also provides guidelines for improvement and specific targets for the inefficient DMUs. DMUs in DEA terminology DEA is used to determine the relative efficiency of the companies and its organizational units. It compares organizations/units, identify poor performers, best performers, allocates resources more efficiently, create plan of productivity improvement and conducts long-term benchmarking researches.

Canonical Correlations Analysis:

The Canonical Correlations procedure is designed to help identify associations between two sets of variables. It does so by finding linear combinations of the variables in the two sets that exhibit strong correlations. The pair of linear combinations with the strongest correlation forms the first set of canonical variables. The second set of canonical variables is the pair of linear combinations that show the next strongest correlation amongst all combinations that are uncorrelated with the first set.
5) COBB DOUGLAS PRODUCTION FUNCTION

Generally for the same level of input factors, everyone should get almost the same level of output. In Paper mills the production and cost related to the Production of paper has been considered as the important indicator of the operational performance.

The log linear form of production function used is based on the following equation.
\[ \ln Y = \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + u \]
This tool is used to find the production efficiency of the paper mills.

LIMITATIONS

- This study is limited only to paper industry in south India.
- The study on implementing operating efficiency was concentrated.
- This study is based on secondary data taken from CMIE Prowess as such its findings depend entirely on the accuracy of such data.
CHAPTER SCHEME

The entire study has been organized into six chapters. They are as follows:

- **The first chapter** deals with the Introduction and design of the study, Importance of the Study, Statement of the Problem, Scope of the Study, Objectives of the Study, Research Methodology, Limitations of the Study, and Chapter Scheme.

- **The second chapter** explains the importance of paper industry in Indian economy.

- **The third chapter** concentrates on the profile of the selected paper mills.

- **The fourth chapter** tries to examine cost components and its pattern.

- **The fifth chapter** analyses the operational efficiency of paper mills.

- **The sixth chapter** offers the summary of research work, suggestions thereon and conclusion drawn for the improvement of paper mills.