



# “A Study On Challenges Faced In Material Handling Management At Transformer Manufacturing Industry”

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## About The Industry

### General information of transformer industry

Materials handling management in the transformer business faces challenges with issues that affect both product quality and operational effectiveness. The industry's primary focus is handling large, heavy components safely and effectively because of this. Operating costs are increased by the requirement for specialized machinery and knowledgeable personnel. Plus, it may be challenging to efficiently store and move massive materials in transformer production sites due to space limits, which could result in traffic jams and other safety risks.

Another major challenge is quality control. Transformer assembly demands accuracy, and any material mishandling might result in defects or damage, demanding expensive repairs or product rejection. Maintaining a smooth manufacturing flow and avoiding expensive delays requires careful inventory management of specialized supplies, such as copper coils and insulating materials.

The role of supply chain management is important. Effective procurement, delivery, and tracking of materials are necessary to avoid failures and delays in production. It might be difficult to coordinate with several vendors and guarantee an ongoing flow of goods, particularly when working with worldwide supply chains.

Materials handling management in the transformer industry is challenged by the handling of heavy components, space constraints, quality control, environmental regulations, and supply chain coordination. Addressing these challenges is essential for ensuring efficient and reliable transformer production.

## 1. Growth and Evaluation of Transformer Industry in India

Transformer Market size valued at 54 billion USD in 2022 and is anticipated to grow at a CAGR of 7.2% between 2023 and 2032. Large scale integration of renewable energy sources coupled with increasing electrification programs primarily across the emerging economies will accelerate the industry scenario.

Favorable government policies for refurbishment of existing grid infrastructure along with growing consumer focus toward smart monitoring units and sustainable electricity networks will further drive the business growth. Increasing regulatory focus toward integration of energy efficient electricity supply systems in line with rapid adoption of smart grid technology will positively influence the industry dynamics.

The transformer market growth is on account of the rising demand for electricity in line with favorable regulatory reforms aimed at expanding the existing grid infrastructure. Up gradation and modernization to improve existing grid infrastructure network coupled with growing focus at improving their liability and efficiency of power distribution systems will complement the industry size. Favorable regulatory schemes and policies in association with ongoing investments in the refurbishment of traditional technologies will drive business expansion. Additionally, the rapid growth of industrialization and increasing energy demand coupled with government initiatives to enhance energy efficiency will further contribute to the industry's development.

In May 2022, Hyundai Electric, a subsidiary of Hyundai Heavy Industries Group won a deal worth USD 122 million for delivering transformers to Next-Era Energy Inc, a global leader in renewable generation. The motive of the long-term deal is to offer medium & large power transformers for solar & wind power plants.

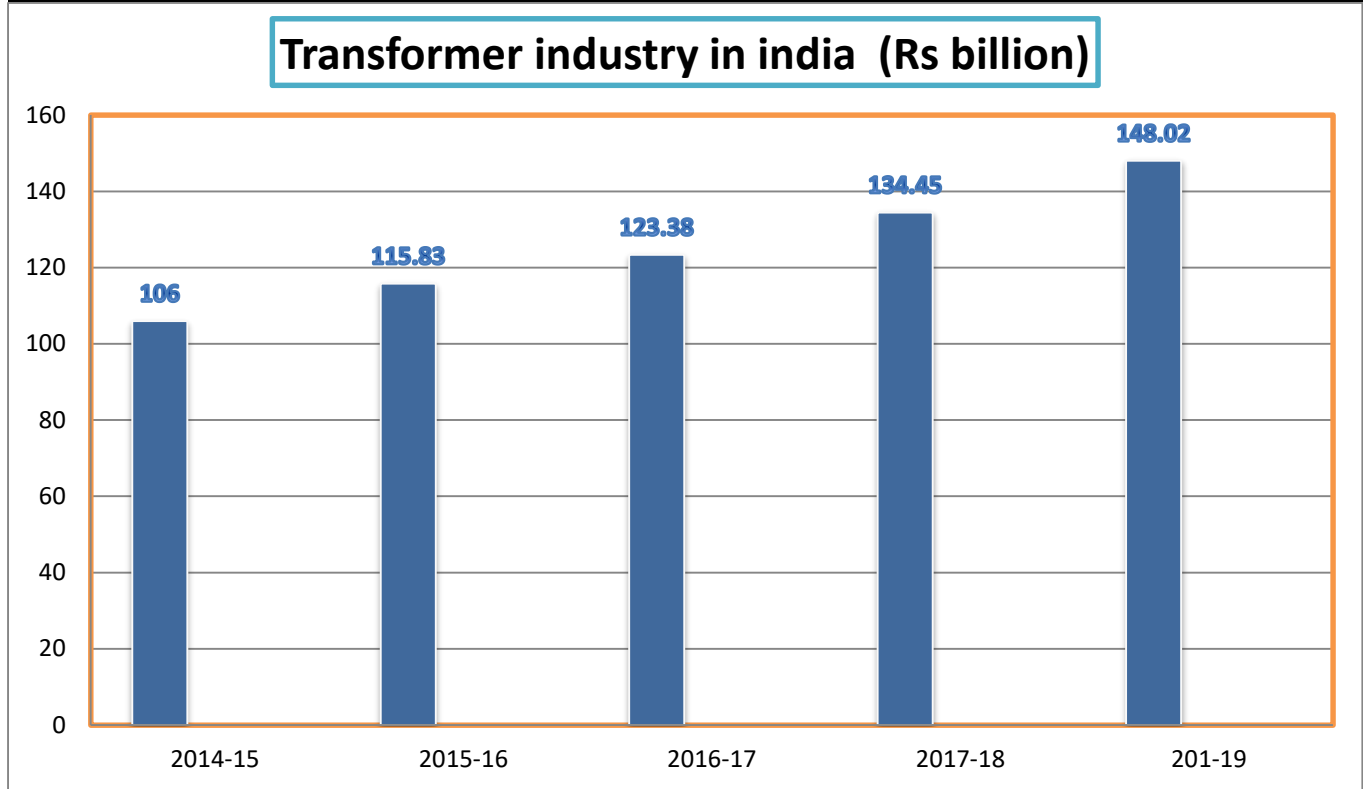


Figure 1 Growth of industry

### India Transformer Market

Market Size

CAGR >5%



Figure 2 Industry future growth rate

Some key factors contributing to the growth and evaluation of the transformer industry in India include:

**Government Initiatives:** The Indian government has launched several initiatives to strengthen the power sector, including the "Make in India" campaign and the "Power for All" program. These initiatives aim to boost domestic manufacturing and ensure reliable power supply, driving the demand for transformers.

**Infrastructure Development:** The focus on infrastructure development, such as the construction of new power plants, transmission lines, and substations, has increased the need for transformers. The government's push for renewable energy projects like solar and wind farms has also fueled the demand for specialized transformers.

**Rural Electrification:** The government's efforts towards rural electrification have significantly increased the demand for transformers. The Deen Dayal Upadhyaya GramJyotiYojana (DDUGJY) and Saubhagya Scheme aim to provide electricity to all rural households, leading to increased transformer installations.

**Industrial Growth:** India's growing industrial sector, including manufacturing, construction, and infrastructure, requires a reliable and stable power supply. This has contributed to the demand for transformers in industrial applications.

**Technological Advancements:** Technology developments have been integrated into the transformer business to improve productivity, reliability, and security. Monitoring, control, and maintenance capabilities have improved as a result of smart grid projects and the use of digital technologies in transformers.

## 2. Product Profile

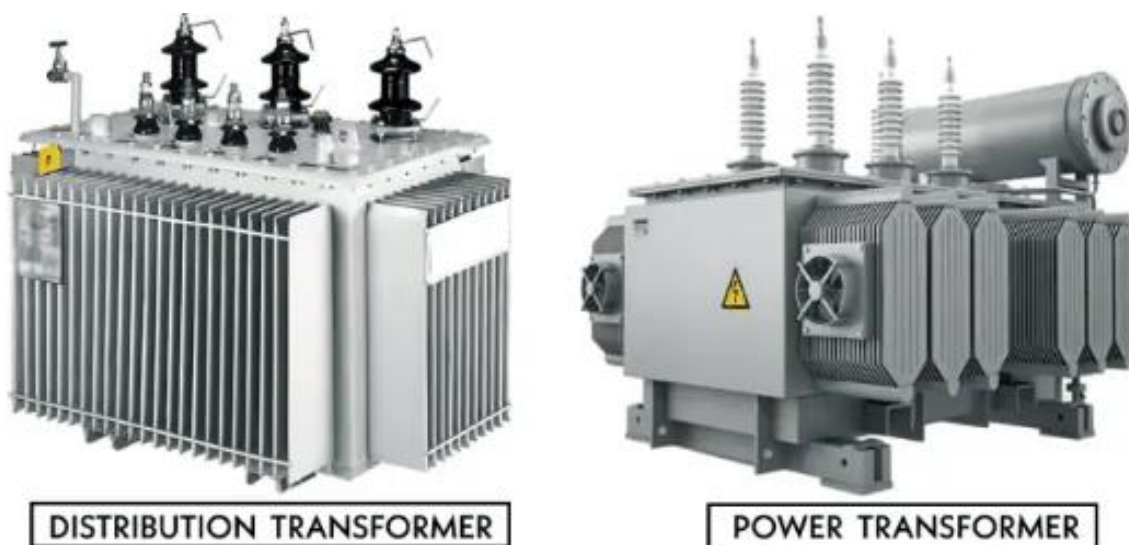


Figure 3 Transformer Product

**Power transformer:-**Step-up the level of low voltage to high voltage and transmit high electric power via transmission lines.

**Distribution transformer:-**Step-down the level of high voltage to the low voltage and distribute electric power to the consumer units.



*Figure 4 Transformer product*

**Insulator:-** Material used in gadgets, circuits, and cables that blocks the flow of electricity.

### 3. Demand Determination Of Transformer Industry

The equipment transformer market is growing quickly on a global scale. The market's expansion can be related to the rising need for electricity brought on by the world's growing urbanization, industrialization, and population. On top of that, the market is growing due to growing electricity utility infrastructures for the rapidly growing commercial and residential sectors. Also, the market is growing at a faster rate due to the increasing utilization of instrument transformers to determine electrical parameters and the use of more electrical power systems.

**Price:**

In the transformer industry sector, price is decided by taking consideration of many elements such raw materials costs, market demand, competition, new technology, legal requirements, and customer preferences. Various variables such as business growth, infrastructure development, renewable energy projects, and power system updates might impact the need for transformers in the market. The types of transformers (power transformers, distribution transformers, etc.), their

features, efficiency ratings, and warranty terms can also affect pricing decisions. Manufacturers can better understand the patterns of demand and set competitive prices by doing market research and analysis.

### **Income of targeted customers:**

Conduct detailed market research, analyzing economic data, and conducting surveys can be useful in understanding the income levels of transformer business customers. By using this data, companies may better target their market group and create products, pricing policies, and advertising strategies that match to their demands.

### **Penetration level:**

The saturation of the market and possible opportunities for expansion are shown by penetration levels, which impact demand in the transformer business. Lower levels suggest growth powered by urbanization, industrial development, and infrastructural expansion, while higher levels indicate established markets with less demand.

### **Availability of finance:**

A number of factors, including market dynamics, advances in technology, size, and rules and regulations affect the demand for financing in the transformer business. The financial demands of the sector are determined by a variety of factors, including large-scale projects, ongoing research and development, market fluctuations, customer preferences, and changing laws and regulations. These factors also influence investment decisions and strategic planning.

### **Replacement demand:**

The requirement for replacement transformers in the sector is driven by a number of causes, including old infrastructure, new technology, legal requirements, and general economic conditions. Transformers have an average lifespan of 25 to 40 years, so older units need to be replaced to keep efficiency and reliability. Demand is also driven by increased regulation and technological improvements. The state of the economy, including stability or growth, is another important factor influencing replacement demand.

### **Promotion scheme:**

Strategic marketing strategies are used in the transformer business to determine demand through promotion schemes that promote purchases. This may involve offering special financing options, discounts, or discounts that motivate buyers to purchase transformers. Manufacturers hope to increase sales, improve demand, and get a competitive advantage in the market by successfully advertising such programmes.

## **Excise duty structures:**

While it impacts pricing factors, excise duty is a significant factor that influences demand in the transformer business. Excise duty structures can influence consumer behavior and have an effect on both domestic and foreign sales. While strategic changes might promote investment and innovation within the sector and ultimately determine market trends and growth, higher taxes may have the opposite effect on consumption.

## **4. Transformer Industry Players**

- **ABB Ltd:**
- **Siemens India:**
- **Lucy switchgear:**
- **Schneider electric and infrastructure:**
- **Voltamp**
- **Toshiba Corporation**
- **Market share of various firms**

Some of the leading market players are ABB, general Electric, Siemens AG, Toshiba Corporation, and Schneider Electric. Among these companies, ABB holds around 12% of market, while General Electric accounts for 8% of the overall share.

## **5. Distribution Channel in The Transformer Industry**

In the transformer industry, an efficient distribution channel is crucial for materials handling management. Typically, this process involves multiple stages. Raw materials such as copper wire and iron cores are procured from suppliers and transported to the manufacturing facility. Once the transformers are produced, they move to distribution centers or warehouses for storage. From there, a well-organized distribution network ensures timely delivery to customers, which can include utility companies, industrial clients, and electrical equipment suppliers. Effective distribution channels employ strategies like just-in-time inventory, optimized transportation routes, and coordination between suppliers and manufacturers. By streamlining this process, transformer companies can reduce costs, improve supply chain resilience, and deliver high-quality products on time to meet the demands of the energy and electrical sectors.

## 6. Key Issues And Current Trends

### Key issue in the industry

**Heavy weight components:** Transformers are made up of heavy parts such tanks, windings, and cores. Avoiding incidents and product damage, handling these components safely and effectively requires specialized tools and skilled employees.

**Space constraints:** Transformer manufacturing facilities often have limited space for material storage and handling. Optimizing space utilization while ensuring easy access to materials is a challenge faced by many transformer manufacturers.

**Safety concern:** In the transformer industry, material handling involves managing big loads and handling very hazardous components like Transformers, power distributors. Strong focus to safety measures and training programs is necessary for maintaining employee safety and prevent accidents.

**Supply Chain Complexity:** A complex supply chain that includes multiple suppliers and subcontractors supplying different parts and materials play a role in the manufacturing of transformers. To ensure that materials and components are delivered to the production plant on schedule, effective material handling management requires careful cooperation among various stakeholders.

### Current trends in the industry

**Energy Efficiency:** There's a strong focus on improving the energy efficiency of transformers to reduce losses during power transmission and distribution.

**Digitalization and IoT:** The integration of the Internet of Things (IoT) and digital technologies is enabling remote monitoring, control, and optimization of transformers, enhancing grid management.

**Green Transformers:** Manufacturers are increasingly designing transformers with environmentally friendly materials and technologies to reduce their carbon footprint.

## 7. Pestel Analysis

A PESTLE analysis gives meaningful information about the company's direction, brand positioning, growth objectives, and productivity threats (such the possibility of another pandemic). It can be used to define new product development and judge the feasibility of already available goods and



services.

## Political Factors:

**Regulatory Standard:** Government rules and policies play an important role for establishing the environmental, economical, and safety requirements for transformers. Regulations that change over time, such as energy efficiency standards or environmental laws, may force businesses to make investments in new technology and modify their manufacturing procedures in order to meet the requirements.

**Trade Policies:** Political decisions related to international trade agreements, tariffs, and trade disputes can affect the import and export of transformers and their components. Trade policies can impact the cost structure and market access for transformer manufacturers, particularly in the case of global supply chains.

**Government Procurement:** Government entities are significant consumers of transformers for various infrastructure projects. Political factors can influence decisions on whether to buy locally or from international suppliers, affecting the competitive landscape for transformer manufacturers and their ability to secure government contracts.

## Economic Factors:

**Global energy demand:** Transformer demand is directly correlated with the world's use of energy. Transformer demand rises in step with economic growth due to the increased demand for power generation and transmission.

**Raw material prices:** The price of raw materials, such as steel and copper, has a big influence on how transformers are made. Price fluctuations for these materials have the potential to impact manufacturing expenses, thus affecting transformer prices.

**Government policies and regulations:** The transformer industry is impacted by various economic factors, including which are not related to government policies, subsidies, and laws related to energy and environmental standards. For example, incentives related to renewable energy may increase the need for particular transformer types.

## Social Factors:

**Environmental awareness:** The transformer industry may be motivated to design more eco-friendly and efficient transformers in order to minimize their environmental impact and reduce

energy losses due to growing concerns about environmental sustainability and the demand for renewable energy sources.

**Workforce demographics:** The age and skill set of the industries workforce can impact innovation and technology adoption. An aging workforce may create a need for knowledge transfer and training in emerging technologies.

**Urbanization and infrastructure development:** The demand for transformers to support expanding cities, industrialization, and energy needs may rise as a result of urbanization trends and infrastructure development in developing countries, which would impact the market's opportunity for expansion.

### **Technological Factors:**

**Smart grid integration:** Transformers are included into smart grids with modern sensors and communication systems to improve monitoring in real time and efficiency.

**Energy efficiency improvements:** Development of transformers with higher energy efficiency through the use of advanced materials and designs to comply with energy standards.

**Advance materials:** Research into new materials like superconductors, for improved transformer efficiency and lower losses.

### **Environmental Factors:**

**Energy efficiency:** Increasing demand for energy-efficient transformers and the adoption of eco-friendly technologies can influence product development.

**Recycling and disposal:** To reduce environmental impact, outdated transformers must be disposed of and recycled properly. Policies and procedures in this field are important.

**Climate change:** Transformer consumption patterns can be impacted by climate change, as shown by increases in demand after extreme weather occurrences.

### **Legal Factors:**

**Environmental regulations:** Regulations related to emissions, environmental protection, and hazardous materials may have an effect on the production and use of transformers. It is essential to comply with laws like the Clean Water Act and the Clean Air Act.

**Safety standards:** For the protection of transformer users and employees, following safety guidelines and requirements, such as those established by agencies like the Occupational Safety and Health Administration (OSHA), is important.

**Trade and tariffs:** International trade agreements and tariffs can affect the import and export of transformers and their components, impacting the global supply chain and pricing.

## PART- II Company Information

### 1. Introduction And Company Profile

The group “EPOXYHOUSE” was established in 1972 with flagship company Baroda Bushings & Insulators and later on other companies like Electrical Controls & Systems, Kaizen Switchgear Products, Baroda Moulds & Dies, Fibre-tech Industries and Green Brilliance Renewable Energy – LLP came into existence.

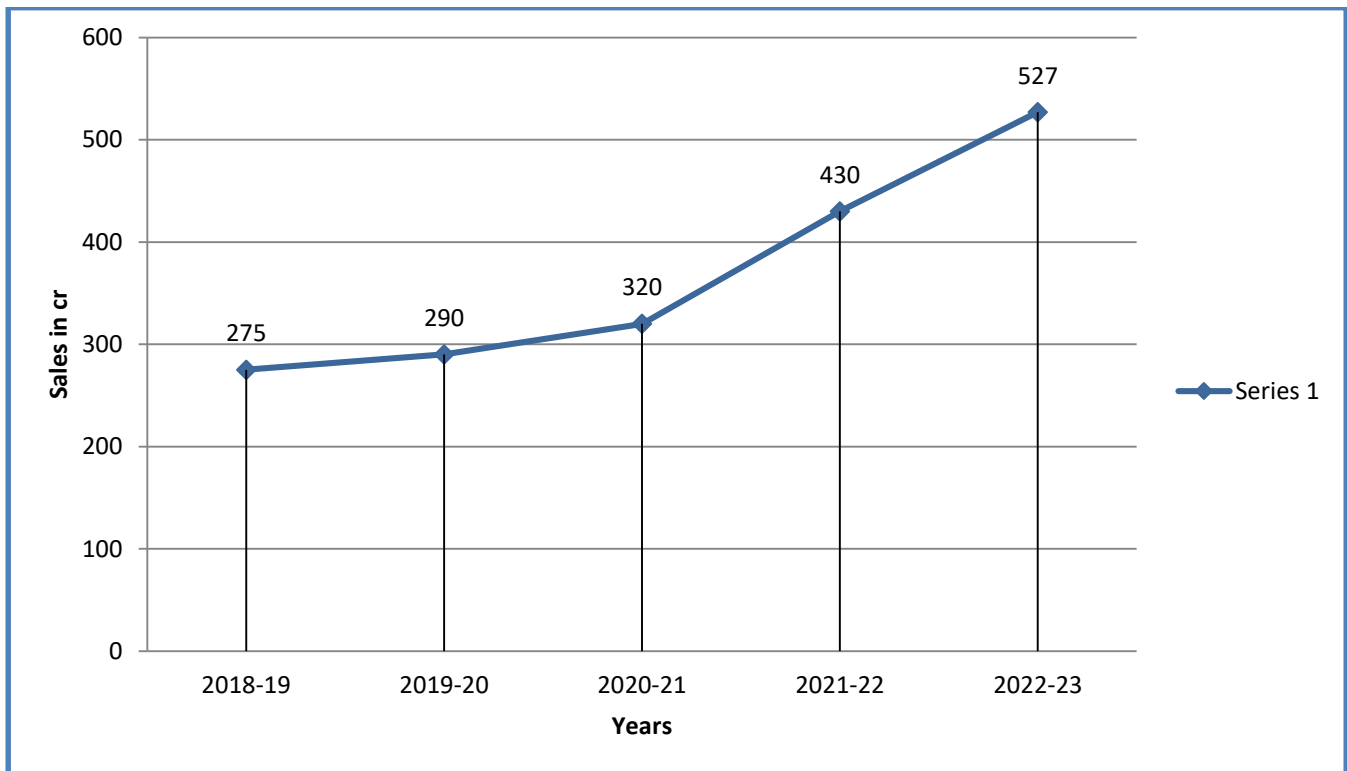
Complete Range of Electrical & Epoxy Moulded Components for Switchgears& Transformer Industries

- Founded in 1973 with the flagship company being named Baroda Bushings& Insulators
- Had launched their first production of Epoxy Insulators
- Corporate office at Vadodara. (India)
- Manufacturing Locations
- Makarpura (Vadodara)
- Waghodia (Vadodara)
  
- Today, with more than 1500 employee’s contribution to provide the complete range of electrical components from LV to HVfor Power Industry.
- Exports to more than 35 countries.
- Quality Management System Certified  
For: ISO 9001: 2015  
ISO 14001: 2004  
OHSAS 18001: 2007  
(NABL Accreditation in process)

The company is mainly engaged in Designing, manufacturing, and supply of a complete range of Epoxy Molded components such as Instrument Transformers, Epoxy Molded Bushings & Insulators, Distribution Transformer (Dry-type/Cast resin), High Current Bushing.

The Group at the moment is exporting various products to UK, USA, Australia, Netherlands, Germany, Italy, Czech Republic, Portugal, Egypt, China, Malaysia, Dubai, Kuwait, Saudi Arabia, Bangladesh, Nepal, Sweden, France, Thailand, Norway, Brazil, Korea, Sri-Lanka, Spain, South Africa, and Poland.

## 2. Growth of The Company



### 3. Product profile



Figure 5 Products 1

**Low and High voltage transformer bushing:** - To facilitates the passage of an energized, current carrying conductor through the grounded tank of the transformer.

**Support insulator:** -To support and separate electrical conductors without allowing current through themselves.

**Seal off bushing:** - Preventing hydrogen from the generator, or oil from transformer.



Figure 6 Products 2

**Indoor LV VTs:** - To transform High voltage to Low voltage with high accuracy.

**Indoor LV CTs:** - To measure the current of another circuit.

**Voltage detecting system:** - The examination of the state VOLTAGEPRESENT or VOLTAGE NOT PRESENT.

**Coils:** - To produce a magnetic field or to provide electrical resistance or inductance.



Figure 7 Products 3

**CT bushing:** - Relaying and metering on existing power transformer or circuit breakers.

**RMU bushing:** - Gas insulated switchgear up to 38KV

**RYB & Spout bushing:** - To terminate the transformer's internal low voltage leads at the tank wall and provide standard threaded connection for the external low voltage circuit.

**Wall through bushing:** - Allow electrical conductors to pass through a wall without any hassle.

## 4. Functional Department

### Production department

The production division plays a vital role to the transformer-making process. It takes responsibility for converting design specifications into physical products, managing production lines, ensuring quality control, and making that resources are used effectively. Key duties include reaching manufacturing goals, following to safety regulations, and assembling components properly. Delivering reliable small transformers to satisfy market expectations becomes possible by the department's continual implementation of quality assurance methods and ongoing process improvement.

## **Marketing department**

The marketing department is responsible for product promotion, reputation building, client cost negotiations, and sales growth. The responsibilities they have include organizing promotions, creating targeted marketing programs, conducting market research to understand client demands, and developing client connections. The department also focuses on competition analysis in order to find market trends and opportunities as well as support the company's growth and overall success in a competitive environment.

## **Finance department**

A company's finance department is responsible for managing financial transactions, creating budgets, and maintaining legal compliance. Payroll, financial reporting, accounts payable and receivable, and tax-related issues are all handled by it. The finance staff is also important to risk management, financial planning, and helping with overall decision-making for the company. The finance department plays a critical role in maintaining the company's financial stability and health because effective financial management is necessary to its long-term viability and growth.

## **Human resource department**

A business that produces transformers must have a strong human resources department for recruitment, on boarding, and performance reviews. They manage personnel administration, making sure that both business and labour laws are followed. HR is the position of supporting professional development, managing employee problems, and creating a healthy work environment. They also help significantly to the advancement of an equitable, open, and diverse culture. All things taken into account the Human Resources (HR) department helps the business succeed by maximizing human resources and creating a positive work environment.

## **Information technology**

A transformer company's IT department takes care of its technological infrastructure to guarantee smooth operations. Network administration, software support, cyber security, and hardware maintenance are just a few of the duties. They are important to the business's overall profitability and competitiveness because they optimize digital operations, increase productivity, and protect company information.

## **Logistics department**

The logistical department of a manufacturing company is essential for maintaining efficient operations. It arranges transportation, controls the effective flow of materials, and maximizes inventory levels. The logistics team minimizes production delays, lowers costs, and increases overall efficiency by managing supply chain procedures. Also, it enhances customer satisfaction by guaranteeing timely delivery of finished products. In short, the logistics department serves as a key point, improving internal procedures and creating external connections to improve the business's

competitiveness within the industry.

## 5. SWOT Analysis

### Strength:

**Registered under LUT bond:** Company registered under LUT Bond in which the company is exempted from Custom duty paid on exports of the company's products.

**Technical expertise:** Company possesses in-depth knowledge and expertise in switchgear production, including design, engineering, and manufacturing processes.

**Established customer base:** Company has a loyal customer base and strong relationships with utility companies, electrical contractors, and industrial clients.

### Weaknesses:

**Limited product range:** The Company has a limited range of switchgear products; it may be at a disadvantage compared to competitors with more diverse offerings.

**Dependence on key suppliers:** The Company relies heavily on a few suppliers for critical components any disruption in the supply chain can impact production and lead to delays.

### Opportunities:

**Growing demand for renewable energy:** The increasing adoption of renewable energy sources, such as solar and wind power, presents opportunities for the company to provide solutions tailored to these sectors.

**Infrastructure development:** Rapid infrastructure development in emerging economies and the need for reliable electrical infrastructure create opportunities for manufacturers.

**Technological advancements:** Embracing advancements in smart grid technology, digitization can enable the company to offer innovative and intelligent solutions.

### Threat:

**Intense competition:** The transformer industry is highly competitive, with the presence of both domestic and international manufacturers.



**Price pressure:** Price competition and the pressure to lower costs can affect profitability, especially. The company is unable to achieve economies of scale or faces increased raw material prices.

**Regulatory compliance:** Compliance with safety standards, industry regulations, and environmental requirements can pose challenges and increase costs for the company.

## 6. Financial Analysis

Brief financial (Rs in cr)	March 31, 2021 (A)	March 31, 2022 (A)	September 30, 2022(P)
Total operating income	92.23	126.22	70.55
PBILDT	12.3	21.16	17.13
PAT	5.72	9.84	6.67
Overall gearing (times)	0.17	0.35	0.35
Interest coverage (times)	7.12	9.77	13.49

## 11. Industry Analysis: Michel Porter's Five Force Model

**Threat of new entrants:** The transformer industry typically requires significant capital investment and technical expertise, which can act as barriers to entry. Often established manufacturers have a monopolistic approach such as, they have strong relationships with suppliers and sub manufacturers making it very difficult for new entrants to compete in the industry. Thus, market penetration by new entrants is necessary for their survival and growth.

**Bargaining power of suppliers:** The transformers industry needs various complex parts and materials such as copper, steel and other materials for transformers production thus prices gets too high in some conditions for these materials as per their scarcity so, the suppliers of these materials possess a level of bargaining power against their materials and these bargaining power is moderate in most conditions.

**Bargaining power of buyers:** Buyers of transformers, such as utility companies and industrial consumers, may have significant bargaining power if they purchase in large volumes or have access to alternative suppliers as they can bargain in their own favor as the supplier also gains due to high volume sales in a single deal or due to fear of losing the particular customer to a different supplier. Thus, the bargaining power of buyers can influence the price of the commodity.

**Threat of substitute products:** Substitute products can pose a threat to the transformer industry. For example, advancements in renewable energy technologies and the push for decentralized energy systems might reduce the demand for conventional transformers. Energy storage technologies, such as batteries, could also serve as alternatives in certain applications. The availability and cost-effectiveness of substitute products impact the overall attractiveness of the industry.

**Intensity of competitive rivalry:** There can be strong competition among the current transformer producers. Competition is influenced by variables like the number of competitors, rate of industry expansion, product differentiation, and capacity utilization. Increased rivalry may result from price competition, technological developments, and struggles for market share. Industry consolidation may have an impact on the dynamics of competition.

## 12. Problem\_identification

It can be difficult to optimize material handling in the transformer production process. Transformers require specialized handling equipment and accurate organization within space-constrained facilities because to their massive size, weight, and complicated components. An additional layer of complication arises from the need to ensure worker safety when handling these heavy highly powered components. The entire manufacturing process may be put at risk by ineffective material handling, which can also cause shortages in production, improper inventory management, and expensive safety risks. Transformer makers must therefore create strong material handling plans that put efficiency, safety, and cost-effectiveness first in order to succeed in the competitive industrial environment.

### Problem analysis and remedial measures

The production of transformers requires placing heavy, expensive parts in small places, which presents challenging material handling situations. Inefficiency and safety risks result from equipment that is inadequate for these particular needs. Space constraints can be addressed and weak components can be handled safely by implementing space-optimized, specialized equipment such as automated cranes and lifting modules. Material movement is simplified and delays and bottlenecks are decreased by integrating real-time inventory management and production flow coordinating software. Thorough safety procedures and operator education also reduce risk.

Investing in these solutions improves productivity, safety, and efficiency across the board.

### **13. Future\_Outlook/Conclusion/Suggestion**

Material handling will go through an evolution because of artificial intelligence, which will improve robotic automation, demand forecast, and improve logistics. Upcoming material handling will be determined by factories and warehouses adopting artificial intelligence (AI)-driven technologies to increase productivity, reduce expenses, and integrate tasks smoothly.

The Internet of Things (IoT) optimizes material handling by enabling real-time monitoring, predictive maintenance, and automated inventory management. The future of material handling will be shaped by IoT-connected devices, which improve productivity, reduce downtime, and simplify procedures in warehouses and logistics.

Blockchain technology reduces fraud and error through the secure, clear, and effective tracking of goods in the supply chain. Its global ledger, which changes material handling processes for future logistics, provides confidence and allows real-time monitoring.

#### **Conclusion**

Transformer production has a lot of commitment, but there are particular difficulties with material handling. Overcoming these obstacles is essential for success, from handling large components in cramped spaces to including security measures and streamlining the production process. Material handling can be made more productive and competitive in the sector by making investments in specialized equipment, simplifying storage options, and putting data-driven inventory management into operation.

#### **Suggestion**

Various issues face material handling management in the manufacturing business, the extreme mass and size of transformer parts present logistical challenges that call for specialized tools and careful preparation. An additional level of complexity results from the need for careful handling of delicate materials, such as copper winding, for the purpose to avoid damage.

The smooth transition of materials between manufacturing stages requires coordinated efforts between suppliers, production lines, and storage facilities. It becomes essential to maintain exact inventory control when delays or errors can lead to production to be stopped. To overcome these obstacles, an effective plan that combines advanced equipment, efficient workflows, and knowledgeable staff is needed to maximize material handling in transformer production.

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